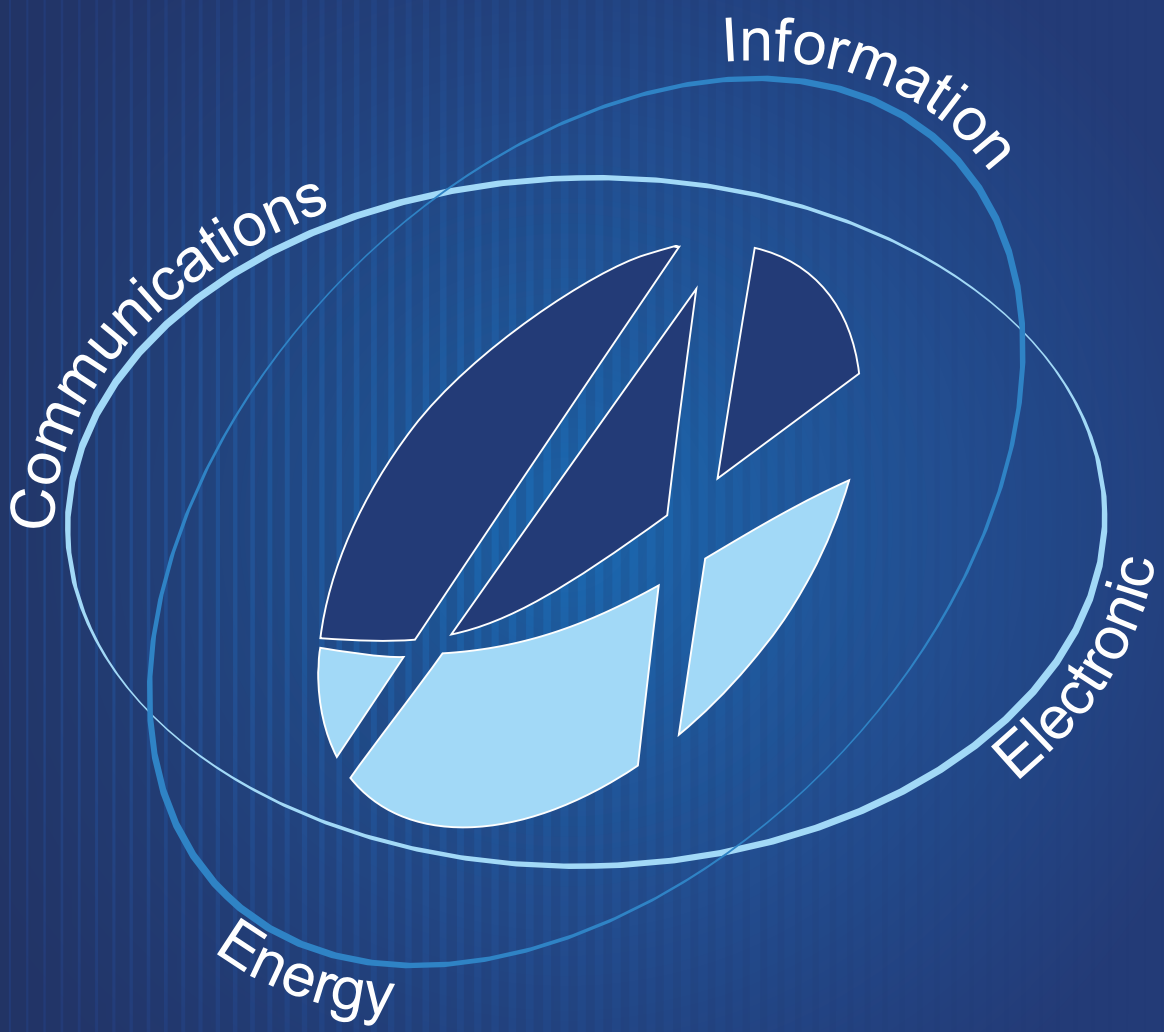
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Editorial

As a result of widening the spectrum of communication, dissemination and implementation of scientific research results, in 2020 was founded the association journal (magazine), issued under the name The Journal of CIEES appearing both in print (ISSN: 2738-7283), and online (ISSN: 2738-7291) format with DOI: https://doi.org/10.48149/jciees.

The Journal of CIEES is published in English and it is open access, peer-reviewed international scientific journal publishing papers submitted by authors themselves for publishing and invited by the Editorial Board. The Journal of CIEES covers all the essential branches of theories, technologies, systems, tools, applications, work in progress, and experiences on all theoretical and practical issues arising in telecommunications, electronics, signal processing and applications, information technologies, energy systems and etc.

As always, many people have contributed to this issue including all authors, the anonymous reviewers, the Associate Editors, the Editorial Advisory Board and, of course, our outstanding production team. We wish to acknowledge each individual's contributions, and to also express our gratitude for everyone's commitment. We hope you enjoy this first issue of The Journal of CIEES.

We have had the privilege to publish truly outstanding, quality manuscripts that, judging by the response of our reviewers and readers, are important contributions to their respective fields of research. We want to take this moment to thank all of our reviewers and authors for entrusting us with their discoveries.

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A method for Assemblage of an Open Access Data Set for Research in Geomagnetic Effects on GPS/GNSS Ionospheric Delay in Sub-equatorial Regions

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Abstract: Space weather, geomagnetic, and ionospheric effects are major sources of Global Navigation Satellite System's (GNSS) Positioning, Navigation, and Timing (PNT) service degradation. Researchers studying the problem often face an obstacle in missing large data sets comprising ionospheric effects variables and space weather ones for their studies. Here a formal assemblage method is proposed for data set assemblage for GNSS ionospheric effects assessment that utilises experimental sets of space weather/geomagnetic observations, and raw GNSS pseudorange observations polluted with uncorrected ionospheric delay effects to estimate Total Electron Content (TEC) as a target variable outlining the ionospheric effects on GNSS. The five Observations Quality Principles (OQP) are proposed for the observations to be used in statistical learning model development to comply to. The proposed assemblage method is demonstrated in a particular case study of an assembled data set for Darwin, NT, Australia, in sub-equatorial zone, using a tailored software developed in the R environment for scientific computing, and a freely available TEC estimation software. The assembled massive data obtained in the demonstration of the proposed method is provided in the open-access manner in support of the international scientific community.

Keywords: GPS/GNSS, ionospheric delay, geomagnetic conditions, sub-equatorial region, data.

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1. Introduction

Satellite navigation has become one of the few cornerstones of the modern civilisation, as it empowers, as an embedded and enabling technology, a vast range of technological, and socio-economic applications, systems and services [1]. Its provision of Positioning, Navigation, and Timing (PNT) services through Global Navigation Satellite Systems (GNSS), such as the US GPS, Russian Federation's Glonass, China's Beidou, and the EU's Galileo, has matured to the levels which require stable, sustainable, and standardised provision of PNT Quality of Service (QoS) [2]. Demand and requests for PNT mean the effort should be made in confinement and mitigation of inherited and emerging shortcomings and vulnerabilities of the system, spectrum, signals, and information being deployed in the provision, and used in exploitation of the GNSS PNT services [3].

Ionospheric effects, the ionospheric delay in particular, emerge as the primary source of the GNSS PNT QoS degradation, particularly of GNSS-based positioning accuracy [4]. Approaches utilised for mitigation of ionospheric delay effects on the GNSS positioning accuracy may involve: (i) provision of standard global ionospheric correction models, such as Klobuchar model [4, 5], (ii) development and provision of local or regional ionospheric correction models [4, 6, 7], (iii) deployment of advanced satellite-based positioning methods, such as: Real Time Kinematics, RTK, or Precise Point Positioning, PPP, [4], and (iv) utilisation of self-adaptive positioning environment-aware GPS/GNSS position estimation [8]. Additionally, the awareness of ionospheric conditions may be utilised for the assessment of risk for GNSS utilisation in position-aware applications, such as electronic navigation, robotics, location-based services, autonomous vehicles and aircrafts, and others [9].

Current state-of-the-art in related disciplines, including statistics and computer science, offers prospect in the predictive ionospheric model development using methods of statistical/machine learning [6, 10], based on experimentally collected observations resulting from the ionospheric, geomagnetic, and space weather processes and conditions [8].

