Book of Abstracts Volume 40

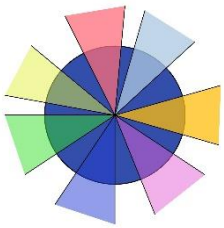
Stream EWG Ethics and OR

30th Satellite Event State of the Art Workshop

32nd European Conference on Operational Research

in Espoo, Finland, Helsinki 03-06 July, 2022

Dorien DeTombe, Gerhard-Wilhelm Weber and Ulrike Reisach (Eds.)



Book of Abstracts Volume 40, the 32th EURO Conference Finland Helsinki 2022
Stream Ethics in OR and Satellite Event State of the Art

Operational Research EURO MSC / EURO MCDA / EUROPT / EURO ORD / Ethics and OR and Societal Complexity and Governance
Dorien DeTombe, Gerhard-Wilhelm Weber and Ulrike Reisach (Eds.) (2022)

Europe, The Netherlands, Amsterdam; UK, Guilford; North-America, Canada, Montreal: Greenhill & Waterfront, ISBN /EAN 978-90-77171-65-3 greenhillwaterfront@hotmail.com

http://www.complexitycourse/greenhillwaterfront
Version 001, 31 pages, November 2022
Nur 916
Language English

10 Euro

Foundations and history of OR

Ethics in OR

30th Satellite Event State of the Art Workshop

Operation Research and Ethics, Societal Complexity and Governance: The EWG OR and Ethics and Societal Complexity

The OR and Ethics EURO Working group is dealing with ethical dimensions of Operational Research (OR). By ethics we understand moral, (descriptive) normative, political principles, regimes and structures. Therefore, the group is particularly focused on using OR for the "common good", to "make an impact", and to address societal challenges.

Since 2017 two Euro Working Groups (EWG), the EWG OR and Ethics (1996) and the previous EWG Methodology of Societal Complexity (MSC) (1993), went together due to a significant overlap of the content of their research field. Both EWGs focus at ethical subjects in doing research on the topic of improving the way of living for all people. Giving that each researcher has only one life, the members of both these research groups decided to dedicate their scientific lives, research capability, brains and efforts to improve the living conditions of all the people in the world in order to make the world a better place to live. This idea of research often includes criticizing issues and circumstances that abuse privacy or provoke danger, like unethical use of data mining for companies, unethical use of social media, abuse of health of people by the alcohol and tobacco industry, criticize unethical labor conditions like child labor, meanwhile improving the position of women by emphasizing education of women, especially in developing countries, by being financial independent, by forbidding child marriages, and stimulate equal pay for equal jobs given that women rights are human rights.

Reflecting and handling these kind of complex societal ethical problems has been the focus of the researchers belonging to the EWG OR and Ethics and Societal Complexity. The latter one turned from European to a worldwide research group. In most complex societal problems, some persons benefit while most people suffer. Given this reality the researchers of our EWG research group of OR and Ethics and Societal Complexity like a responsible bound of minimalizing the personal benefit for those who profits from complex problems, like the banks who created the credit crisis and the pharmacy industry who benefited for dangerous drugs and Covid vaccinations and to maximize the situation of all people in a social based democracy where all people can be protected by the rule of law.

The EWG Methodology of Societal Complexity (MSC) is a part of the International Research Society on Methodology of Societal Complexity (MSC), founded and chaired by Prof. Dr. Dorien DeTombe, created in 1993. The International Research Society on Methodology of Societal Complexity (MSC) and the EWG Methodology of Societal Complexity (MSC) has since 1993 organized many conferences in all continents all over the world and published many books and articles in scientific journals, see http://www.complexitycourse.org. The EWG Methodology of Societal Complexity organizes each year special sessions on this topic on the

EURO conferences of the Association of European OR Societies along with the EWG OR and Ethics.

Methodology of Societal Complexity focuses on methodologies, methods and tools for analyzing, structuring, advising, guiding and evaluating complex societal problems. Complex societal problems are often policy problems that can occur in many fields, like in the agro-industry (water pollution by too much manure, fowl plague), in the transportation sector, in healthcare (Malaria, HIV/Aids, Flu, Covid), in water affairs and in economy (credit crisis). The field focuses on handling local safety problems like large city issues and natural disasters as flood, earthquakes and hurricanes and global safety problems like climate change and terrorism. Although many of these issues have different causes, they have so much in common that they can be approached in the same way by using the Compram methodology, a methodology based on the cooperation of experts of different fields and actors and the opinion of the people in a democratic way.

Complex societal problems, as such, are unstructured, dynamical, constantly changing and have a large impact on society on macro, meso and micro level. Handling complex societal problems needs a special multi-disciplinary approach. The content knowledge comes from content experts. The process knowledge comes from facilitators. The power is in the hand of actors. The attention of the research of Methodology of Societal Complexity is on the methods and tools facilitators need for guiding these kinds of problems. The facilitators use methodologies specially created for the field of societal problems combined with methods and insights derived from fields like medicine, law, economics, societal sciences, methodology, mathematics, computer sciences, technology, engineering sciences, socio-cybernetic, chaos theory and operational research combined with content knowledge of the specific problem. Often a combination of methods is needed as is prescribed by the framework methodology for handling complex societal problems.

