VÉDELEM TUDOMÁNY
KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT

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CITIZEN SCIENCE AS AN ETHICAL AND MULTI-DISCIPLINARY APPROACH FOR DISASTER RISK MANAGEMENT AND IMPLICATIONS FOR EDUCATION OF HUMANITY DURING COVID19.

Abstract

Disaster risks management (DRM) in the 21st century interlinks DRM practitioners, citizens and researchers through interactions that provide a way to improve humanity's understanding and resilience. Citizens, scientists, the DRM practitioners, and all of humanity is impacted by disasters in the 21st century, such as COVID19. The current article presents the authors' perspective on citizen science as a mechanism/platform for participatory approach to DRM. Ethical background and framework of citizen science are discussed as examples of the implementation of citizen science in the DRM space and on the ground. Citizen science can be used as a means of collaboration among the disaster-prone populations, scientists, and the DRM practitioners. This collaborative relationship can be a source of strengthening the epistemic authority of DRMPs, scientists, and the populations in disaster-prone areas in their mutual relationship to each other. Public pedagogy takes place during the *in-in model* of citizen science in DRM. The need to see the COVID19 space-time as a shared ontological realm, where all of humanity must work together to find a way to maintain positive and forward fluidity in the continuum of *Homo sapiens*. One of the reasons is that all of humanity and all of the world have been impacted by the COVID19 pandemic and all of humanity produces data in various forms that can help address the problems and find solutions to the challenges of coronavirus. Data from everyday experiences, from track-and-trace programmes must be owned, post-hoc analysed and exploited by impacted populations in the continuum of *Homo sapiens*, i.e. the global populations, the DRM practitioners, and scientists. The case for this reasoning is made using a combination of bioethics and literature data.

Keywords: epistemic authority, ontology, participatory approach to disaster risk management.

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KATASZTRÓFAVÉDELMI ONLINE TUDOMÁNYOS FOLYÓIRAT

A POLGÁRI TUDOMÁNY ETIKUS ÉS MULTIDISZCIPLINÁRIS MEGKÖZELÍTÉSE A KATASZTRÓFAKOCKÁZAT-KEZELÉSBEN, VALAMINT JELENTŐSÉGE AZ OKTATÁSBAN A COVID19 IDEJÉN

Absztrakt

A XXI. században a katasztrófakockázat-kezelése egy összehangolt tevékenység a beavatkozók, az állampolgárok és a kutatók részéről. A cikkben a szerzők bemutatják saját nézőpontjukon keresztül a polgári tudományt, mint a katasztrófakockázat-kezelésének egyik elemét. Példákon keresztül részletezik a polgári tudomány etikai hátterét és kereteit a katasztrófakockázat-kezelésében. Az oktatás az állampolgári tudomány beépített modellje során játszik fontos szerepet a katasztrófakockázat-kezelésében, hiszen a COVID-19 térben és időben is megköveteli az emberiség szoros együttműködését. A koronavírussal kapcsolatban számos olyan adat létezik, amely segítheti a problémák kezelését és a megoldás megtalálását. Ezeket az adatokat elemezni és használni kell a katasztrófakockázat-kezelésében résztvevőknek és a tudománynak is. A szerzők ezt bioetikai és irodalmi adatok segítségével támasztják alá.

Kulcsszavak: episztemikus autoritás, ontológia, katasztrófakockázat-kezelésben való részvétel.

1. INTRODUCTION

COVID19 is a disaster, an infectious disease of natural origin (Frutos et al., 2021), which has caused widespread disruption to the human endeavours across the globe. It is a disaster, which can be approached using the methodology of disaster risk management (DRM). The ribovirocell stage of the SARS-CoV-2 virus lifecycle and the continuity of human existence and functioning during the COVID19 pandemic was presented (Tandlich et al., 2021). A brief introduction to this reasoning is provided here and the context is developed further to introduce the current study. A virus has two stages in its lifecycle, namely virion and the virocell (Forterre, 2013).

Virion is a non-living stage in which the virus has all the features of a non-living entity that is transported passively in the environment through various physico-chemical mechanisms (Tandlich et al., 2021). On the other hand, once the virion enters the human host cell, it hijacks the cellular and sub-cellular machinery of the host's cell to facilitate its own replication or new virion production, i.e. the virus exists inside the cell as a virocell (Forterre, 2013). Alternatively, the host cell is the ribovirocell stage of existence in the post-infection space-time, where the host cell can maintain the ability to divide and continue to function in a semi-normal fashion in spite of the virus presence inside it (Forterre, 2013).