A growing number openly available internet-based databases allows researchers for embracing the trends in

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development of new, perspective, and productive models to improve the GNSS PNT positioning performance through more accurate prediction of the GNSS ionospheric delay. However, a researcher may encounter a number of obstacles and shortcomings, including, but not limited to: partially restricted access to the original data, unknown or complicated formats of raw observations, different sampling methods/times used for different variables, and different formats used by different sources of observations. Finally, researchers who undergo the whole process of observations collection, aggregation, collation, data cleaning, parsing, and formatting rarely publish datasets in an open-access manner, leaving the other potentially interested research parties with the same challenging and daunting task for their research. For the reasons above, studies of ionospheric effects on GNSS positioning performance are usually constrained both geographically, to the place of data collection, and in time, spreading to a couple of days when an ionospheric anomaly lasts. Such approach downgrades prospects for learning from data and development of understanding of the long-term ionospheric effects on GNSS positioning performance.

Here a formal methodology for GNSS – space weather data sets assembly is proposed, and demonstrated in the case of a data set creation for the purpose of an ionospheric correction model development and GNSS positioning performance ionospheric effects assessment in a geographically constrained environment (Darwin, NT, Australia), and with the reasonably wide set of potential deterioration scenarios considered by extension of the time span to the whole calendar year of 2014.

The manuscript reads as follows. This Session sets the stage by stating the problem and motivation for research. Section 2 outlines the proposed methodology for data set assemblage, and the openly accessible internet sources that may be used for raw observations collection. Section 3 presents the results of the proposed method's demonstration in the particular case, as well as a massive data set assembled and provided to interested research parties in an open manner. Section 4 discusses the proposed methodology, identifies its shortcomings, and summarises the contribution of the presented research.

2. Method and material

Assembling a relevant and related data set for the GNSS ionospheric effects mitigation purposes emerges as a research problem. Here a method for such an assemblage is proposed, together with a set of openly accessible data sources, which will yield a data set suitable for the GNSS ionospheric correction modelling, ionospheric effects on GNSS positioning accuracy assessment, and risk assessment of GNSS ionospheric effects on the QoS of GNSS-based applications.

The GNSS ionospheric delay results from the passage of a satellite radio wave signals through non-homogeneous ionised layers of the upper Earth's atmosphere, known collectively as the ionosphere [11]. The amount of delay t_{iono} is directly proportional to a single parameter resulting from the ionospheric conditions, called Total Electron Content (TEC) given in (1), with $N(h)$ denoting the vertical ionospheric profile, a surface density of electrons on height h [km] above the sea level, in [electrons/m2], and h_{min} and h_{max} denoting the height of the lower bound, and upper bound of the ionosphere, respectively.

$$TEC = \int_{h=h_{min}}^{h=h_{max}} N(h)dh \quad (1)$$

The GNSS ionospheric delay affects GNSS pseudorange measurements by creating an error which further propagates into GNSS position estimation error [4, 8]. GNSS ionospheric delay may be determined using the expression (2), with f denoting the frequency of the satellite radio wave carrier, as derived from the Appleton-Hartree formula [11, 12].

$$t_{iono} = \frac{40.3}{f^2} \cdot TEC \quad (2)$$

2.1. Method

Here a formal method for data set assemblage for GNSS ionospheric effects assessment is proposed that utilises experimental sets of space weather/geomagnetic observations and raw GNSS pseudorange observations polluted with uncorrected ionospheric delay effects.

Accomplishments of a successful data set assemblage calls for requirements on the raw observations, frequently obtained from various sources. It is proposed here that observations used in statistical learning model development should comply to the five Observations Quality Principles (OQP), as follows. (i) Observations should come from the trusted sources, who guarantee the objective and unbiased process of data collection. (ii) Observations should focus on phenomena of research interest, preserving the effects of the studied phenomena in data, while suppressing and eliminating the effects of the others, (iii) Observations should be of variables expected to serve as both predictors (input variables) and target (the output variable). (iv) Observations should be collected in all related, or anticipated scenarios, both in time and space. (v) Data should be structured in a known format to allow for machine reading.

Assuming compliance to aforementioned OQP principles, the assemblage method is proposed, as depicted in Figure 1.

Raw GPS pseudoranges collection comprises tasks of identification and collection of data, complying to the before mentioned five OQP. Data collected may either enter the assemblage procedure directly, or be stored locally on the computing system beforehand.

TEC estimation from GNSS pseudoranges may be performed using the common method utilising dual frequency GPS/GNSS observations. Let us assume a reference station performs simultaneous GPS pseudorange measurements on two carrier frequencies, L1 and L2. The process yields two pseudorange observations ρ1 and ρ2, on frequencies L1 and L2, respectively, for every time instant.

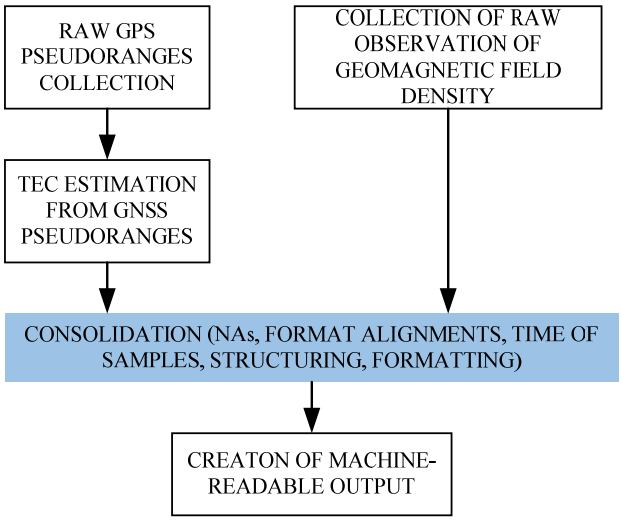


Fig. 1. Relationship between step size and path length.

With two time series of observations, TEC may be estimated using the method depicted with (3) … (5), where STEC denotes slant (actually observed) TEC, at elevation angle E in [rad], b_s denotes satellite bias in [m], and br denotes receiver bias in [m].

$$STEC = \frac{\rho_2 - \rho_1 - b_s - b_r}{40.31 \cdot [\frac{1}{f_2^2} - \frac{1}{f_1^2}]} \quad (3)$$

Satellite bias may be determined using trusted services, such as the one provided to the international research community by University of Bern in Switzerland [4]. Receiver bias may be estimated using various methods involving post-analysis of time series of TEC estimates [4].

Furthermore, TEC is determined in a standardised manner for the comparison purpose, as a so-called Vertical TEC (VTEC) given as a projection of STEC on a vertical at the point of observer (GNSS receiver observing pseudoranges), using the mapping function m(E), as given in (4) and (5) respectively.

$$m(E) = \frac{1}{\sqrt{1 - (\frac{R_{Earth}}{R_{Earth}+h} \cdot \cos(E))^2}} \quad (4)$$

$$TEC = \frac{STEC}{m(E)} \quad (5)$$

Referring to (4) and (5), REarth denotes radius of Earth's sphere, in [km], and h denotes height above the average sea level, in [km]

Collection of raw observations of geomagnetic field density components is requested as the result of hypothesis of TEC relation to geomagnetic conditions, which also determines ionospheric conditions [4, 7, 13]. Collected data should comply to the five OQC principles, including the condition of observations collection in the close geographical vicinity of the GNSS pseduorange collection site.

Consolidation tasks of the proposed data assemblage process comprise dealing with the NA (Not Available) observations, formatting alignments for data provided by different sources with differing formatting standards, resolving problems of data observed at different time instants or with the different sampling frequency, and definition of the conversion into output structure and data format.

As the result of the assemblage process, the output data set is created, with the requested structure and machine-readable data format.

2.2. Material

Observations should comply to the five OQP. Here the following sources are used for experimental observations access: (i) International GNSS Service (IGS) raw GNSS pseudorange repository [14], with the observations taken by world-wide network of stationary GNSS reference stations, and (ii) INTERMAGNET repository [15], with the observations taken by the world-wide network of stationary geomagnetic reference stations.

The IGS reference stations network has been established to allow for continuous raw GNSS observations collection, with suppression of all sources of pseudorange errors, apart from the ionospheric ones. Strict requirements are imposed to operators of IGS reference station to ensure the quality of observations. Continuos 24-hours-a day observations ensure collection of data in all real scenarios of GNSS positioning degradation scenarios due to ionospheric, geomagnetic, and space weather conditions. Methodology of observation collection, including description of utilised devices, is transparently presented, and the quality of data monitoring process consistently and transparently operated. In that sense, the IGS is considered a trusted source of raw GNSS pseudorange observations from which TEC may be estimated as a target variable, in compliance to the five OQP.

The assessment returns the same results for the INTERMAGNET network of geomagnetic observations, rendering it a trusted sources of geomagnetic field density components observations, as presumed predictor variables of TEC.