The Operational Research (EURO) branch OR and Ethics: Operational Research and Ethics, was created in 2001 at EURO XVIII by Prof. Dr. Jean-Pierre Brands of the Free University of Brussels, Belgium. The goal of OR and Ethics is creating increasing interest on ethical issues in OR research, teaching, consultancy and practice. This can be reached by organizing OR and Ethics on the EURO and IFORS conferences.

At the 32th EURO conference in Espoo/Aalto/Finland (2022), OR and Ethics and Societal Complexity organized eight lectures and a 30th Satellite Event State of the Art Workshop.

Chairs of the EWG OR and Ethics and Societal Complexity

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EWG Methodology for Complex Societal Problems (MSC), EWG EUROPT**,** EWG OR for Development Founder and Chair International Research Society on Methodology of Societal Complexity Amsterdam, The Netherlands, Europe,
https://www.researchgate.net/project/Handling-Societal-Complexity.

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EURO working groups, initiatives and projects related to EWG OR and Ethics and Societal Complexity are:
EWG EUROPT, EURO Working Group on Continuous Optimization
EWG OR for Development
EURO MCDA
OR for the Common Good: https://www.researchgate.net/project/Operational-Research-for-Common-Good

Keywords: Governance, Methodology, Complex Societal Issues, Decisions, Sustainable Development, Healthcare, Economy

Amsterdam,
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The stream Ethics in OR of the 32th EURO conference in Helsinki, Finland,

A Ethics, Societal Complexity and Governance

B Digital Ethics & Governance

C 30th Satellite Event State of the Art Workshop

Subsequently we present the abstracts of these sessions.

A Ethics, Societal Complexity and Governance

Societal Governance: Atlantic Wind and Wave Protecting Europe from Energy Deficiency

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Terence MacSwiney https://www.corkuniversitypress.com/The-Art-and-Ideology-of-Terence-MacSwiney-p/9781782055037.htm

Two opposite approaches to governance power are societal and the individual, with the latter corporate or dictatorial. Both use political and institutional systems as mediators. The individual-driven approach takes resources, uses political means to bring resources to the people, then institutional means to make things of value, intending to give benefits to society. The alternative society-driven governance starts with communities, such as the people of Europe, and our energy deficit, our reliance on imported energy. It next makes European institutional systems source and distribute energy adequately to satisfy European societal needs. It then uses political means to bring energy from sources to institutions, and onwards to people. And finally, it uses individual points of sourcing energy, to get the process of energy supply started. The current project is to distribute energy from the Atlantic across Europe. Its elements: First is 'bobbing energy': where Atlantic waves cause ships to bob up and down. Second: Atlantic wind is used to power jet engine wind turbines. Third: both are incorporated on redundant cruise passenger ships. Fourth: both wave and wind energy are converted into Green Hydrogen. Fifth: the Green Hydrogen is converted into electricity and brought into the grids. Institutions and politicians have vested interests in the old ways, and don't understand the opportunities. The EURO OR community should drive this, and also resolve its technical challenges.

Keywords: Alternative Society-Driven Governance, Europe, Energy

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Better policy for future pandemics

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In the years 2020-2022 the SARS-CoV-2 pandemic created a disastrous situation in the whole world. Many governments panicked; what to do? How to protect the people? Most governments were not prepared to handle a pandemic despite the long-time warnings from epidemiologists. In trying to diminish the deaths and mitigating the infection the governments isolated the people from each other by several lock-downs. This had negative consequences not seen by the governments for the well-being of people such as for the education of children, the healthcare of small children, the depression of teenagers and the delayed medical care of many vulnerable people. Isolation created in many ways disastrous situations.

Because it looked like a healthcare problem, the governments asked only advice to healthcare specialists. They gave advice, however based on their own expertise, which means they gave healthcare related advices such as lockdown to prevent more people getting infected and so to prevent intensive care units of hospitals not to be overflown by vulnerable people, people with underlying diseases and elderly obese people above 75. Later on, in the second year of the pandemic, economic experts were included, because of the economic effects of the lockdown for the entertainment, free time and tourism industry. However, in many countries the government policy was not optimal, not effective and not efficient.

A pandemic such as this, is not a healthcare problem neither an economic problem. It is a complex societal problem, including many more aspects than only healthcare and economic aspects. Therefore the government should not only consult the healthcare and economic experts but also people from the field of law, psychology, educational, psychiatry, and sociology should be consulted. These people should exchange their knowledge about the situation among each other to see what the best strategy should be taken.

A complex societal problem should be handled according to the guidelines of the field of Methodology of Societal Complexity. This scientific field advised to have Knowledge Institutes, advocated by the OECD in 2006, that are ready to act as soon as a complex problem arrives. Then based on the Compram methodology (DeTombe, 2015) they can start inviting experts and actors to discuss the problem and to decide, based on their models of the problem, which changes would be the most fruitful and sustainable. With this scientific work they could advice the government in its decision. In this way decisions of the governmental are based on scientific advice and are more sustainable in a democratic may. Handling this way the governments would have saved more lives, sorrow and money.