Prior to the onset of the COVID19 pandemic, there were virtually no limits on the movement or access to space on the surface of the Earth for a large section of human population. After the onset of the pandemic, lockdowns and similar measures limited the physical and spatial dimension of the existence of a single human being (Bagrath et al., 2020). The main aim of such non-pharmaceutical measures was to contain the COVID19 spread and to maintain human existence in a state similar to that of a ribovirocell, i.e. they can function more or less normally (Tandlich et al., 2021; Iheanetu et al., 2021). The need for the adherence to non-pharmaceutical interventions is still relevant in 2021, due to the uneven vaccination rates across the globe. At the time of the writing of this article, the developed countries achieved vaccination rates around 59 % in the USA, 77 % in Canada and 80 % in Spain (NY Times, 2021). On the other hand, middle-income and developing countries trailed far behind with full vaccination rates equal to 0.1 % of the population in the Democratic Republic of Congo, 1.7 % in Nigeria and 24 % of the population in South Africa (NY Times, 2021). The non-pharmaceutical interventions were aimed at getting humanity back to some level of normalcy of human beings, to a state of existence which is similar to the ribovirocell state of a cell that had been infected with a virus (Iheanetu et al., 2021; Tandlich et al., 2021). This is the realm of professional conduct and activities of the DRM and disaster risk management professionals (DRMPs).

DRM is a multi-faceted field where decisions are made based on information and inputs from various disciplines. These disciplines include the geographical information systems (van Westen, 2010), the use of drones to assess damage in the disaster-impacted zones (Restas, 2015) (Muyambo et al., 2017), provision of drinking water and sanitation for the population that has been impacted by a disaster (WHO, 2011), provision of medical care that is culturally appropriate and that is aimed at vulnerable populations in the disaster-prone/impacted zone

(USGOV, 2015), the use of 3D printing to manufacture housing (Dancel, 2019) and personal protective equipment (MIT News, 2020), use of the urban search and rescue teams in the recovery operations (INSARAG, 2015), logistics and the supply chain management in the distribution of the humanitarian supplies and assistance (Viagi, 2016), governance and the functioning of legislated DRM systems (e.g. Ngqwala et al., 2017), the human resource management in DRM (Government of India, 2013). A DRM practitioner (DRMP) must also understand the basics of psychology and be able to collaborate with medical professionals on the mental health management of impacts of disasters, e.g. along the holistic approach and the principles of 6Rs (Math et al., 2015). Finally, safety and security, protection of society's well-being is of critical importance to be success of the DRM interventions (e.g. Comfort, 2005). This DRMPs' knowledge must always be linked to the disaster management cycle and the impacted communities that DRMPs ultimately work with/assist.

The multi-disciplinary nature of the DRM calls for the integration of knowledge and vocabulary from various academic/engineering fields of knowledge. In a way, DRMPs need to learn, understand, and practice in trans-disciplinary environment, where the vocabulary is often not transferrable from one of the fields into the next. Thus in a way a metaphor, or similar of parallel cases unrelated to each other at first glance or based on their nature (Erden, 2012), or competing professional scopes of knowledge which the DRMPs must integrate into a working paradigm of response to disaster, into mitigation, preparedness, and recovery from disasters such as COVID19. Working in an environment like this, indicate a complex situational reality of COVID19, the DRMPs must understand other practitioners to maintain a state of ribovirocell for themselves and for the communities they serve (based on the reasoning by Iheanetu et al., 2021 and Tandlich et al., 2021). This is especially important, as COVID19 is an almost 'dirty' term by now, as it has redefined the way that human society functions (Bengtsson and van Poeck, 2021). It is problematic to say that the human society can't go back to the way things were before the onset of the pandemic. The 'new normal' has been imposed on society and can be seen everywhere. Vaccinations and even some medicines to treat the disease are becoming available. Fatigue in adherence to non-pharmaceutical interventions and vaccines hesitancy pose challenges, which DRMPs must often deal with as coordinating officials at various levels in the government hierarchy (based on the reasoning by Iheanetu et al., 2021; Tandlich et al., 2021). Resources must be repurposed, living and permeating metaphors and lived experiences

of the members of *Homo sapiens*, who live in the disaster zone of COVID19, must be considered by DRMPs in the execution of their mandate. They must be seen by practitioners as sources of information that describe the COVID19 space-time and thus the ontological realm, which humanity currently lives in during the coronavirus pandemic. Such information, its collection in an ethical manner, the cooperation between the DRMPs and the producers of the knowledge, or citizens impacts by the pandemic, are needed to make the DRM space liveable for the communities DRMPs serve.

In a recent paper, Kunguma et al. (2021) reported on the perceptions and experiences of South African disaster risk management practitioners (DRMPs) about the application of the DRM legislation during the COVID19 pandemic. The DRMPs found the legislative framework acceptable in terms of the regulations that were issued by the national government for the management of the pandemic (Kunguma et al., 2021). However, several challenges were identified, e.g. in the assignment of final responsibility at the local government level to execute the DRM operations and action in the COVID19 pandemic space-time. This is based on the feedback the DRMPs from the metropolitan municipalities in South Africa provided about section 2(1) of the Disaster Management Act no. 57 of 2002 (Kunguma et al., 2021). This can pose a challenge in the execution of the unit operations of the disaster management cycle, as DRMPs are deemed to have coordinating powers or mandate, and cooperation of their counterparts from other municipal departments is necessary to carry out the DRM activities, to assist impacted communities. The Sendai Framework for Action and its predecessor frameworks have called for the DRM decisions to be taken based on local data and the results of research (UNDRR.org, 2020-2021). This implies the use of research methods and gathering of data plays a critical role in DRM. Based on the nature of their profession, DRMPs must understand and be able to use multi-disciplinary data and use of the scientific method for the data collection (Hicks et al., 2019). These data form an essential foundation in the DRM planning. Collaborative approaches to DRM are based on the principles of epistemic justice, i.e. all stakeholders at the table or in other words all members of a population which is at risk from a disaster needs to be consulted. This consultation take place during policy preparation, implementation of the resilience and vulnerability reduction programmes, to name but a few examples (Hicks et al., 2019). Focus of the DRM has shifted to the reduction in the vulnerability of the population, lifelines, and assets to impacts of disasters, as well as to increasing resilience