3. Research results

The GNSS data assemblage method proposed in Section 2 is implemented in a set of software packages, and demonstrated in the case of GNSS and geomagnetic observations assemblage for the case of sub-equatorial region GPS ionospheric delay assessment in relation to components of geomagnetic field density. Sources of data involves the IGS reference station at Darwin, NT, Australia, as the source of daily raw dual-frequency GPS observations at 30 s sampling time, and the INTERMAGNET reference station at Kakadu, NT, Australia, as the source of daily geomagnetic field density components observations taken at 1 min sampling period using precise magnetometers. The two reference stations are set at distance of approx. 195 km, which can be seen as a very close distance, considering the nature of the observed phenomena.

The data assemblage procedure is implemented, as follows.

The raw GPS pseudorange observation collection is performed for the whole year 2014 and for the IGS

Darwin data using a bespoke software developed by authors in the open source R environment for statistical computing in version 4.2.2 [15]. Raw GPS observations were taken every 30 s, 24 hours a day. Collected daily data sets are stored on a local disc of a computer, where preparatory analysis and consolidation take place.

The raw geomagnetic filed density components observation collection is performed for the whole year 2014 and for the INTERMAGNET Kakadu data using another bespoke software developed by authors in the open source R environment for statistical computing in version 4.2.2 [16]. Geomagnetic filed density components observation *s* were taken every minute, 24 hours a day. Collected daily data sets are again stored on a local disc of a computer, where preparatory analysis and consolidation take place.

The TEC estimation from dual frequency GPS pseudorange observations is performed using the GPS-TEC [17, 18], a third party software developed by Dr. Gopi Seemala, and provided freely to the international research community. Dr. Seemala's software performs the TEC estimation, as presented in Section 2, using satellite bias estimates from University of Bern, and determining the receiver bias by setting the lowest estimated nightly TEC of a day under consideration to zero.

Consolidation tasks of the data set assemblage is again conducted by a tailored R-based software developed by authors. The tasks involve the removal of cases with NA, for whatever reason they appear, time formats alignment, harmonisation of data by time stamps (observations without counterparts taken at the same time are removed from the set), as well as structuring data by variables a storing them in a table format. Finally, the obtained table is stored to a Comma Separated Value (CSV) textual file, which is proven to be machine-readable. As the result of the proposed data assemblage procedure, a massive data set of 522 298 individual instances is created, providing TEC and geomagnetic field density data in Darwin, NT, Australia throughout 2014 for the purpose of the research.

The file comprising the assembled data set carries approx 28.5 MB of data, and is provided as a Supplementary Material to this manuscript in the open access manner to the international research community at the internationally recognised repository *figshare* [19].

4. Discussion and conclusion

Presented research addresses the problem GNSS PNT performance researchers face in modern times, where diversity of data resources and formats prevent researchers from having a structured and consistent data sets to utilise for accomplishment of improved understanding of geomagnetic and ionospheric effects on GNSS positioning accuracy. Here a formal method is proposed that outlines tasks for multi-source GNSS and geomagnetic data assemblage into a single data set, which can be used for the GNSS ionospheric correction model development using statistical/machine learning methods, as well as for risk assessment of the ionospheric/geomagnetic impact on Quality of Service of GNSS-based applications, systems and services. Further to this, the set-of-five Observation Quality Principles are proposed as the set of standard requirements for data sets to be assembled.

The proposed method is implemented in a combination of tailored software developed in the R environment for statistical computing, and a freely available GPS-TEC estimation software. As a result, a massive data set is assembled for the case of sub-equatorial region, comprising Total Electron Content (TEC) values derived from experimentally collected raw (un-corrected) dual frequency GPS pseudorange observations of a trusted third-party, as well as observations of geomagnetic field density components for the same area, produced by another trusted third-party. The assembled data set for Darwin, NT, Australia in 2014, obtained as a result of demonstration of the principle, is rendered available in the open-access manner, and presented as a Supplementary Material to this manuscript.

Authors continue work on the software consolidation to publish the R-based implementation of the proposed data assemblage method as an open-source and open-access software, available to the international research community.

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In Silico Toxicological Approaches in Safety Estimation of Chemical Compounds with Stepwise Prioritization Model

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Abstract: In the modern living conditions and in spite of the wide variety of existing pharmaceutical preparations, the search for new sources of biologically active compounds for the production of more effective and safer drugs remains relevant. The creation and management of alternative approaches to assess the safety of chemical compounds with potential activity, and combining information with experimental data and computational toxicological results are becoming more common and preferred models, carried out without the use of animals.

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1. Introduction

Drug discovery and development is a very lengthy and high-risk process, during which a complex set of activities are carried out, including analysis of information sources, synthesis of substances, conduct of pharmaceutical, pre-clinical and clinical studies, culminating in registration of the drug.

The main sources of medicinal substances are:

- compounds derived mainly from plant or microbiological sources;
- compounds obtained by chemical synthesis;
- compounds obtained by biotechnology and biochemical methods providing secondary metabolites and recombinant proteins by exploiting natural metabolic pathways and generating new ones.

Biological and bio-based products are becoming a large branch of pharmaceutical production with their own specificity.

Data indicate that 96% of drug candidates are dropped in the early stages [1] and the average cost of developing a new drug has reached up to USD 2.6 billion in recent years [2]. New molecules need to meet a number of medical and non-medical criteria: specificity (defined mechanism of action); efficacy (high affinity for a chosen target), selectivity for other possible biological targets and, above all, safety for patients. Intellectual property rights for the active molecule should be clearly defined and well protected; the compound should be available at a reasonable cost and a technically feasible process, easy to validate and control, consistently providing the active substance with high chemical purity and desirable physicochemical properties [3].

One of the main reasons for the high dropout rate in the early stages of research is safety. The safety assessment of drug candidates is most often carried out by pre-clinical tests – in vitro (on cell cultures) and in vivo (animal models). The first type are high-throughput, based on interaction with target proteins or selected cell lines, which allow the affinity/activity of a large set of compounds to be tested very quickly (within hours), and the second type are low-throughput , working on tissues, organs or animals, in which pre-selected compounds are tested by more detailed procedures, over weeks or months.

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2. In silico toxicological approach

In silico toxicological approach refers to the use of computational methods and models to predict the potential toxicity of chemical compounds. The following are the steps that can be taken to perform an in silico toxicological assessment [4]:

- *Data collection and preparation* – Collecting data on the chemical structure and properties of the compound, as well as any available toxicity data from previous experiments or studies. The data needs to be curated and standardized to ensure accuracy and consistency;
- *Selection of predictive models* – Choosing appropriate computational models for predicting toxicity based on the type of chemical and its intended use. There are various types of models that can be used, such as QSAR (Quantitative Structure-Activity Relationships), PBPK (Physiologically Based Pharmacokinetic) models, and read-across methods;
- *Model development and validation* – Developing and training the predictive models on the available data, and validating their accuracy and reliability. The models should be tested against independent datasets to ensure their robustness and consistency;
- *Prediction of toxicity* – Using the validated models to predict the potential toxicity of the chemical compound. The predicted toxicity can be compared to regulatory safety thresholds to determine if the compound is safe for its intended use;
- *Risk assessment* – Combining the predicted toxicity data with exposure data to assess the risk associated with the use of the compound. This involves

estimating the likelihood and severity of any adverse effects that may occur;

- *Reporting and interpretation of results* – The results of the in silico toxicological assessment should be reported in a clear and concise manner and the implications of the findings should be interpreted and communicated to stakeholders.

Overall, in silico toxicological approaches can provide valuable insights into the potential hazards and risks associated with chemical compounds, and can help guide decision-making around their safe use. However, it is important to note that these methods are not a replacement for traditional toxicology testing [5], and should be used in combination with other approaches for comprehensive safety evaluation.

2.1. In-silico research principles for toxicology

In silico toxicology studies follow the principles of the 3Rs (Replacement, Reduction and Refinement) proposed by Russell and Burch and support the creation and refinement of modern methods for assessing the safety of medicinal products.