The governments should have been prepared for pandemics. Pandemics come and go. In order to do prepare themselves for the next pandemic the governments can get support of the Field of Societal Complexity based on the Compram methodology (DeTombe, 2015). The government policy can be guided to prepare for and mitigate the damages of a pandemic focusing not only on healthcare aspects but all aspects of the society.

Keywords: Government, Policy Compram, Knowledge Institutes, Corona, SARS-CoV-2, Pandemic, Future.

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A general economic system to meet all basic needs of society

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This article presents the general economic system, the main purpose of which is to meet all the basic needs of society. Important features of the economic system are described. The classification of the economic system according to the ability to meet the main goal is given. It also takes into account the fact that the essence of the economic system depends on the political system in society, which is constant at certain intervals of time, but can change at any time unknown in advance.

Indicators of efficiency and effectiveness of the economic system are introduced, which give us information about the state of the economic system at a given time interval and at a given point in time, respectively. Based on the performed analysis, three types of tasks for optimal management of the economic system are posed. One simple optimal control example is presented for illustration.

Keywords: Economic Modeling, Efficiency Analysis, Optimization Modeling, Political System

B Digital Ethics & Governance

How alarmism and generalizations impede diplomacy

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Propaganda and disinformation are components of war. They are the opposite of mindfulness and caring for all individuals which shaped European discussions in recent years. Diplomacy tries to provide a rational, well-balanced discourse, fostering mutual understanding as well as decisions for a fair compromise, collaboration and mutual or global benefit, but gets more and more overwhelmed by misunderstandings and pieces of publicized (dis)information. This research will use historical and current examples to (1) explain how negative and generalizing comments and campaigns on both sides create anger and hate, (2) why and how the negative narrative will go viral globally, and (3) why a smart diplomacy by both sides is an art that is difficult to practice in the digital world. Generalizing, distancing, and cutting off contacts causes more problems than keeping in touch and trying to see the issues and goals from multiple perspectives. Even if there are few Ethics in war, mutual respect, humanitarian care and two-sided proposals during in-person meetings can and shall be applied to avoid further harm for all sides.

Keywords: Propaganda, Disinformation, Diplomacy, Ethics, Decision Analysis, Disaster and Crisis Management

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Moving beyond a framework for the continual improvement of healthcare service: a modeling study

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Healthcare system is widely recognized as complex and difficult to manage in practice because of the inherent uncertainty as well as widespread interactions between operating units. If policymakers or managers treat each part of the healthcare system as independent units, well-intended health policies and management strategies usually fail or make the current situation even worse. In order to avoid policy resistance and to improve management performance, it would be beneficial to apply systems thinking to the fundamental problems existing in the healthcare domain. Therefore, this research emphasizes the importance of incorporating improvement knowledge within the management cycle into professional knowledge within the clinical cycle in modern healthcare institutional operation. To illustrate the point, a mathematical simulation model is developed to enhance our understanding of why we get queues and waiting lists in medical service and more importantly how we can solve this problem better in real environment. In theory, this study can also contribute to the development of current operational research in healthcare system by advocating systems thinking and modeling methodology.

Keywords: Health Care, System Dynamics and Theory, Strategic Planning and Management

Fostering engagement in AI design to aid communication decisions in the NHS

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We describe ongoing research that uses a Human Centric Analytics (HCA) approach to foster engagement that positively impacts both an AI design and the communicators who are likely to use it. Through a series of workshops, weekly research meetings, and an iterative design of classifiers to perform Natural Language Processing on social media posts we have created outputs that are being bought together with decision makers. The 'citizen panel' workshops informed the research design, and the design of the classifiers, the classifiers informed the workshops to create a dialogue between the possibilities afforded by AI and the thoughts and experiences of citizens. Bringing our finding together with decision makers whose job it is to communicate health messages to the public creates an opportunity to fit the classifiers into a landscape of knowledge and measurement such that health communicators can assess how their messages are landing and how they can best design and target information.

Keywords: Analytics and Data Science, Health Care, Soft OR

Artificial Intelligence for Skin Cancer Classification

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Several studies have shown the potential of artificial intelligence (AI)-based models for skin cancer classification. However, successful translation of these findings into clinical practice is yet to be achieved. We therefore analyzed the current state of research on studies comparing AI and human experts with particular reference to their potential clinical relevance. We reflected the actual impact and forthcoming challenges expected with the implementation of AI into dermatological care by assessing three main aspects: test set characteristics (holdout/out-of-distribution data set, composition), test setting (experimental/clinical, inclusion of metadata) and representativeness of the participating clinicians. All reviewed studies demonstrated superior or at least equivalent performance of AI in comparison to human experts. However, almost all studies were carried out in highly artificial settings. Test sets mainly consisted of holdout images and did not represent the full range of patient populations and melanoma subtypes encountered in clinical practice. To increase clinical relevance, future comparisons should be conducted under less artificial settings and validated with external testing.