of the affected populations (UNDRR.org, 2020-2021). In many instances, the tools that have been used included policies such as building codes, but many tools have been focused on the changes in behaviours of the communities at risk, as well as the societies as whole. Human from different backgrounds have been brought together to tackle development and its links to DRM.

The ontological realm of *Homo sapiens* that has been 'created' or seemed to have been created after the onset of COVID19, requires that the continuum of *Homo sapiens* at various levels of complexity and dealing with the pandemic, speak with the same voice. It is necessary to build on the common understanding of the living experiences and human knowledge and interpretation of this new realm. The lived experiences of the individual 'Communities of I' in the continuum of *Homo sapiens*, the data that document the movement and limitations thereof, the pieces of digital dust (based on the reasoning by Iheanetu et al., 2021; Tandlich et al., 2021), which indicate where humans have been and who might have contracted the SARS-COV-2 document situational reality of *Homo sapiens* in the COVID19 space-time. The situational reality should then be interpreted through the common language between the producers of the lived experiences or the data (Iheanetu et al., 2021; Tandlich et al., 2021), i.e. the individuals at the centre and inside the 'Communities of I', must be part of the use and exploitation of this data in dealing with the COVID19, as disaster. Thus a collaborative relationship must be used as legislated inside the existing laws, e.g. the Disaster Management Act on 57 of 2002 in South Africa. At the same time, the lockdown regulations which had been issued in the scope of this legislation, must be accomplished by collaborative nature of the investigations into the nature of the COIVD19 space-time between the DRMPs and the data producers or population of a country like South Africa (as indicated by the citizen science review of Hicks et al., 2019). In this way, the state of ribovirocell can be maintained for a single member of *Homo sapiens* and the continuum of humanity (Iheanetu et al., 2021; Tandlich et al., 2021).

The DRMPs duties and challenges, or rather balancing acts in accommodating competing interests in the conduct of their profession, pose onto the DRMPs similar and difficult ethical challenges. The nature of those challenges is similar to the ethical challenges faced by healthcare professionals (Lobo et al., 2018). DRMPs and healthcare professionals. Both of these groups of frontline workers in the COVID19 space-time must always act with the best interests of the disaster-impacted/prone community in mind. In this context, accountability plays a fundamental role, and it practically stands for the availability of recourse for all the actions that

both groups of professionals execute in the context of their professional conduct. For successful DRM, accountability must apply at all levels of action (Polack et al., 2010). A lack of accountability within DRM could be seen to be a breeding ground for conflict (Polack et al; 2010). The ever-evolving nature of the COVID19 pandemic will likely have lasting effects on the society in South Africa and across the globe (Bengtsson and van Poeck, 2021). Accountable government will likely play a crucial role in this context. Consultative nature of the DRM in the country already contains embedded elements of the participatory nature of the DRM in South Africa. In the context of the relationships or networks which must exist in the multi-stakeholder participatory, it is common for the DRMPs to interact with the laypersons or stakeholders from the impact zones in the disaster-prone areas (Hicks et al., 2019). Collaboration of the DRMPs and the disaster-affected population, i.e. the 'Communities of I' and the continuum of *Homo sapiens*, which have been impacted by the coronavirus pandemic. Thus the disaster management cycle operations should be performed in line with the constructive relationships between the micro- and macro-assemblages in the education and development of one's self and the continuum of *Homo sapiens* during various educations stages of the ontological realm of COVID19 (Tandlich et al., 2021). The DRMPs represent the legislative authority of the society, or a country's macro-assemblage (Tandlich et al., 2021), that sets laws and formulates their mandate. However the DRMPs need the buy-in from the disaster-prone or impacted communities they serve for that mandate to make the necessary impact on the ground.