Substitution refers to technologies or approaches that directly replace or avoid the use of animals in experiments where they would otherwise be used. Animal models are often expensive and time consuming and, depending on the research question, present scientific limitations such as a weak link to human biology. Over the last decade, advances in science and technology mean that there are now realistic options to replace the use of animals [6]. The replacement can be divided into two categories:

- Full replacement refers to methods that avoid the use of animals for research and testing purposes. It involves the use of human volunteers, tissues and cells, mathematical and computer models and established cell lines - often collectively referred to as animal-free technologies or NATs. In recent years, the term New Approach Methodologies (NAM) has been adopted by the bioscience sector specifically to describe non-animal technologies for use in assessing chemical or drug toxicity.
- Partial replacement involves the use of certain animals that, based on current knowledge, are not considered to be capable of experiencing suffering. This includes invertebrates such as Drosophila , nematode worms and social amoebae and immature forms of vertebrates . Partial replacement also involves the use of primary cells (and tissues) taken from animals killed solely for this purpose (i.e. not used in a scientific procedure that causes suffering).

Reduction refers to methods that minimise the number of animals used in an experiment or study, consistent with scientific objectives. It is essential for reduction that animal studies are appropriately designed and analysed to ensure robust and reproducible results.

Reduction also includes methods that allow the information collected on an animal in an experiment to be maximised to reduce the use of additional animals. Examples of this include the use of some imaging methods that allow longitudinal measurements of the same animal (rather than, for example, culling cohorts of animals at specific points in time) or blood microsampling, where small volumes allow repeated sampling in the same animal. In these scenarios, it is important to ensure that the reduction in the number of animals used is balanced against any additional suffering that may be caused by their repeated use.

Enhancement refers to methods that minimize pain, suffering, distress or lasting harm that may be experienced by the animals being tested and that improve their welfare. Enhancement refers to all aspects of the use of animals, from their housing and husbandry to the scientific procedures carried out on them. Examples of refinement include providing animals with housing that allows the expression of species-specific behaviours, using appropriate anaesthesia and analgesia to minimize pain, and training animals to cooperate with procedures to minimize any distress.

Evidence suggests that pain and suffering can alter an animal's behaviour, physiology and immunology. Such changes can lead to variations in experimental results that impair both the reliability and repeatability of studies.

Compared to experimental approaches, computational methods have shown great advantages as they minimize testing time as well as the need for animal experiments and associated costs [7].

Innovative skills, methods, and processes, as well as novel ways to use established processes provided by artificial intelligence, can help research and regulatory entities overcome many of the identified challenges to data collection, processing, and analysis, and help participants identify and manage risks more effectively and efficiently in creating new and safe medicines. The advent of computational methods and processes complement conventional experiments and accelerate hypothesis generation and the research validation cycle.

Analyzing the numerical data of a huge number of new molecules with their characteristics enables their stratification. This is achieved by introducing technologies for handling big data collected from biomedical sources.

In silico toxicological investigations use approaches to help solve safety problems based on chemical-biological informatics. (Fig. 1) With in silico methods, hazards can be assessed at an early stage, eliminating the need for synthesis. This can be particularly important during drug development, where in silico prediction of a compound can guide the choice for lead compounds, not only in terms of efficacy but also safety. Testing can therefore be targeted to specific hazards before a compound is referred for preclinical safety testing. In preclinical evaluation, IST methods are actively used to ensure the safety of impurities, degradants, metabolites and excipients , which is particularly valuable in cases where the test material is difficult to synthesize [8]. Acute and chronic toxicity, including carcinogenicity, reproductive and developmental toxicity, mutagenicity, organ toxicity, irritation/corrosion, sensitisation and lethality are considered at this stage.

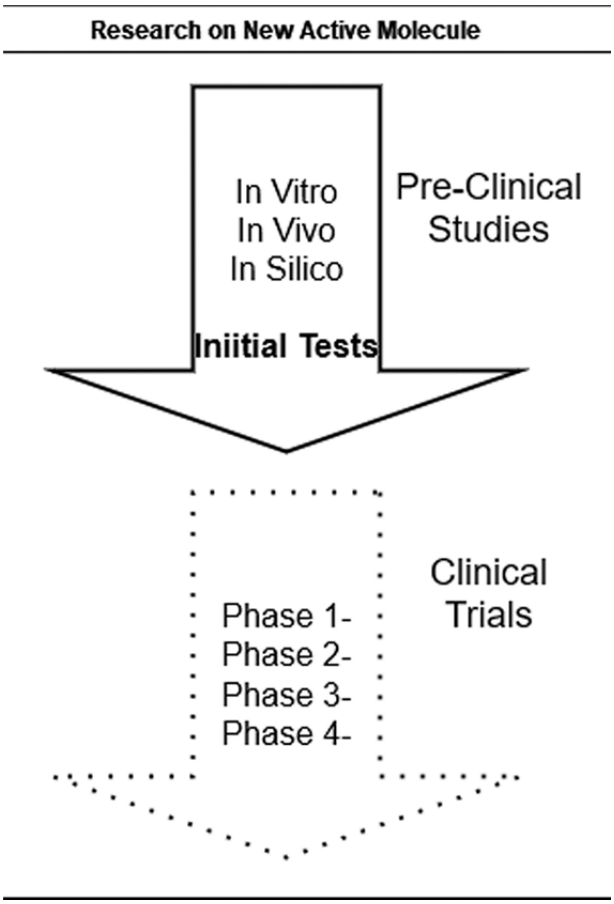


Fig.1. Position of the in silico research methods in pre-clinical studies.

2.2. In silico research rules and regulations

In silico toxicology studies follow consistent, transparent and well documented rules:

1) Analysis planning - identification of toxicological effects or mechanisms to be predicted; selection of in silico;

2) Database search and conduct appropriate individual software predictions;

3) Documentation of the in silico analysis and combined evaluation of the experimental data;

4) Standardized reporting of results and expert review against principles of Good Scientific Practice.

Toxicology-based computational approaches typically focus on toxicity database building, QSAR modeling, human rule-based methods, descriptor- and ligand-based methods, etc. There are even some data visualization tools available that are a hybrid containing toxicology prediction tools such as QSARs and systems biology and pharmacology pathway analysis [6].

2.3. Availability of in silico database

There are publicly available databases on toxicity, QSAR and effects on human health. With a great wealth of information there exist: AERS, ACToR, BDSM, CEBS, CEDI/ADI Database, CERES, Danish (Q)SAR Database, DevTox, Drugs FDA, DSSTox, EXTOXNET, TOXNET, and others. Toxicity databases are used to support the prediction of adverse effects of pharmaceuticals and other xenobiotics for safety assessment, support lead selection and optimization, and ideally to add to safety or risk assessment high-quality test data from generated structures. The key concept for developing a drug and chemical toxicity database is the ability to use data of acceptable scientific quality from previous toxicity studies to build an electronic resource that can be searched, modeled, and used in "read-through" strategies with structurally related compounds(7) . Toxicity databases typically serve as predictive models or "mines" of data rich in authenticated structures, substance-induced toxicity experiments, or other similar scientifically based evidence.

2.4. In silico methodology

The main silico forecasting methodologies include the following:

- Statistical forecasting based on quantitative structure-activity relationships (QSAR). The method is based on the concept that molecules with similar structures potentially exhibit similar chemical and biological activities. The QSAR approach uses experimental data sets including the biological activity of chemical compounds; their chemical and physical characteristics represented as molecular descriptors and statistical methods to correlate these molecular descriptors with biological activity.
- Molecular descriptors are arithmetic values representing the physicochemical properties of compounds and can be categorized depending on the amount/type of information provided. The most common types of descriptors used in QSAR are constitutional, electronic, topological, and geometric descriptors and include molecular weight, total number of atoms, total number of carbon atoms, atomic network, total number of bonds, and van der Waals area (8). Over the years, the original QSAR analysis has been extended by various groups. Today, in the field of in silico toxicology, the term QSAR is very widely used to describe all forms of predictive modeling, including more complex (and less quantitative) machine learning models.
- Machine learning is a term encompassing supervised model building for classification and regression, unsupervised techniques such as clustering, and reinforcement learning techniques applied mostly to sequential decision tasks such as molecular design [9].

3. Cloud computing-enabled in silico research

Cloud computing has proven to be useful for in silico research, and its applicability for more highly specialized computing related to high performance computing (HPC) and similar applications is yet to be proven. There have been quantitative performance analyses performed on a set of benchmarks designed to represent a typical HPC workload on the Amazon EC2 cloud infrastructure. Their results show [10] a strong correlation between the time spent by an application in communication and its overall performance on EC2. It is also known that performance degrades as communications increases. In addition, the communication pattern of the application has a significant impact on its performance. Some applications with

significant global communication are reported to perform worse than those with less global communication. Thus, it appears that the amount of variability in environments such as EC2 cloud performance can provide significant gain. Variability is introduced by the shared nature of the virtualized environment, by the network, and by differences in the underlying non-virtualized hardware.