Keywords**:** Artificial Intelligence, Health Care, Decision Support Systems

Gender insights within the EURO OR community

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This work reports on the outcomes of a survey carried out as part of the EURO WISDOM Forum research agenda on "gathering data to model the OR network of actors" to "stimulate a conversation around how OR can be utilized to help create a diverse and inclusive future". The survey was carried out in 2021 and aimed to identify some of the reasons people choose to pursue a career in OR, explore the participation in OR sub-disciplines by gender, map any potential emerging challenges to participation, and, eventually, create insights into different OR career paths. To the best of our knowledge, WISDOM has been the first to produce a survey to enquire over a gender dimension within the EURO OR community. This research first provides a description of the survey: questions mostly explored respondents' background (e.g., caring responsibilities, career break avail, OR sub-discipline expertise, employment circumstances), career progression (e.g., time since PhD award, motivations associated to either an institution "change" or "no change" decision), and participation in OR (e.g., authors' ordering convention, perceived or experienced challenges to build a career in OR). Then, the emerging themes in gender and OR are discussed based on descriptive and predictive analytics techniques. Finally, building on this analysis, some propositions are laid out to further enhance EDI in OR within EURO.

Keywords: Sustainable Development, Ethics, Social Networks

C 30th Satellite Event State of the Art Workshop

How to avoid the Farmer protest in The Netherlands

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Due to the European law on protecting vulnerable habitats The Netherlands must mitigate their nitrogen (ammonia and nitrous oxide (NO2)) emission in view of diminishing the climate change. Nitrogen pollution is the result synthetic fertilizer use and high volumes of animal manures due to intensive livestock units. Excessive nitrogen can have a negative impact on climate, the environment and health. The intensive farming of Dutch farmers breeding cows and pigs is responsible of a large amount of nitrogen emission. Too much nitrogen emission deriving from manure of pigs and cows pollutes the water, air and land quality. The Dutch government realized this long ago. But the right-wing liberal government in The Netherlands, the last twelve years in charge together with the religious parties, refused to take adequate measures on time in fear of losing their voters. At last in 2019, the government was called back by the European law, and was forced to take the European demands of mitigating the nitrogen extension serious. Therefore, in March 2019, the Dutch government created a special program: the 'Program of Approach on Nitrogen' (Programma Aanpak Stikstof) in which they demanded the Dutch famers to diminish their nitrogen emission by diminishing their live stocks. This means that many farmers must close their business. These measurements were quite radical and suddenly taken, without consulting the farmers themselves. Many farmers were furious! This resulted in a huge and wild farmer protests with radical actions during the following two years. Roads were blocked by tractors and fires were burned on the road sides.

Was it right to demand diminishing the many intensive farming businesses in the highly densely populated Netherlands? Yes, diminishing the nitrogen output is absolutely necessary. There is too much nitrogen which pollutes ground, air, water and it is a danger for human health. However, one can wonder, whether these furious protests could have been avoided meanwhile still stimulate the farmers to diminish the nitrogen.

Yes, these protests could have been avoided when the governments would have dealt with this plan according to the Compram methodology. As soon as the government became aware of the danger to the biodiversity by too much nitrogen in the environment, the government should have approached this complex societal problem in the way the Compram methodology for handing complex societal problems advises. In this way they could have avoided much protests. What should they have done?

As soon as it became unavoidable to diminished the intensive farming in The Netherlands (DeTombe, 1993) the government should have approached this problem as a complex societal problem. Starting with organizing meetings guided by a facilitator with experts to see what is really going on. Experts on the field of farming, biology, business, psychology, biodiversity, nature etc. in order to find out which kinds of output is polluting, with what effect for the

ground, air, water and people and what is the effect on the climate. Then the experts define the problem by making a description and a model of the relations between live-stock farming and pollution. Pollution by nitrogen and also pollution by other substances. The definition includes how the pollution can be mitigated and which effect this mitigation will have on the business of the farmers.

Then according to the Compram methodology the government, who is the problem owner, should continue the problem handling process by inviting the different actor groups involved in this complex societal problem. The actors in this problem are the action groups of climate change, the farmers of pigs, cows, or chicken, the nature protectors, the local and provincial and government political groups. All these actors give their view on the problem. Then in step three of the Compram methodology the actors and the experts try to come to a mutual agreement of diminishing the nitrogen and other contaminators according to the demands of the European law. This way of problem handling should have started twelve years ago. The farmers would then be stimulated realize the problem and the necessity and could have to organize themselves to diminish the livestock, meanwhile negotiated for compensation, and find other ways of living. This would have diminished the huge protests, sorrow and fear.

Keywords: Government, Policy, Compram, Protest, Farmer Nitrogen, Live-Stock.

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The End of "Might is Right"