2. ACCOUNTABILITY AND COVID19

Accountability is important in the context of the DRMPs conduct and it provides a kind of feedback loop for the utilitarian application of the ethical principles of the DRMPs, as well as ethics of healthcare professions during the COVID19 pandemic (Savulescu et al., 2020). COVID19 is a natural disaster from natural origin (Frutos et al., 2021). In the 20th century, the practice of DRM or disaster management at the time, and healthcare was in many ways paternalistic, i.e. the DRMP had the control in a power dynamics in their relationship with the disaster-affected population. Similarly, medical and healthcare professionals often had more

control of the treatment protocol to implement than the patient. Practical problems and challenges have led to the shift towards a more balanced relationship and more equal distribution of power among the DRMPs and the disaster-affected population, as in the relationship between the healthcare professionals and the patients. The relationship is also become a little more collaborative in the 21st century, participatory and reciprocal in terms of communication, healthcare outcomes and knowledge generation. This cooperative approach to DRM and healthcare provision is, at least in part, the result of the shifting landscape of factors controlling disaster risk and the underlying factors of healthcare/types of diseases that are treated by healthcare professionals. Ethically speaking the collaborative approach is necessary in the ontological realm of humanity and this has been taking manifesting in various ways.

Firstly, the COVID19 pandemic marked the onset of the massive increase in the use of technology in dealing with the disaster, e.g. the collection of private information for the track-and-trace programmes, the massive collection of the biological data and its processing for the management of the spread of the variants of SARS-CoV-2, would not be possible without collaborative input from the Community of I' (as defined by Carless, 2021 and further developed by Iheanetu et al., 2021; Tandlich et al., 2021) of the tested and traced persons, in would not be possible by at least a partial consensus of the continuum of *Homo sapiens* about the execution mechanism of the data collection (as defined by Iheanetu et al., 2021; Tandlich et al., 2021). Therefore the knowledge and data generated and needed to understand the ontological realm of the COVID19 space-time is co-shared by the continuum of *Homo sapiens* and by the individual 'Communities of I' (as defined by Carless, 2021), who assisted in the generation of the data. There is still a lot of uncertainty in the current space-time of human existence. Thus to maintain the case for positive forward fluidity of the one's 'Community of I' and the continuum of *Homos sapiens,* ethically it is necessary and justified to share the governance of the data generated through the use of technology across the continuum of our species. People and 'Communities of I' across the globe should have a say in the management of this data. The ethical management of the state of *utilitarian qubit* of *Homo sapiens* (Iheanetu and Tandlich, 2021), would best be resolved through the inclusive decision related to the DRM of COVID19, i.e. all 'Communities of I' must have a share of the benefits from the data and value generated during the pandemic space-time, they must have a say in how the data is

exploited to maintain a state of ribovirocell of self in the COVID19 ontological realm. The meta-ownership of such data is what is advocated here.

Following the line of reasoning from the previous paragraph, it is ethically imperative that the DRMPs, healthcare professionals and other representative of the macro-assemblage of society collaborate actively on the use and exploitation of the data with the continuum of *Homo sapiens* and by the individual 'Communities of I' (Tandlich et al., 2021). This way a just solution to the state of the *utilitarian qubit*, namely that humanity is currently experiencing pain and pleasure at once and it is not possible to determine which one dominates. Therefore humanity is going through a state in the COVID19 space-time, can be dealt with most effectively. This is also supported by the fact that novel approaches to the data collection, a form of intellectual property. For example, the way to collect data about the everyday life of the population in a local municipality in South Africa was described recently by Iheanetu and Tandlich (2021). The focus was on the detailed and sometimes challenging provision of safe drinking water from alternative resources during the COVID19 pandemic and the concurrent drought in the study area (Iheanetu and Tandlich, 2021). Maintenance of the constant access to safe drinking water is critical to the survival of humanity in the COVID19 pandemic space-time, as non-pharmaceutical interventions still play a critical role in the containment of the SARS-CoV-2 virus. This is especially due to the recent emergence of the Omicron variant (WHO, 2021) and the current uncertainty about how it will influence the further development of the continuum of humanity and the individual 'Communities of I' in the COVID19 space-time. Given that we are dealing with such a complex system, with many intricates, with complex nature and impacts of disruptions of the coronavirus pandemic on human society, and internal perturbations that the continuum of *Homo sapiens* and the 'Community of I' will undergo in response to the disruption (based on the interpretation of the definitions of perturbations and disruptions by Todman et al., 2016).

Complex disaster systems, ontological realms, and systems, such as the COVID19 space-time, are inherently prone to failures and interruptions (Cook, 2008). These failures are latently present in the system and not generally caused by single triggers, all system components or participants contribute to the smooth running of the system, i.e. the continuum of *Homo sapiens* in the COVID19 space-time and post-coronavirus ontological (based on the interpretation of

the treatise by Cook, 2008). More than one trigger is necessary to launch a failure in a system, i.e. to cause a disaster. This is necessary to monitor and can only be achieved based on a complex system of monitoring, a system which is inclusive of as many 'Communities of I' as might be affected by a disaster. Such a monitoring system is at the boundary of the DRM and education of the continuum of *Homo sapiens*, i.e. a form of education which takes place outside of the classroom and could thus constitute a form of public education, public pedagogy (Bengtsson and van Poeck, 2021). In the current thesis, the COVID19 and the ontological realm that humanity finds itself in, are taking place at the boundary of the fundamental and situational reality of humane existence, e.g. interactions between the virus and the atropized space in the circulatory model (based on the application of the circulation model of the SARS-CoV-2 origin by Frutos et al., 2021). In their paper, Bengtsson and van Poeck (2021) characterise the COVID19 as a hyperobject, i.e. an entity which is outside of the perception of the human beings. It cannot be localised, or pinned to particular space and time, that it does not have specific GPS coordinates (Bengtsson and van Poeck, 2021). In addition, the *viscosity* or sticky nature of the coronavirus as a make it difficult to deal with, as it impacts all of human life, or situational reality of the 'Communities of I' and the continuum of *Homo sapiens* (Bengtsson and van Poeck, 2021; Iheanetu et al., 2021; Tandlich et al., 2021).