Virtual machines have been around and used for a very long time, the technology is widely used and is the basis of all modern cloud platforms. Furthermore, thanks to years of development and use, virtual machines have also proven themselves in a huge number of in-silico model trials. Container-based virtualization works by sharing the operating system kernel. Containers cannot completely replace virtual machines. There exists open source container platform that was explored to make containers easier to use for developers and system administrators. The renowned product comes with an easy to use container management interface and provides a robust ecosystem for sharing container applications in the form of templates, also called - images. Nowadays, more and more companies and educational institutions which perform large-scale in-silico research appear to be switching to the use of containers.

Current trends in industry pharmaceutical transformation require a transformation of both the education sector and the IT infrastructure used. There is a need for delivery models and the ability to deliver dynamic IT infrastructure using modern technologies where virtualization is at an unparalleled level compared to when it was invented. In future projects in the in-silico field, there would be the focus to investigate appropriate options for virtualization choices and to derive criteria that would be useful for training IT architects at the pharmaceutical companies and specialized universities, who are tasked with transforming or building infrastructure for the research needs of educational institutions.

Since then, virtualization and operating systems have been constantly evolving. Nowadays, the understanding is that virtualization is not used to run several simple tasks at the same time, but to run several software (such as operating systems) on the same physical machine without them interfering with the main operating system of the machine. There are many options for virtualization. Each user, whether an individual or an organization, has completely different needs. Nowadays, there is a wide range of solutions that fit the different situations where isolation is more or less needed.

Until recently, the typical method of virtualization, among individual users and organizations, was the use of virtual machines provided by hypervisors developed by different companies - Oracle (VirtualBox), VMWare (ESXi) or Microsoft (Hyper-V). The main advantage of full virtualization is that isolation is at the highest level from the host machine (the machine supporting the virtualization), providing the ability to have a wider choice of supported operating systems and a clear separation between the running host operating system and the virtualized one, providing a safer environment. Nevertheless, virtual machines have a major disadvantage - the amount of resources required for virtualization is higher, as it is a completely isolated system that does not share its resources with the host OS kernel, whereas containers share the host OS kernel.

Given the performance of servers today, it is almost impossible to use their full potential with a single application. This is where the ability to install more than one application on each server comes in. However, this technology has certain risks. What happens when one application needs specific libraries or an entire environment with a certain version, and another needs something different? Then virtualization is the tool that helps the most. Using virtualization, we can run many applications on one machine without them being aware of each other.

Virtualization does not solve all problems. One of the main problems with virtualization servers is the difficulty of scaling, as there is no easy way to automatically react when resource needs or application requirements change. A simple example: let's partition a website and create a virtual environment for it that we deploy on two servers (due to replication in case one machine fails). Along with this application there can be many others running in their virtual spaces. When traffic rises to unexpected levels, the application can quickly demand more resources than the virtual machine can provide, and since there are more virtual machines on the server, the resource allocation cannot be increased. Therefore, the entire virtual machine must be moved to another physical machine that has more resources. Even after moving, this situation may occur again a few hours later when this application will not need many resources and another will be busier.

With the rapid development of technology, the main focus of IT companies is on virtualization, load balancing, scaling the deployment process, managing dependencies, ensuring stability across platforms, cyber security, etc. This can now be achieved through containerization. Containerization offers an alternative virtualization method where a single operating system (OS) on a host can run many different applications from the cloud. Compared to virtual machines, containers provide the ability to virtualize the OS. Containers offer a logical encapsulation mechanism where applications can be abstracted from the environment in which they actually run. This separation allows containers to be deployed easily and consistently, regardless of the target environment.

Software containers offer a different type of virtualization. The advantage of containers is that they offer a reduced level of isolation (compared to virtual machines), at an affordable cost, as they use and share resources with the host OS kernel already running. Docker, as an open source platform, provides abstraction layers to help the user leverage this type of virtualization. Because of its design, it offers a convenient way for users to create new containers and make applications "portable", which is to signify that a given container can be run on any other operating system on which Docker is installed. This eliminates the need to deal with dependencies needed for the software to run when moving to another machine.

The Docker platform has evolved significantly in recent years. The fact that all products are open source

makes the community play a huge role in choosing what functionality to develop with priority in the next stage. The user base continues to grow and many large companies are publicly announcing that they are actively using Docker as part of their own infrastructure. However, this rapid evolution makes Docker a product that cannot yet be considered stable and reliable (compared to traditional virtual machines) due to the rapid pace of change.

4. Usage of datasets for silico toxicological research

In silico toxicology studies use computational methods to predict the toxicity of chemicals and other substances. The accuracy of these predictions depends largely on the quality of the data used to train the models. This requires defining the scope of the study, which includes identifying the specific research questions that the in silico toxicology study aims to answer, as well as the types of chemicals or substances to be analyzed and the toxicological endpoints of interest.

Identifying the specific research questions that the in silico toxicological study aims to address is a critical step in the study design process and depends on the objectives of the study and the toxicological characteristics of interest. These may be : determination of potential carcinogenicity, mutagenicity, genotoxicity or endocrine disruption as a consequence of candidate drug or chemical use.

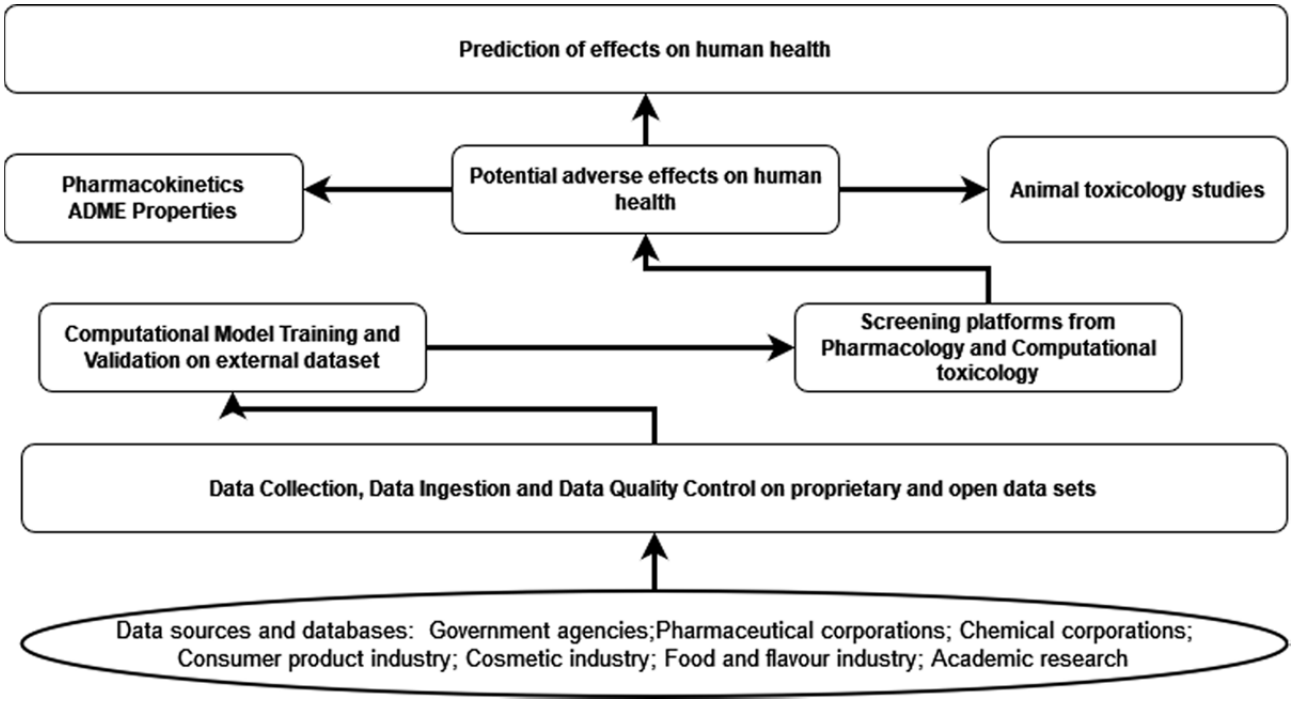


Fig.2. Processes and data workflow of data within in silico toxicology research.

Following the scoping of the toxicology study, a data collection and preparation stage for in silico toxicological studies follows. There are various sources of information, such as public databases:

- Tox21 [17]: A database maintained by the US Environmental Protection Agency (EPA) that contains data on the biological activity of chemicals.
- PubChem [16]: A database maintained by the National Institutes of Health (NIH) that contains information on the chemical properties and biological activity of small molecules.
- ChEMBL [18]: A database maintained by the European Bioinformatics Institute (EBI) that contains information on bioactive molecules and their targets.