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The two opposite drivers of governance are Property-Driven and People-Driven. With Property-Driven the sequence is Might, Bright, Fight, and Right. The intention is Gain, Pain, Blame and Shame. The great powers of the world Direct, Connect, Project and Protect. They Propose, Perceive, Push and Persuade. They Take, Bring, Make and Give. Because they Would, Could, Should, to then do Good. Because they are come from Bad, Mad, Sad to Glad. Always the same order. Some remain stuck in Bad and Mad. Russia killing millions to take Ukrainian land is either Bad or Mad. They presume the West would Fight: join NATO. But that is not Right or Good. As operational researchers we know there is also a shadow solution: the Dual of the Primal. Instead of maximizing Profit, minimize Cost. Instead of increasing your Property-Gain, reduce your People-Shame, for not saving people's lives, homes, livelihoods. Start with Protect. Declare a United Nations 100 km safe zone on the Russian borders with western countries, and have United Nations peace-keepers in these zones. Declare similar safe zones on the Israeli border with Palestine, and in other places of conflict. Russia thought that Europe would not Fight because Europe is dependent on Russian oil and gas. West of Ireland there is enough Wind and Wave Energy on the Atlantic to provide for Europe's energy needs, through conversion into Green Hydrogen, store in batteries, put into the European electricity grids, and even sell to China. We OR experts can use our intellectual talents organise this, now instead of waiting 30 years. Property-Driven is a Childish attitude: I want, I want. The world is burning up, because the great countries: Russia, China, and the United States, behave like bold children. Time to grow up, to be Right. Europeans, let's be Good Citizens, Persuade others to Protect the People on the Planet, be Glad we still can, or be Shamed when we no longer can.

Keywords: Nomology

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Who Trusts which Type of Artificial Intelligence?

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AI in the form of Machine Learning is increasingly successful in manifold contexts. This is impressive but at the same time people start questioning themselves and the developers and users of those algorithms whether those newly acquired skills of machines are always beneficial for humans. This question is not easy to decide because it depends on the respective goals of developers and humans, the ethical aspects and multiple perspectives, purposes, humans and contexts. In order to start a discourse on how humans perceive certain Machine Learning results, university teachers and students were invited to an introduction that explains Machine Learning and Human Cognition. After this basic introduction, teachers and their students got a list of 10 short samples of a Machine Learning application. The participants were anonymously asked to contribute their sentiment about each of the 10 samples, whether they welcome this new skill of the machine or whether they have resentments and why. The tests started in 2022 with 2 universities (others are welcome), and will further lead to an open discussion on how (different) humans (with different backgrounds and values) perceive the respective innovations of Machine Learning.

Keywords: Ethical AI, Machine Learning, Human Cognition, Critical Thinking

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Ethical AI and the Determinants of Healthcare Accessibility for Medicare Beneficiary Disease States

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Healthcare accessibility is a complex measure rooted in the ability of an individual to receive healthcare effectively with demonstrated anxiolytic effects. A health equity disparity occurs when socioeconomic characteristics define differences in access to or availability of medical facilities and services. Each year the Center for Medicare and Medicaid Services (CMS) collects survey data from current beneficiaries of Medicare in the United States and Puerto Rico (excluding healthcare facilities) to assess healthcare equity. Survey questions interrogate chronic risk factors related to disease states and mental health conditions. According to CMS, most Medicare beneficiaries have multiple (two or more) chronic conditions. Individuals with multiple chronic conditions are at increased risk for poor outcomes (e.g., mortality), functional limitations, and impaired blood supply to the brain (i.e., pronounced cognitive impairments including depression and some form of dementia). COVID-19 stay-at-home heightened all effects (Tshimula et al., 2022). This study innovates extant Medicare patient care models by identifying the error minimizing determinants underlying the probability of delivering a correct chronic condition diagnosis in the COVID-19 era (DiStefano et al., 2022). First, we propose a novel multivariate specification (three binary response variables). Binary survey responses reflect respondents' positive diagnosis of hypertension, depression, or other mental health condition. Second, for robustness, we provide comparative analytics across linear (Logistic regression) and nonlinear models (Lu & Uddin, 2021). The study's objectives are achieved by introducing a novel neural network architecture used to estimate the probability of an econometrically correct diagnosis. The novel network architecture relies on a specification of a shallow-learning radial basis function artificial neural network (RBFN). Unlike deep-learning networks, which consist of many layers and introduce nonlinearity by repetitively applying nonlinear activation functions, the RBFN consists of an input layer, a hidden layer, and an output layer. The RBFN input layer receives recorded data and feeds it into the hidden layer of the network. The computation inside the hidden layer is where the novel enhancement occurs. Each neuron in the hidden layer has a prototype vector and a bandwidth (shape) denoted by μ and σ, respectively. Influenced by the shape parameter setting (σ), each neuron computes the similarity between the input vector and its prototype vector. The output layer performs the prediction task, such as classification or regression (Dash et al., 2021). Managing computational complexity was a primary reason data scientists eschewed using a variable versus a constant shape parameter strategy in the application of RBFN methods. This research embraces the

variable shape parameter strategy with a novel use of variable settings based on a rodent study that uncovered sex and trait anxiety differences in psychological stress modified by environment (Liu et al., 2018). We provide simulation evidence to demonstrate how the RBFN (WinORSe-AI, 2021)with a variable rodent-inspired shape parameter provides policy-based results and a feature map with comparatively smaller error measure (see Figure 1). Using Medicare panel data, performance analytics include error metrics and the confusion matrices attributable to the alternate classification algorithms. As a second extension, we model the determinants by sex (i.e., males, n=1,415 and females. n=1,585). In addition to the total sample results, the sub-sampling based on sex produces sex-differentiated policy inferences. Preliminary RBFN solutions show a classification accuracy (overall correct classification) of 98.73%, 87.33%, and 88.03% for hypertension, depression, and other mental health conditions. SPSS V27 multivariate logistic regression results show a classification accuracy of 65.7%, 74.3%, and 90.0%. Likewise, RBFN precision accuracy (how often the prediction is correct) is 99.90%, 84.66%, and 40.88% versus the SPSS results of 65.88%, 68.07, and 38.46%. Initial findings provide evidence of superior RBFN classification accuracy.