One thing, which is not exactly correct from the point of view of the analysis here, is the lack of visualisation of the SARS-CoV-2 virus in the human domain, as posited by Bengtsson and van Poeck (2021). The disagreement with absence of visualisation and localisation is based on the following reasoning. Cases are present everywhere for the coronavirus, all of humanity, all of Earth is impacted by the virus. In addition, discovery of the evolution of the variants and mutations of the virus have been documented at the genetic level with publication and journalistic coverage of the alpha, beta, delta and omicron variants. In addition, the presence of the SARS-CoV-2 virus and cases of COVID19 in more than 200 countries indicate that the virus is localised everywhere on Earth. In addition, electron microscope pictures are available in scientific literature Haddad et al. (2020, Figure 1), from public awareness sources (SARS-CoV as predecessor of the SARS-CoV-2; CDC, undated) and journalistic sources (NPR, 2020). All 'Communities of I' and continuum of *Homo sapiens* have been impacted by the coronavirus, the related lockdowns and the limitations on the personal freedoms, needs to be seen as the virus is not directly visible, but its manifestations are present everywhere on Earth. The whole

continuum of *Homo sapiens* has experienced the COVID19 pandemic, DNA from the virus is detectable in the wastewater (see https://www.nicd.ac.za/diseases-a-z-index/disease-index-covid-19/surveillance-reports/weekly-reports/wastewater-based-epidemiology-for-sars-cov-2-in-south-africa/ for details), and the public health campaigns of track-and-trace, the virus and its impact on the ontological realm of humanity, the 'Communities of I' and the continuum of *Homo sapiens*. Thus this is a clear indication that the virus is visible to humanity at the boundary between the fundamental and situational reality. Dealing with the new ontological realm and the development of the new knowledge by *Homo sapiens* must take this into account, and humanity as a whole must be involved in it. How this is done is unpacked further in the next section on the example of environmental monitoring, citizen science and inclusive execution of the unit activities in this context.

3. COLLABORATIVE APPROACHES TO DRM AND ENVIRONMENTAL MONITORING

The importance of environmental monitoring and early warning systems has been stressed as one of the fundamental elements of efficient DRM systems in the 21st century (UN, 2015). However, at least some of the current monitoring systems such as the epidemiological monitoring systems can struggle to detect negative health outcomes of climate change (Ghazali et al., 2018). This indicates that at least some DRM impacts will not be picked up by the existing monitoring and early warning systems. Innovative strategies, and/or strategies which will allow for gathering of more localised data in environmental monitoring, might be necessary. One such mechanism could be citizen science (e.g., Tandlich et al., 2014; Angala et al., 2019). Citizen science can be defined as the data collection and the execution of various types of scientific activities which are at least in part, by non-scientists or members of the general public (Heigl et al., 2019). The citizen science approach can help in collection of data for monitoring the efficiency of the DRM interventions, e.g. provision of alternative drinking water sources in a drought-stricken area (e.g., Tandlich et al., 2014; Nondlazi et al., 2019; Angala et al., 2019, and Iheanetu and Tandlich, 2021). As such, citizen science can be a method to obtain localised data on the efficiency of DRM interventions. This is in line with provisions of the Sendai Framework

(UN, 2015), as well as the principles of environmental management and monitoring (Ghazali et al., 2018).

The principles under which the data or citizen-science projects are performed should adhere to the best practice, e.g., to the Ten Principles of Citizen Science (ECSA, 2015). The best practice and the related principles are aimed at achieving collaborative nature of the project where citizen science lays an important part. In addition, they should provide an avenue for the development of novel capacity in terms of scientific understanding and the potential for the authorship of scientific papers by laypersons (ECSA, 2015). Measures of the sustainability of programmes focused on citizen science include the number of academic outputs, e.g. publications, number of laypersons as co-authors on these, frequency of social media posts and the number and retention of citizen scientists in particular programmes (Cox et al., 2015). Cooperation and the active generation of knowledge in a participatory and fashion between scientists and citizen scientists is important (Angala et al., 2019). Scientific rigour of the produced data must also be done, e.g., comparison of the citizen science results with standard methods in a given field of academic inquiry (Tandlich et al., 2014; Angala et al., 2019; Malema et al., 2019). Execution of environmental monitoring projects using the citizen science approach would normally follow the formation of an ad-hoc multi-stakeholder platform, as described for the DRM field by many authors (e.g., Ngqwala et al., 2017; Mkwakwami et al., 2019).