Proprietary databases are typically held by companies that maintain their own databases of chemical toxicity data that they can use to support their own research or product development efforts.

Toxicity data collected and analyzed from published animal studies, in vitro and human studies, and quantitative structure-activity relationship models or the expertise of toxicologists.

Quality control of the collected toxicological databases is an important step to ensure that the toxicological databases used in in silico studies are of high quality and suitable for generating accurate predictive models.

The skilful combination of all these sources of information, as well as their quality and completeness, serves to build successful predictive models and identify the toxicological characteristics of interest.

5. Approach for experiment conducing for in-silico toxicology research

The characteristics or variables that are most appropriate for in silico toxicology studies may vary depending on the predicted endpoint of the test and/or the specific data set used. Common characteristics to include are [11]:

Molecular Descriptors - These are numerical values that are used to describe various aspects of the molecular

structure of a chemical. In in silico toxicity prediction, molecular descriptors are used to develop quantitative structure-activity relationship (QSAR) models that can predict the toxicity of chemicals based on their molecular structures. The molecular descriptors can be calculated using various of computational methods including quantum mechanics, molecular mechanics, and molecular dynamics simulations. Some common types of molecular descriptors include:

- Topological descriptors- These are based on a graphical representation of a molecule and include information about the number of atoms, bonds, and rings in the molecule.
- Electron descriptors- Determined by the electronic properties of the molecule, such as its ionization potential or electron affinity.
- Geometric descriptors- Depend on the geometry of the molecule, such as its shape or symmetry.
- Constitutional descriptors- These descriptors are based on the composition of a molecule, such as the number and type of atoms and functional groups.
- Hydrophobicity descriptors- depend on the ability of the molecule to interact with water and include information on its partition coefficient and hydrophobic surface area.

1. Bioactivity data - Used to develop quantitative structure-activity relationship (QSAR) models that can predict the toxicity of chemicals/drug candidates based on their bioactivity profiles. Commonly used bioactivity profiles in toxicological studies are :

- Receptor binding affinity - Describes the ability of a chemical to bind to specific receptors in the body, such as estrogen receptors or androgen receptors, and cause an endocrine disorder.
- Enzyme inhibition - Defines the ability of a chemical to inhibit specific enzymes in the body, such as cytochrome P450 enzymes or acetylcholinesterase, and to exert adverse effects on metabolic processes.
- Ion channel modulation- There are cases where a chemical can modulate the activity of ion channels in the body, such as voltage-dependent sodium or calcium channels. This is used to predict the potential of a chemical to cause cardiac toxicity or neurotoxicity.
- Transport activity- Knowledge of a chemical's potential interactions with specific transporters in the body, such as P-glycoprotein or organic anion transporters, allows prediction of drug-drug interactions or the ability to accumulate in specific tissues.

2. Physicochemical properties are commonly used as descriptors in in silico toxicological studies to develop quantitative structure-activity relationship (QSAR) models that can predict the toxicity of chemicals. Some commonly used physicochemical properties include:

- Molecular weight - a measure of the mass of a molecule and can be used to predict properties of a chemical, such as absorption and distribution.
- LogP - indicates the hydrophobicity of the chemical and can be used to predict the ability of the chemical to cross biological membranes.
- Polar surface area - property tells us the surface area of a molecule that is polar or can form hydrogen bonds, and can be used to predict a chemical's ability to interact with biological systems.
- Constant of acid dissociation (pKa)-A measure of the acidity or basicity of a chemical and can be used to predict the ionization state and solubility of a chemical under various pH conditions.

Water solubility- The ability of a chemical to dissolve in water and can be used to predict the toxicokinetic properties of a chemical and the potential for accumulation in the environment, etc.

Other important variables used in toxicological prediction are structural signals referring to substructures or functional groups known to be associated with specific toxicological effects (For example, the presence of a nitro group or epoxide ring in a structure serves as a signal to predict mutagenicity or genotoxicity). Exposure data, on the other hand, refers to information on how a chemical is likely to be encountered or absorbed by humans or other organisms. This may include information on routes of exposure, such as inhalation or ingestion, as well as information on the frequency and duration of exposure.

The choice of an appropriate method of predicting toxicity is a critical step in the development of in silico toxicological studies and is determined primarily by the factors considered so far, such as - structure and type of test substance, exposure and the available database for predicting acute toxicity, chronic toxicity, genotoxicity or other specific toxic effects. For this purpose, the training of predictive models is necessary, which is done by converting the collated information into a format that is convenient for analysis. The features or discriminators [12] to be used for model training are also identified. This involves selecting a set of physicochemical, biological or structural properties, which were discussed in above. After model construction, it is essential to confirm its performance or validate it. Model validation can be performed using a set of statistical metrics, such as accuracy, sensitivity, specificity, and area under the curve (AUC) [13].

Key steps for predicting the potential toxicity of new compounds include:

1) Inputting the chemical structure of the compound into the predictive model using computer fractions or using identification numbers.

2) Generation and recognition of molecular descriptors that can be used as input features for the predictive model. These descriptors may include physicochemical properties, structural features, and biological activities.

3) Apply the model and generate a prediction of the toxicity of the compound. The output of the model may be a binary classification (e.g., toxic vs. nontoxic) or a quantitative prediction of toxicity (e.g., LD50 or IC50). A concurrent risk assessment is performed to determine the likelihood and potential consequences of exposure to the chemical based on the toxicity prediction generated by the model.

4) Evaluate the model and compare the predicted toxicity with experimental data, if available, or assess the uncertainty or confidence in the prediction. The results of the prediction can be used to prioritize compounds for

further testing, to identify potential mechanisms of toxicity, or to support regulatory decision making.

6. Conclusion

The main features of in silico methods that make them preferable to in vitro and especially in vivo studies are:

- higher throughput;
- lower cost;
- less time consuming;
- continuous optimization possible;
- higher reproducibility if the same models are used;
- low compound synthesis requirements;
- have the potential to reduce the use of animals
-

Disadvantages include:

- quality and transparency of experimental data from the training set;
- transparency of the programme;
- sometimes confusing descriptors;
- area of applicability sometimes not clear;
- specific features of metabolism not taken into account;
- prediction of carcinogenicity is under refinement.

To date, positive experiences have been reported with in silico toxicology studies mainly for mutagenicity, sensitization which are areas with relatively well known mechanisms. Hepatotoxicity, neurotoxicity cannot yet be accurately predicted with in silico methods. The perspective here lies in the separation of complex endpoints into different steps or pathways with the common problem of how to validate and unify them to make a single prediction.

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Use of Multimedia and Distance Learning in Children with Special Education Needs (Deaf Children) in Greece

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Abstract: Education is an important and integral part of society. Regarding the society of deaf students, many elements are observed that make this part of the population in a position to be investigated more and to be helped especially in the matter of education. These children are in need of aids that will cover the deficiencies created due to hearing loss. Interactive applications are an accessible and easy-to-use means to increase the quality and effectiveness of these children's learning. The education of deaf children has a long course and development. Studying the historical path of the education of the deaf, we notice that it has gone through various stages where each time specific issues had to be addressed and resolved, depending on the needs of the time. Given the - to a great extent - heterogeneity of the population of deaf children, we cannot speak of a correct and universal educational approach.

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1. Introduction

Providing the definition for the term of special education, this is not an easy task, since people and persons are talking about persons with special educational needs. For the term *"person with special educational needs"*, there is not any specific limits which have been set, but instead there is an ambiguity, since the different categories of disability have not yet been clarified [1].

Also, this aspect is due to the fact that in the past there was also the opinion that people with special educational needs should also be considered mentally ill. For this reason, several definitions have been formulated from time to time, in order to somehow make visible all the forms that special education and training can take [2].

The pioneer in the process of defining special education, was actually Rosa Imbrioti, who was given the title "*Mother of special education*" due to the fact that she accomplished a very important work, daring to assert in 1939 that "*special education is the science that takes care of for the education, teaching and welfare of all children whose physical and mental development is continuously impeded by individual and social factors*" [3].

Upon this specific definition, it becomes clear that the main goal of special education and training is beyond education and teaching, the offer of support to those students who, either for personal or social reasons, did not manage to be at the same level as the student's typical development. It should be noted that social factors are also mentioned as a root cause in the definition, something that has not been mentioned in the definition.