Keywords: Ethical AI, Healthcare

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The Kerkenes Eco-Center project in Anatolia - future chances by Operational Research
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OR Meets Archaeology, Architecture and Engineering for Science and the Improvement of Living Conditions in Rural Anatolia

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In Anatolia, usually, projects in *OR for Development* are of a highly interdisciplinary character and go hand in hand with other scientific studies, or even originate out of them. In fact, both the insight that such studies are conducted in a societal context of rural life with a real development need and the methodological offers of modern OR, have initialized and fostered a process of consideration about how OR, together with state-of-the-art tools and devices from engineering, natural and social sciences, could even better serve in projects of architecture, history, of water management, agriculture and education, etc. Efforts of this kind in Anatolia have regularly been presented and discussed at various conferences, workshops and seminars of our international OR community. This report briefly introduces into this fascinating process by the example of an exciting combined project that aims at the improvement of living conditions, at scientific advances, collaboration and social peace.

In 1993 the *Kerkenes Mountain Project* by *Geoffrey Summers*, *Françoise Summers* and their colleagues was inaugurated to study the Iron Age capital that had once stood on the Kerkenes Dağ which overshadows the village of Sahmuratli. From the outset, the Project Directors were conscious that this international research project would not only have an impact on the village and the local area, but also that it had potential for development at regional and inter-regional level. A central concern was, and continues to be, that any impact, social, cultural or economic, should be for the benefit of the village and the region. Clearance of the Cappadocian Gate in 1999 revealed that the defenses were built entirely of stone with wooden parapets on the towers and buttresses. It is now though highly likely that the foundation of the city predated the peace treaty between the Medes and the Lydians. We consider the foundation date of that archaeological site was around 600 B.C..

The *Kerkenes Eco-Center Project* was initiated in 2002 with the help of the Australian Embassy Direct Aid Program. By 2003 the concept of establishing an Eco-Centre devoted to research into and promotion of renewable energy and sustainable village life was developing. The aim is to halt, and even reverse, migration from rural areas to urban centers. Advocating an environmentally friendly approach to the development and improvement of rural settlements, the project works closely with SAH-DER (The Sahmuratli Village and Kerkenes Association

for Public Relations, Prosperity, Help and Support), which was established in 2003 to promote the welfare of the village.

The purpose of the Kerkenes Eco-Center is to promote sustainability through environmental studies. It pursues the following objectives:

- To advocate the use of renewable sources of energy;
- To act as a stimulus and a catalyst for environment-friendly building with appropriate materials and energy efficient designs;
- To act as a dynamic experimental base for testing designs, materials and activities suitable for viable and sustainable village life.
- To encourage village development and income generating activities that might halt and even reverse migration from rural areas to the cities.

As well as seeing the completion of its first straw bale building and the Erdoğan Akdağ Center for Research and Education, the Kerkenes Eco-Center Team in collaboration with ŞAH-DER conducted a very successful program for the promotion of solar energy, a drip irrigation scheme for organic gardens and pursued other ongoing programs, including solid waste separation for composting and recycling, reuse of grey-water and promotion of appropriate materials and design for energy efficient buildings. The British Council supported studies on the environmental performance of building under the Britain-Turkey Partnerships Programme between the METU Department of Architecture and the Environment and Energy Studies Programme of the Architectural Association, London.

Şahmuratlı Village possesses a world class cultural heritage site, ancient Pteria, an Iron Age mountain-top city founded on the Kerkenes Dağ. The Kerkenes Eco-Centre has piloted schemes for renewable energy and appropriate technologies against a background of climate change, socio-economic inequality and rapid depopulation of rural areas in favour of urban growth. The Kerkenes Eco-Centre experiments with appropriate building materials and energy efficient designs, drip irrigation for organic gardens, solar energy, solar drying and cooking, recycling, stimulating and creating income generating activities for both men and women. Rural economies on the Anatolian Plateau are underdeveloped; gender inequality is rampant while opportunities for young people are limited. Development of sustainable, environmental friendly, rural economies supported by renewable energy will provide a reduced rural population with acceptable levels of comfort (appropriate dwellings) and economic security. The model offered at Kerkenes can be replicated in the Yozgat region and beyond.

The British Embassy is working to improve political commitment to a low carbon high growth economy in Turkey. A key part of this is mobilising support at local levels, which in turn will help convince the government to develop new policies at the national level. This small project makes use of an existing Eco-centre in Turkey to promote energy efficient and renewable energy designs. It brings together local officials, businessmen, MPs and villagers to stimulate more formal work at the Municipality level, greater replication of ideas in other regional areas, and an increased media awareness of how local projects fit into the bigger strategic goals on energy and climate change.