Various ICT provides platforms offer a unique avenue that democratises the input of disaster planning information such that non-professionals and laypersons can share or contribute data from their areas or locations (Pereira et al., 2017). Specialists have historically been the holders of the scientific (GIS) data about the disasters (van Westen, 2010). This indicates that the DRMPs are the holders of the epistemic authority in the DRM space (Spaić, 2018; page 147). Now, DRM used to be paternalistic in nature, i.e. the practitioners had fundamental epistemic authority, or it is expected of the disaster-affected population or human population in a disaster-prone area to follow the instruction of the DRMPs. This could be seen as an execution of the biopower of the state by DRMPs in the paternalistic management of the disaster management cycle operations. However, in recent decades the nature of the epistemic authority has shifted to more derivative epistemic authority, i.e. the disaster-affected population or human population in a disaster-prone area will follow DRMP's instruction if the population trusts the DRMP in

question. The derivative epistemic authority is based on the increased uncertainty of the disasters, similar to the COVID19 pandemic and the interconnectedness of the socio-ecological systems in the 21st century. This in turn can result in the failures due to complex and multi-fold triggers (Cook, 2008).

Professional conduct of the DRMPs is guided by codes of conduct (DMISA, 2016; UN/UNESCO, undated). As many DRM activities are carried out by specific organisation, conduct of the members is guided by the internal codes of conduct and generally reflects the context of the everyday activities that DRMPs in such organisations are faced with. However, DRMPs interact with the general public due to the nature of their profession, e.g., by DRMPs who provide DRM assistance to the disaster-prone/impacted communities and working with communities at risk to mitigate impacts of disasters. The "common good" and the reduction in the vulnerability and strengthening resilience of the socio-ecological systems. In this context, it is important to focus on the continuous engagement between the DRMPs and other stakeholders. These stakeholders include the school children and the families they are part of. This is based on the fact that climate change, whether mitigated or managed actively or passively, will have wide reaching consequences into the future and will therefore have a massive impact on the life of future generations (as summarised, for example, in the ASSET project by Drager et al., 2019). Given the uncertainty and the complex nature of the DRM ontological realm, epistemic authority is fluid and ever-involving concept and the solutions to the COVID19 challenges can only be found by the combination of the knowledge of the 'Community of I' for every human and the continuum of *Homo sapiens*.

Derivative epistemic authority of the DRMPs towards communities they serve, can be strengthened through ongoing engagement between DRMPs and the disaster-affected population or human population in a disaster-prone area. Principles of citizen science will be important and can facilitate constructive interactions amongst the citizen scientists who can be the disaster-affected population or human population in a disaster-prone area and DRMPs. This reflects the collaborative approaches to DRM are imbedded in the code of conduct of DRMPs in the international sphere (UN/UNESCO, undated). Citizen science can be used in designing early warning systems for climate-changed related disasters. Through participation in citizen science projects, members of the public are trained in scientific techniques and encouraged to gain scientific skills, become more informed about the scientific method and the related data

collection (Cox et al., 2015). Further to this, participation of citizen science can contribute to the empowerment of communities to be able to actively participate in environmental management, e.g., through advocacy and through stronger and more informed participation in the democratic process in the European Union countries. They can also, at least theoretically, contribute to establish the working platforms for the interactions between DRMPs and the general public (Mkwakwami et al., 2019). Involvement of the disaster-affected population or human population in a disaster-prone area can make the assistance and execution of the unit operations of the disaster management cycle more targeted to the DRM profile of a particular disaster-affected population or human population in a disaster-prone area. This in turn can contribute to the DRM operation being more ethical in nature, and the maintenance of the ribovirocell for the 'Community of I' and the continuum of *Homo sapiens* (Tandlich et al., 2021).

4. SPECIFIC ETHICAL DIMENSION TO INTERACTIONS BETWEEN DRMPS AND DISASTER-AFFECTED/PRONE COMMUNITIES

DRMPs are in the middle of situations, which at least from the ethical points of view are challenging. The challenges include the fact that the DRMPs control and facilitate the distribution of resources to vulnerable communities. The power dynamic is clear and there are multiple angles which can indicate potential abuse, e.g., sexual exploitation for aid and corruption through the DRMPs potentially pocketing part of cash assistance to disaster victims. The DRMPs should theoretically and from an ethical standpoint adhere to the following four principles in their conduct: transparency, accountability, accessibility, justice, and integrity. Transparency means that the conduct of the DRMP in the execution of their legislative and professional mandate must be clear and all their actions understandable to all stakeholders in the disaster-prone or disaster affected area. Continuous engagement of DRMPs with relevant stakeholders is therefore and ongoing process and must take place throughout all four phases of the emergency/disaster management cycle. The citizen science approach can be an example of such a continuous engagement if it is focused on a specific topic in the DRM space.