Finally, it should be said that for younger readers, fairy tales with various animals as protagonists have been selected, while for older readers, stories based on human characters have been selected. At older ages, the choice of stories with human characters may have more appeal as many of the children may identify with one of the heroes. Considering the many difficulties faced by deaf children in understanding texts, all texts were simplified, and the most common Italian words of primary education were used. According to research, it has been stated that images effectively help in understanding texts. For this reason, static as well as animated images were used in some stories with the aim of making the stories more attractive, but also visual references may enhance the narration of the events.

2. Literature Review

The role of the teacher is particularly essential both during the evolutionary course of the pedagogical process and the practical implementation of every educational policy. For this reason and at the same time for how special and complex he is, a lot of research has been done in order to clarify in detail who exactly he is. As it has been argued, the one who is called an educator should, throughout his professional career, develop and interact with his peers in order to become better [2].

Teachers are characterized by the society as the people who have the responsibility for any reform or innovation that takes place within the education sector, decide on the organization of educational programs, come into contact with young people, in order to guide them in new knowledge, in the development of their critical thinking and democratic views as well as in dealing with all social phenomena in a fair and objective way. Thus, they manage to be those who welcome everything new and promote it in a universal way. The multifaceted personality of the teacher has brought him/her face to face with demanding situations that have more to do with the adequacy of knowledge and support.

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More specifically, the vulnerabilities, which arise during the professional career of teachers, are related to the following issues:

- The level of education and professional career in the specific context. For example, if a teacher has not been trained in dealing with people with special educational needs, then he/she will certainly feel helpless and not will be able to provide appropriate support, resulting in either being informed by others about what steps to take or even exemplary refusal to deal with such cases, arguing that it is not within his own competence. This whole situation could have taken a completely different turn if the teachers were properly trained. In particular, in matters concerning Special Education, this would be necessary, given that there are many developments, and this makes it necessary for teachers to show a different approach to the specific students, through the guidance they will receive from the responsible for special education and training.
- Its socio-cultural context. The teacher is a result of each society that has been educated, following a specific protocol with principles, values, and rules. Between teachers and parents there is likely to be some gap in opinions, ideas and tactics due to education and the different way they have learned to live. This makes meaningful communication difficult.
- The feeling of loneliness felt by the teacher. The teacher is the only person who is called upon to carry out what was planned together with the counselors, the principal and the parents of each child with special educational needs. In the case, in particular, that he does not have the necessary knowledge about issues of special education and training, then his work becomes more difficult, as a result of which he feels frustrated. In this situation, of course, a key role is played by the lack of logistical infrastructure, the syllabus, as well as the lack of cooperation that characterizes the relationships between colleagues.

Thus, it becomes clear that there are many causes that lead to the downgrading and mitigating the value of the teacher's profession, thus letting it be seen that not everything is rosy in his professional path. The potential teacher needs to be informed, flexible and adaptable to new data, in order to accept this new condition and continue to try, in order to pass on the torch to the students of the knowledge, values and principles that promote a democratic school environment [4].

In relation to the teacher of special education, the responsibilities that weigh on him/her are much greater, given that students have increased needs compared to those of typical development. As Kalatzis also mentions the special education and training teacher is the "*unquestionable and irreplaceable body and operator of special education and training*" [5].

This particular profession appeared all over the world from 1940-1980 and it was about the one who was responsible for the education of people with special needs and disabilities. As soon as society's views on these individuals began to change, their role automatically changed, thus ushering in a new era regarding the obligations and what their work entails [6].

When people use the *term New Technologies in special education*, they refer to the support devices that are an integral part of the life of the person with a disability, the shared devices (SD) and the special educational software that help the student to develop basic learning skills despite any weaknesses [7]. The use of technological means, support devices and the SD staffed with the appropriate software contributes decisively to the learning process, primarily enabling people with special needs to acclimatize to the educational context and function more easily than any physical or their mental handicap compared to the rest of the student population.

The computer is the most established device in the educational field since it seems to contribute to the educational process by offering new experiences and the possibility of achieving an interesting and entertaining lesson. Plenty of research [7, 8, 9] confirms the assumption that the SD and its peripherals, the new technologies as a whole contribute positively to the educational practice.

The various electronic components and educational software can, on the one hand, restore any physical weaknesses [10] of the students, such as vision and movement problems, on the other hand, smooth out any learning-type difficulties [9]. Students with special educational needs, either due to physical disability or learning difficulties, can benefit from the application of New Technologies in the educational process as it provides them with physical, cognitive and supportive access to the educational activity [11].

The students with physical disabilities gain physical access to the educational process through the use of assistive technology such as the use of eyelid switches or other communication devices that replace speech. They, as well as students with learning difficulties, achieve cognitive access by using appropriate software on the PC (for example digital use of image or video with written text). At the supportive level, the use of the computer helps the teacher to provide feedback and positive support to his students. Overall, students through technology take learning into their own hands, become more active and more responsible without any of their weaknesses being an obstacle to learning [9].

A new path opens up for special education students that offers new and interesting perspectives [12] "*The computer offers the possibility of introducing the student into a controlled environment...it helps the student to maintain his attention and concentration on an activity*" [13].

At this point, it should be pointed out that the basic technology around which the other auxiliary devices and the various educational software used in special education revolve and operate is the SD. Familiarity of the student with special needs with the computer is considered necessary in order to benefit from the use of this and other technological applications. For this reason, the ICT program (Information and Communication Technologies) has been introduced into the curricula of all levels of education in many countries as a basic teaching subject in general and special education.

"*The recognition of the educational value of computers led to the building of active relationships between the education of children with disabilities and Information Technology in general. Therefore, the education of children with disabilities must include the full range, diversity and diversity of possibilities offered by the introduction of the specific medium, in order to utilize it aiming at the support and promotion of children and people with disabilities*" [14].

The ICT has evolved and continues to evolve rapidly affecting people's lives at an individual, interpersonal, social, professional level and consequently their quality of life. "*So, for an inclusive society it is important to give the possibility to every citizen who wishes to participate in the digital transformation despite any individual or social disadvantages*" [11]. In this context, the society of the 21st century for the upgrading of the educational system, it sets as a basis the conversion of education to the needs of the students. The modern school must create suitable conditions for all students to come into contact with new technologies and to use and utilize them according to their needs.

Another category of students with special needs are those who face speech and language disorders. The use of appropriate technology can help these individuals interact within the classroom. When speech is absent or poor, the use of special devices called augmentative and alternative communication devices help individuals overcome their communication problem. The use of these devices is particularly helpful for the educational process, since it gives the opportunity to express and participate to the student with speech disorders, but it costs a lot and this is the main reason why it has not been established as a trend in the educational field as a supporting tool for people with speech disorders.

Today, of course, there are corresponding computer software and tools that are even more flexible and easy to use than stand-alone augmentative and alternative communication devices. There are also devices that incorporate synthetic or digital speech output and can be connected to the computer. A letter read at a Software Publishers Symposium in 1998 by a young man whose PC was equipped with a text-to-speech device is typical: "*Until now, I have never had a voice or any other means of communication. Until last year I was a student in a special school class. Now, I am in the eighth grade of a regular school. The computer was the best thing that happened in my life. Now people don't have to read my words. They can hear them like everyone else*' [15].

Students who are also visually impaired need the assistance of support programs so that they are able to engage in the learning process inside and outside of school. Students with partial vision are helped by the use of the interactive whiteboard or the computer screen as these two media allow images and text to be enlarged (zoom). Regarding students who have no sight at all, there are programs such as the Screen Reader and the Braille Display that allow them to be more autonomous in their learning process.

Screen Readers are tasked with informing the blind person about what is displayed on the screen. It is a software that shows the content of the screen using the voice synthesizer. The Braille Display converts the data it receives from the screen reader into Braille, allowing the user to read the content displayed on the PC screen line by line. The Optical Diagram Machine (Piaf Printer) is also a computer-independent device for the blind that produces relief graphics [16]. The Braille 'n Speak machine is the most popular 'notetaker'.

It is a talking device with a rich range of functions that particularly help the student. It requires knowledge of braille, is based on seven keys and includes a text editor (write, copy, paste) and the ability to store over 200 pages of braille text. Finally, Voice Navigation software that allows commands to be executed simply by voice recognition, and Braille Translation software that translates typed letters into embossed Braille characters, are very important learning tools for blind people [16].

The schools that deaf and hard of hearing children can attend are boarding schools, special day schools, special parallel classes or special classes within the general school and the choice depends on factors such as the degree and type of hearing loss, the intelligence, the presence or absence of other disorders, or the ability to learn [17].