Activities at Kerkenes during the summer months bring together teams of academics and students from all over the world. Educational activities in 2005 permitted a group of architecture students from the METU to work with a group of children from the village to produce ‘papercrete’ from recycled paper and other alternative building materials. In September the Classe de Première from the Lycée Charles de Gaulle in Ankara, spent a few days in the Kerkenes Eco-Center to conduct a survey in the village. It is hoped that more such programs and courses will be developed and that the improved facilities at the Kerkenes

Eco-Center will benefit both the Sahmuratli villagers and others within the region. The promotion of renewable energy and the initiation of other approaches for a sustainable future continue to provide a good forum in which educational activities can evolve.

One other activity was the production of stabilized mud bricks with the Parry Brick Press. This press was also used to compress waste paper into briquettes to be burnt as fuel in the traditional stove during winter months. A tractor load of paper to recycle was provided by the Municipality of Sorgun. If workshops for recycling could be established locally this would eliminate the undesirable long distances covered by lorries delivering their loads to distant recycling plants. We especially mention the meetings organized for young girls to make bead necklaces and bracelets during the 2005 summer months. They were extremely pleased when visitors expressed their interest and acquired several of the items. Using donations from the appreciative visitors, the young group bought some more material for further production.

Finally, garden activities in the Kerkenes Eco-Center continued to yield vegetables that, cooked in a special Kerkenes fashion, are much appreciated by the team and visitors. Emphasis centers on the promotion of renewable energy in an attempt to deal with climate change and its disastrous global consequences. Meetings with housewives in the village helped to understand their needs and aspirations. The suggestion of using solar energy for cooking and domestic water heaters was well received. Ways of taking advantage of this renewable source of energy for income generating activities were also discussed. As the introduction of a village wind pump was evaluated, it became clear that limited water resources initially required a comprehensive hydrology study to assess the potential for satisfying an increased demand. It is also evident that the introduction of a water management scheme such as drip irrigation and the use of energy efficient greenhouses are essential for an income generating permaculture and organic farming program to be successful.

In Kerkenes, Ankara and various places in Europe and all over the world, modern OR offers a platform and methodology for scientifically discussing and supporting local development and the improvement of living conditions.

Keywords: Kerkenes Eco-Center Project, Anatolia, Architecture

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Photos:

Şahmuratlı Village viewed from the ancient Iron Age city on the top of the Kerkenes Dağ.

The changing face of the Anatolian Village

Acknowledgement: Compliments and thanks to Kerkenes Eco-Center Project for courtesy and support.

The 7e's instructional model and its longitudinal impact on the mathematics achievement of tertiary students

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Abstract. This study aimed to determine the effectiveness of utilizing the 7E's Instructional Model on the Mathematics achievement in Calculus of tertiary students of the Don Mariano Marcos Memorial State University, Philippines in comparison with the traditional teaching method. The study sample consisted of sixty students who were divided into two groups: the experimental group of thirty students, who studied Calculus by using the 7E's Instructional Model -Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend; and the control group of thirty students, who studied the same concepts using the conventional teaching method. ANCOVA results of the students' scores in the mathematics achievement tests indicated that the 7E's Instructional Model is more effective than the traditional teaching method. Furthermore, the paired-sample t-test findings revealed that the model had a significant positive longitudinal effect on the retention among the students.

1. Introduction

Mathematics plays a key role in shaping how individuals deal with the various spheres of private, social, and civil life [1]. It is regrettable; therefore, that many students struggle with Mathematics and consider it as a very difficult subject It is an irrefutable fact that the success of learning the subject is influenced by different factors one of which is teacher factor. Research findings indicate that effective teachers facilitate learning by truly caring about their students' engagement and creating the right atmosphere that enhances student learning [2]. In the light of these, teachers need to utilize different teaching strategies and methodologies in teaching mathematics to further encourage them to love the subject.

Mathematical concepts are considered as the principles and foundations on which the mathematical knowledge is built on, as principles, rules and theories which are the relationships that link between concepts, and the mathematical skills. In its essence, they are a practical application of these concepts by putting them into rules and algorithms, which are used to solve the mathematical problems [3]. [4] also mentioned that modern mathematics is no longer just a routine processes, or separate skills, but it has become coherent structures which are firmly connected together to become one integrated structure, in which concepts form its basic foundation [5].

A constructive educational pattern called 5E's was developed by [6] in 1993. This is an instructional model based on the Constructivist Approach to learning, which says that learners build or construct new ideas on top of their old ideas. The 5 Es can be used with students of all ages, including adults. Each of them describes a phase of learning and each phase begins with the letter "E": engage, explore, explain, elaborate, and evaluate. The 5 E's allows students and teachers to experience common activities, to use and build on prior knowledge and experience, to construct meaning, and to continually assess their understanding of a concept.

ENGAGE: this stage is to pique student interest and get them personally involved in the lesson, while pre-assessing prior understanding.

EXPLORE: is to get students involved in the topic; providing them with a chance to build their own understanding.

EXPLAIN: this stage provides the student with an opportunity to communicate what they have learned so far and figure out what it means.

EXTEND: the purpose if this stage is to allow students to use their new knowledge and continue to explore its implications.

EVALUATE: this stage is for both students and teachers to determine how much learning and understanding has taken place.