Accountability is a general term which provides the disaster-affected communities or communities at risk from specific disasters can seek recourse is any elements of the DRMPs' conduct is (perceived) as questionable (Polack et al., 2010). Accessibility of the DRMPs is practically embodied by clear lines of communication between the DRMPs and the affected communities or communities at risk from specific disasters, e.g., where is the contact office of the DRMPs in a disaster zone, what are the types of assistance that the affected communities or communities at risk from specific disasters can access through such offices, etc. Integrity of the DRMPs conduct can be seen, as the ability of the DRMPs to take quick, necessary and the best-informed action(s) in individual phases of the disaster management cycle. Finally, justice represents the ability of DRMPs to distribute the available resources with prioritisation of the most affected or most vulnerable first. No preference in resource distribution should be given based on any criteria besides the immediate need of the disaster-affected population. Therefore no preference can or should be made based on ethnicity, religious and/or affiliations. Participation in the citizen science projects can help facilitate the establishment of an ad-hoc multi-stakeholder platform (Mkwakwami et al., 2019), that can facilitate the adherence of the five ethical principles in the conduct of the DRMPs.

In addition, the nature of these interactions has become more complex and fluid in terms of the DRMPs' everyday duties. This has created new challenges for the DRMP professional conduct, e.g. in interactions with vulnerable and disaster-prone/disaster impacted communities and in navigating the landscape of practice in dealing with complex/Natech disasters. This ever-increasing complexity and nature of the DRMP profession continues to require the DRMPs to have the ability to adapt to new situations and to manage competing interests. As a result, DRMPs must practice in a field which is highly complex, ever-changing and where the knowledge is highly inter-disciplinary. This requires that DRMP master knowledge from a variety of academic fields or fields of practice, in order to make well-informed and ethical decisions on the ground. Citizen science can be seen as a mechanism for the collection data of data that can inform the risk assessment and analysis, e.g. hazards type, triggers of disasters and types of vulnerability, as well as extent of resilience.

Citizen science and the related ad-hoc multi-stakeholder platforms for DRM (Ngqwala et al., 2017) can provide a forum for conducting the DRM activities in the spirit of epistemic justice.

This means that all voices relevant to a particular disaster or a phase of the disaster management cycle are herd, i.e. the disaster victims and DRMPs. As a result, more informed decisions can be made by DRMPs and/or better DRM solutions can be found, as they are based more inputs and diversity or views, i.e. both the views/opinions of DRMPs and the general public are taken into account. Such a "roundtable" provides best solutions in DRM, as it comes from a platform which facilitates communication between DRM stakeholders based on the principles of justice, transparency and accessibility. Accountability could therefore be achieved through the application of the citizen science approach. Through running of the ad-hoc platform with multiple stakeholders and through focusing the activities on a specific problem in the DRM space, a mechanism for non-formal and informal learning could be created for the DRMPs and the populations which might be at risk from a particular disaster. Fundamental epistemic authority and derivative epistemic authority are shared among the DRMP and the human population in a disaster-prone area. Besides accountability, transparency and other ethical principles of the DRMP's conduct are strengthened and should become more understandable to the human population in a disaster-prone area.

Community of stakeholders in DRM has expanded substantially in the last 40 years or so. Governmental and non-governmental stakeholders play an important role in the DRM and disaster risk reduction. Therefore, the positionality of the DRMPs has shifted since and in between the adoption of the Sendai framework and its predecessors in the international policy domain (UN, 2015). Due to "Anthropocene" and other factors (Crutzen and Stoermer, 2000' Steffen and Crutzen, 2007), the complexity of ever-increasing complexity, participatory approach to disaster management is strongly encouraged (Tandlich et al., 2014; UN, 2015; Angala et al., 2019) and even legislated in countries like South Africa (Ngqwala et al., 2017). Approaches such as citizen science are becoming more and more common, both as tools for completing various types of research and also for answering the related research questions (e.g., Tandlich et al., 2014; Angala et al., 2019; Ngqwala et al., 2017; Tandlich et al., 2019). Given the COVID19, the public's interest in the maintenance of the positive forward fluidity and resilient survival of humanity requires that public pedagogy be part of the recovery and the adaptation to the pandemic. Citizen science could be adapted to improve education credentials of the disaster-impacted communities, who will help DRMPs to collect and understand the data

collected in the COVID19 ontological realm of human existence. The details about the practical implementation is outlined in the next section

5. LINKS BETWEEN THE QUALIFICATION FRAMEWORKS AND CITIZEN SCIENCE

Executing government departments are commonly Ministries of Education/Higher Education and organisations of state that are subordinate to these ministries. However, the national standards are based on the EU-wide adherence to the European Qualifications Framework (EQF). Formal qualifications are awarded in line with the national qualifications framework (NQF) and crisis/disaster management leads to the EQF 6 qualification upon graduation of the candidates from a Bachelor's or Magister's university programme. Non-school educational activities in DRM are generally executed by commercial providers of non-formal training/short courses. In many cases, the DRMPs in EC/EU take these short courses through on-the-job training and this non-formal learning is driven by the targeted need to develop new skills amongst the DRMPs. These non-formal programmes are structured, not necessarily tied to a formal educational institution and do not lead to a formal qualification listed in the NQF. Regulation of the non-formal and non-school education varies between countries but should adhere to the principles of the E2020 programme. One of the main ones is the increase of participation of adult learners in the continuing and life-long learning. Informal learning also occurs on the job of DRMPs, but not is a structured format and it is generally a "side-effect" of DRMPs' everyday duties. However, it is important in the local context.