According to the new Law on Special Education 2817/2000, students with special educational needs, including deaf and hard-of-hearing students, can study in the regular school classroom with parallel support from a special education teacher, who serves in the KDAY or in the school units of special education and is defined by the KDAY or in specially organized and appropriately staffed integration departments that operate within the schools of general and technical vocational education [18].

The special school is most often chosen on the basis of the specialized help it can offer the child, since deaf adults they act as role models for children, while general school and integration are chosen based on social acceptance. The education of deaf children in Greece is based on empirical educational practices without the required organization, supervision and guidance necessary to meet the educational needs of deaf children.

The ENG does not exist as a subject in the school curriculum. Parents of deaf children who choose "mainstream" school attendance argue that their child has the right to attend a less segregated environment than a special school [19]. In the "normal" school their deaf children have opportunities to communicate with the hearing world. Daily contact of deaf children with hearing children can help them develop communication skills, which are essential for their future lives.

On the other hand, Deaf Language is a kinesthetic-visual language, it is the main axis around which the most important issues of deaf culture and education revolve. Some experts argue that deaf children who acquire sign language as a first language later avoid and refuse to try to acquire sign language [20]. Stokoe after studying sign language argued that it satisfied every linguistic criterion of a real language in terms of its lexicon, syntax and ability to create an infinite number of intentions.

Despite this, the special school does not always provide the appropriate specialized learning structures [21].

James Fay (1869): "*No, we are delighted by the ordinary achievements of the deaf and mute in the field of language. The majority of students who are born deaf graduate from our institutions without the ability to express their ideas using proper idiomatic language or to understand the language of books. Even college-entering students who make up the nation's highest-intelligence and highest-achieving percentage of the deaf and mute have difficulty understanding the abstract and often technical jargon of college textbooks*."

Fay's comments reflect the difficulties faced by educators of the deaf for generations and are in line with the views of many of his contemporaries [22]. Choosing a special school seems to have negative effects on the child's social development. The deaf child may have to move away from his home to attend the special school, which may lead to his estrangement from his family [21].

A hard of hearing child learns language in the same way as a hearing child and is able to use speech to communicate. Of course, he needs support and help, as well as using headphones, if he has not undergone a cochlear implant. In the deaf child, the absence of the most important factor of communication with hearing people, the absence of hearing, has a direct and serious impact on their education, on their spiritual cultivation and development of their mental and emotional make-up, on the formation of their personality, social of his position and professional career, since the deaf child does not master oral communication reflexively but to a limited extent through interventional teaching [23].

Most hearing children come to school with the ability to process and integrate verbal information, whereas deaf children rarely have the same language background or similar language skills as hearing children, resulting in complex communication problems [24, 25] concluded that spoken language was not a necessary condition or even an important factor in early personality development [22].

3. Results and Analysis on the Use of ICT and Distance Learning in Children with Special Education Needs in Greece

The 59% of the participants were female and the 41% were male. The 57% of the participants were from 41-50 years old, the 26% from 51-60 years old, the 15% from 31-40 years old and the rest 2% from 24-30 years old.

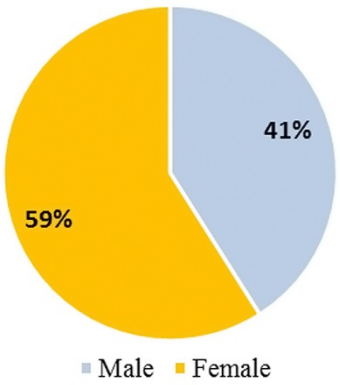


Fig. 1. Gender of the participants.

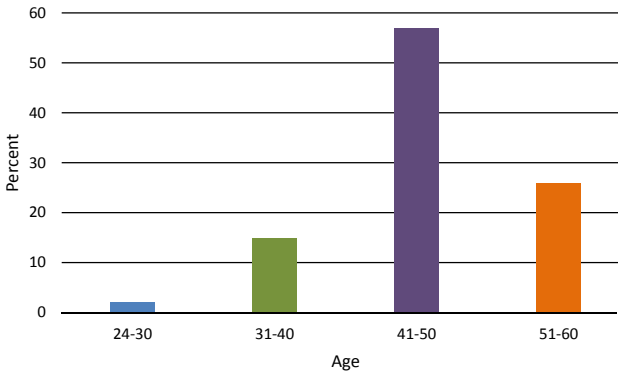


Fig. 2. Participants divided by age.

The 41% of the participants had a working experience in education from 11-20 years, the 32% over 20 years, the 16% less than 3 years and the rest 11% from 4-10 years. The 50% of the participants had a working experience in special education less than 3 years, the 30% from 4-10 years and the rest 20% from 11-20 years. The 41% of the participants have participated in seminars for special education, the 35% had a PhD and the rest 24% had a Master.

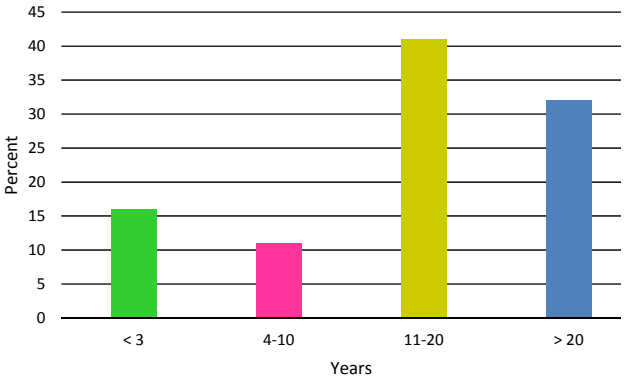


Fig. 3. Working experience in Education.

The 40% of the participants have dealt with children with Hearing impairment (including deafness) during their career as teachers in special education.

The 65% of the participants have dealt with children with Visual impairment (including blindness) during their career as teachers in special education. The 74% of the participants have dealt with children with Developmental delay during their career as teachers in special education. The 56% of the participants have dealt with children with Down syndrome during their career as teachers in special education. The 39% of the participants consider the use of ICT in Children with Special Education Needs quite important, the 30% moderately important and the 26% very important.

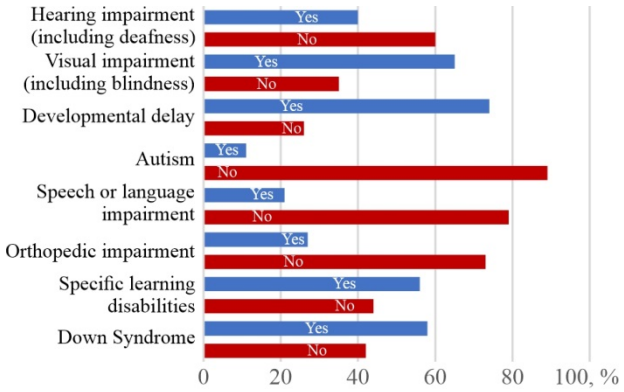


Fig. 4. Question: Which categories of special needs children have you dealt with over the years?

According to the above mentioned, two specific (2) definitions have been formulated from the international arena, which, however, deal with special education and training from a different point of view. In the first case, where special education and training is treated sociologically, it is pointed out that its importance depends on the positive consequences it has in society, in the educational sector and in general in everybody that has to do with it [26]. However, the second definition argues that special education and training is not defined by the context in which it is provided but based on the particular requirements of the student. Furthermore, a clarification is given regarding the disadvantages that are not linked to the individual but to the respective school context and the wider social one [3].

From the above definitions, it becomes clear that there is not a complete definition for special education and training but also that the reason for its existence and its contribution have been recognized. Furthermore, it is emphasized that special education and training is not necessarily offered in a separate context, but a student can receive it within the general school and that the reason for existence its purpose is not to impart knowledge to students with special needs but to equip them appropriately so that they can socialize and balance any adjustment difficulties they may have.

4. Conclusion

Education is an important and integral part of society. Regarding the society of deaf students, many elements are observed that make this part of the population in a position to be investigated more and to be helped especially in the matter of education. These children are in need of aids that will cover the deficiencies created due to hearing loss. Interactive applications are an accessible and easy-to-use means to increase the quality and effectiveness of these children's learning. In addition, play is one of the most important means of communication for children.

Deaf people and people with disabilities in general from antiquity to the renaissance were not accepted by society and for this reason lived on the margins without rights and education. The role of the teacher is particularly essential both during the evolutionary course of the pedagogical process and the practical implementation of every educational policy. For this reason and at the same time for how special and complex he is, a lot of research has been done in order to clarify in detail who exactly he is. As it has been argued, the one who is called an educator should, throughout his professional career, develop and interact with his peers in order to become better.

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