Another Instructional Model called “The 7E’s Instructional Model” is a constructivist approach developed by Lawson in 1995 and narrated by [7] in 2007. It is an expansion of the 5E’s Learning Cycle. It is an educational pattern consisting of seven teaching and learning steps, used by the teacher with his students inside the classroom, aiming at enabling the student to build his scientific knowledge acquisition by himself. Also, it aims at developing a lot of other scientific concepts and skills, depending on motivation, reconnoitering, curiosity, explanation, exploration, and expansion, connecting concepts together and amending some of students' wrong concepts. The 7E’s Learning Cycle is featured by a lot of advantages that help learners acquire concepts and apply them in new contexts and real situations, it also develops the students' skills of scientific research, improves their problem solving abilities, develops their skills of dialogue and team work spirit, in addition it helps them amend their wrong visions on the previous mathematical concepts related to the lesson topic [5].

The approach allows learners to construct their own learning. They construct learning that is meaningful for their lives. It makes use of the following:

ELICIT: This involves drawing out students' prior knowledge. What do they already know about the topic? This can be achieved through brainstorming, quick quizzes, traffic lights and statements of learning (what I know, what I want to know and what I have learned). This is also a good time to address any misunderstandings and to discover what areas students are interested in.

ENGAGE: This involves the level of interest students have in the subject or topic. What makes your class interesting? This is a pivotal stage in the learning process. As educators one needs to spark curiosity and captivate the attention of the students. This can be achieved through addressing the big questions, showing startling facts or statistics, using engaging technology or interesting video clips. The method used at this stage will depend on the subject/topic.

EXPLORE: What can students find out? This stage of the learning cycles promotes a very student centered, constructivist approach. Students should be given opportunities to work together through group work or pair work. Peer teaching should be incorporated into this stage. This is the point where the teacher becomes the facilitator and the students take a more involved and direct role in their own learning.

EXPLAIN: At this stage the teacher takes a more direct role. What input is needed from the teacher to formalize the concept? This can be achieved through setting students the task of explaining concepts or definitions in their own words. It is important, at this point, that no new learning is undertaken without clarity that previous learning is understood.

ELABORATE: This stage students should have obtained a meaningful understanding from their learning and in order to demonstrate this they should be able to develop and apply their learning.

EXTEND: How can you encourage students to apply or extend the concept in a new situation? Students make connections not just in the subject/ideas studied but also beyond it. They are able to apply ideas/ generalize and transfer principles

EVALUATE: How much progress have students made? Self-reflection is a significant part of evaluation. Students should be able to self-evaluate their own learning. At this stage of the learning cycle the statement of learning could be revised. (What I know, What I want to know, What I have learned)

2. Objectives of the Study

This study aims to find out if there is a significant difference

a. between the Mathematics performance of the experimental group (the use of the 7Es Instructional Model) and the control group (use of conventional method of teaching)

b. in the mean gain scores of the two groups of respondents

c. in the mean scores achieved by the students in the post-immediate application of the achievement test and their scores in the post delayed application test attributed to the teaching method using 7Es

3.Methodology

This study made use of the experimental research design with 60 students as sample divided into two matched groups-the experimental group using the 7Es Instructional Mode - Elicit, Engage, Explore, Explain, Elaborate, Evaluate and Extend; (and the control group making use of the traditional method of teaching.

G1: First group (Experimental group). The group where the 7E's strategy was used
G2: Second group (Control group). The group where traditional teaching method was utilized
O1: Pretest administered to both groups before the experiment
O2: Post-test administered to both groups after the experiment
X: Experimental treatment, that is, teaching by using the 7E's Instructional Model

The researcher-made tests used in the experiment have undergone validity by experts with the value 4.99 using a 5-point Likert Scale and passed the reliability test with the value 0.89. The two parallel tests were utilized as pretest and post-test were administered to both groups before and after the experiment respectively. ANCOVA and paired sample t-test were utilized in the treatment of data and it was tested at.05 level of significance. All computations were done using SPSS (Statistical Package for the Social Sciences).

Topics considered in Integral Calculus were the 10 topics under the Standard Integration Formulas.

4. Results and Discussions

Results indicated that:

a. The use of the 7Es instructional model is more effective than the conventional teaching both in the immediate achievement and delayed achievement of the students. The retention of the experimental group is far better than the control group. The experimental group displayed their interest and they were more active in the discussions. This displays the longitudinal impact of learning using 7E's.There is a significant difference in the mean scores of the two groups of respondents with the experimental group having a higher mean compared to the control group. ANCOVA results of the students' scores in the mathematics achievement tests indicated that the 7Es Instructional Model is more effective than the traditional teaching method with a p-value of .023.

b. Furthermore, the paired-sample t-test findings revealed that the model had a significant positive longitudinal effect on the retention among the students as reflected in the p-value of .037.

c. There is a significant difference in the mean scores achieved by the students in the post-immediate application of the achievement test and their scores in the post delayed application test attributed to the teaching method using 7E's.

5. Recommendations

Based on the findings of the study, the following are recommended:

a. Teachers should try to use the 7Es Instructional Model in teaching mathematics concepts.
b. The institution should send teachers to seminars on the use of the 7Es Instructional Model
c. More studies on the use of the 7Es are encouraged.
d. Other instructional models should be developed in order to improve the mathematics achievement of students.

Keywords: ANCOVA

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