Ministries of Education, Higher Education and Research generally administer the NQF, but they also collaborate with the Ministries of Labour and Social Welfare (depending on the national title) which are normally in charge of the national skills frameworks. For DRM and crisis management, public sector universities and higher education institutions play a critical role in the regulation of the DRM professions. Non-school qualifications and the skills acquired through professional practice are generally handled across the EU/EC according to the 2012 European guidelines for validating non-formal and informal learning. The latter guidelines have been updated in 2015 by professional community's input. Recognition of non-formal education

is also handled by voluntary subscription of professional organisation and recognition of short courses offered by specific providers. Latest drive in the education sector in the EU/EC states is towards an inclusive education, which is horizontally and vertically integrated. Costs of the tertiary education in the DRM space are either born by candidates or students in the respective Bachelor or Magister programmes, or by the governments through subsidizing higher education. Budgetary constraints of national Ministries of Education can be partially offset by contributions from the business sector, e.g., through a skills levy collected by the Ministries of Labour and Social Development (Affairs).

Business contributions to the on-the-job training in non-formal education are also considered important. This can fill large gaps in the DRMPs' education and skills through providing targeted skills development. However, the associated costs might be prohibitive and access to these courses might be a problem in remote areas of the EU/EC. Citizen science might provide a novel approach to obtain and develop new skills here. Validation of the acquired competencies is done through assignments which are linked to specific topics from DRM, after a candidate has completed a short course. Novel types of DRM challenges, which have appeared in 21st century, lead to the development of new skills that DRMPs must have. These new skills are highly trans-disciplinary and require continuous updates of the curriculum and course in the CPD realm for DRMPs. Citizen science and related approaches/activities create a community of practice, where non-formal and informal learning will be shared between the members of the community, i.e. certification and course candidates. Assessment of skills will be based on the community of practice and the standard assessment tools of informal, non-formal and formal education in the EU/EC in the 21st century. Participation of academic personnel and interaction with practitioners will provide a framework to align the curriculum and certification assessment with the rigour of EQF 6 of the DRM Bachelor or Magister degrees. Implementing the skills from the 'Community of I' and the continuum of *Homo sapiens*, which form the basis for understanding of the new realm of the COVID19 space-time and the post-coronavirus equivalent, could be used to develop two fold. They could be the source of curricula for the improvement of the DRMPs to manage citizen science as data collection in the disaster zones, as a valuable and equitable way of data collection.

Secondly, the citizens skills could be recognised through these mechanisms, e.g. through schemes such as OECD micro-credentials. These incorporations could in turn provide a way to

maintain an epistemic authority balance in the DRM activities and maintenance of the ribovirocell state of 'Community of I' for the members of *Homo sapiens* after they have been impacted by disasters. Citizen science could be expressed in terms of standard credits and incorporated into the existing structures of educations. Thus in turn could serve as a resilience mechanism of the knowledge-generating structures in the space-time where humans are impacted by COVID19. Finally, citizen science should be seen as an empowerment tools here, as a form public pedagogy which is, in the ontological realm of COVID19, an inescapable tool to maintain the survival of humanity, to ascertain the milieus of study (Bengtsson and Poeck, 2021). … the disaster-impacted areas with the presence of coronavirus, where the DRMPs' responsibility to assist impacted communities must be executed in an epistemic balance between the citizens and DRMPs. The models to be adopted in the context should include the in-in and analytical data collection and interpretation of citizen science in the COVID19 space-time as a DRM landscape with DRMPs, scientists and citizens impacted by the pandemic,

6. CONCLUSIONS

Concepts of fundamental and situational reality of human existence should be seen here, as the authors' attempt to approach the analysis of the ontological realm of the COVID19 space-time and the related DRM implications. Citizen science can be the basis of a cooperative relationship between DRMPs, scientists and citizens, as through a collaborative effort towards effective DRM. Its practice in the ontological realm of COVID19 is a form public pedagogy or learning outside the classroom or saying the continuum of *Homo sapiens* anywhere on Earth. This is part of the teaching and learning in the new COVID19 space-time. Humanity as a whole should participate in that process, in the data collection, exploitation, analysis and ownership…data about the boundary between the situational and fundamental reality of "Community of I' and the continuum of *Homo sapiens*. In this way, integration of knowledge can be achieved that in turn allows humanity to deal with disasters, which have been transpiring and in which humanity deals with it at the boundary between fundamental and situational reality. This mechanism of citizen science can be the link for strengthening the epistemic authority of DRMPs in relation to the disaster-prone populations, and of the disaster-impacted citizens to scientists and the

DRMPs in the mutually cooperative and mutually beneficial feedback relationships. In this way, accountability of all stakeholders and their ethical conduct towards each other could be strengthened. Skills developed through citizen science could be used for certification and acknowledgement of informal learning using the OECD micro-credentials.

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