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PHILOSOPHY OF INTERDISCIPLINARITY: JAN CORNELIUS SCHMIDT'S CRITICAL-REFLEXIVE PROBLEM-ORIENTED INTERDISCIPLINARITY

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ABSTRACT

Philosophers were reluctant to address interdisciplinarity during the 20th century. But things have changed in the 21st century, since a two-level relationship between philosophy and interdisciplinarity has been established: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. Thus far scholars have shown more interest in exploring the first level of that relationship.

The aim of this article is to closely examine the developmental path of a *philosophy of interdisciplinarity* envisioned and constructed by Jan Cornelius Schmidt in the past two decades. In our opinion, it has reached two milestones. The first (2008) being the one in which he clarified the vague notion of *interdisciplinarity* and classified its four types with the help of philosophy of science, and the second (2011) being the one in which he opted for problem-oriented interdisciplinarity. Schmidt's *philosophy of interdisciplinarity* has reached its (current) peak (2022), resulting in a philosophical framework which promotes problem-orientation and critical-reflexivity in interdisciplinary endeavors. Thereby Schmidt has created prerequisites for the construction of philosophy *as* interdisciplinarity.

KEY WORDS

philosophy *of* interdisciplinarity, problem-oriented interdisciplinarity, critical-reflexive interdisciplinarity, Jan Cornelius Schmidt

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INTRODUCTION

Specialization, professionalization, disciplining and departmentalization were some of the main outcomes of the establishment of the modern university in the 19th century, and these outcomes have not, expectedly, circumvented philosophy. Ever since, academic philosophy has been on a quest of finding its own disciplinary identity, as well as discovering its relationship with other disciplines. The latter has especially been so in the past 50 years, since new scientific paradigms or approaches have been presented to the general academic public in the 1970s, namely multi-, pluri-, cross-, inter-, and transdisciplinarity [1-3].

Here we shall offer a brief history of the relationship that academic philosophy has established with one of the aforementioned scientific paradigms: interdisciplinarity. Unfortunately, philosophers have not sufficiently considered the role and relationship of philosophy towards it. Evidence to support this claim is abundant. On this occasion we shall mention just one of them: e.g., Michael H.G. Hoffmann, Jan C. Schmidt and Nancy J. Nersessian state that "in general, philosophers have remained reluctant to address 'interdisciplinarity' " [4; p.1858]. However, in spite of the inattention of philosophers towards interdisciplinarity and the fact that "until quite recently the field of interdisciplinary studies has attracted few philosophers," Julie Thompson Klein and Robert Frodeman rightfully argue that the situation is changing today [5; p.150]. This change has been going on for at least 15 years.

The development of a more intense relationship between philosophy and interdisciplinarity can be traced to a series of international workshops and conferences, starting with a workshop held in Atlanta in 2009 and ending with a conference held in Tübingen in 2012. According to a report from the Atlanta workshop, the primary purpose of it was to "reflect on interdisciplinarity – for the first time – from a philosophical point of view" [6; p.42a]. Two outcomes have emerged from this workshop: (1) it developed "the idea of philosophy not as a metadiscipline, but as an engaged participant and partner in interdisciplinary discourses"; (2) it resulted in establishing a network of philosophers and other scholars interested in interdisciplinarity named *Philosophy of/as Interdisciplinarity Network* (PIN-net) [7; pp.169-170].

Therefore, the mentioned workshops and conferences stimulated the progress of the relationship between philosophy and interdisciplinarity. Moreover, two levels of that relationship have been identified and defined during the Atlanta workshop: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. According to Hoffmann and Schmidt, philosophy *of* interdisciplinarity encourages "philosophical inquiry into problems regarding the practices and theories of interdisciplinary research in the style of traditional philosophy of science." On the other hand, philosophy *as* interdisciplinarity is focused upon "initiating a new philosophical practice of reflective and reflexive engagement in the world – one that questions and overcomes the boundaries that have constituted philosophy as a discipline in the 20th century," with its leading idea being that "philosophers leave the study and enter the field, integrating their work with scientists, engineers, and policy makers" [7; p.170].

Besides the mentioned workshops and conferences, other proof of the ongoing progress of the relationship between philosophy and interdisciplinarity can be found elsewhere. One of them is provided by the 2010 edition of *The Oxford Handbook of Interdisciplinarity*. As the handbook's editor-in-chief Robert Frodeman claims in the introductory text, this edition "heralds the centrality of philosophic reflection for twenty-first century society," since interdisciplinarity is "inherently philosophical, in the non-professionalized and non-disciplined sense of the term" [8; p.xxxi]. This

edition of the Oxford's handbook contains a short yet noteworthy textual addendum on prospects for a philosophy of interdisciplinarity authored by Schmidt [9]. The handbook's 2017 edition contains only one contribution which discusses not the relationship between philosophy and interdisciplinarity, but the one between interdisciplinarity and a single philosophic discipline, i.e., ethics, authored by Carl Mitcham and Wang Nan [10]. The other two hallmarks in the history of considerations on philosophy *of* and *as* interdisciplinarity we would like to point out are two special issues of scientific journals: (1) issue 11 of the 190th volume of *Synthese* (2013) edited by Hoffmann, Schmidt and Nersessian; (2) and issue 3 of the 6th volume of *European Journal of Philosophy of Science* (2016) edited by Uskali Mäki and Miles MacLeod.

Due to the fact that more literature regarding the first level of the relationship between philosophy and interdisciplinarity has recently emerged, e.g., Choudhary [11, 12] and Curis [13], we shall examine what we consider as the peak of its development. Thus, we shall analyze the opus of the German physicist and philosopher Jan Cornelius Schmidt, who has been developing his *philosophy of interdisciplinarity* for the past 20 years. Special attention will be given to Schmidt's latest monograph *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability* (2022), which we perceive as his intellectual crown on the matter.

THE TRAJECTORY OF SCHMIDT'S PHILOSOPHY OF INTERDISCIPLINARITY

In this chapter, we shall shed light upon the development of Jan Cornelius Schmidt's thought on *philosophy of interdisciplinarity*. For that purpose, we have selected two of his articles which we consider to be milestones in the trajectory of his theory. These articles from 2008 and 2011 were, in our opinion, crucial for constituting his capital work published in 2022. Thus, we divided our article into three sections. The first section includes Schmidt's conceptual sketch of *philosophy of interdisciplinarity*, in which he clarified the role of philosophy in considering interdisciplinarity and elucidated the vital components of *philosophy of interdisciplinarity*. The main topic of the second section of our article is problem-oriented interdisciplinarity, that is, the dimension of interdisciplinarity which will turn out to be central for Schmidt's *philosophy of interdisciplinarity*. The third section is focused upon the realization of Schmidt's goal in the form of a comprehensive *philosophy of interdisciplinarity*, which has a critical-reflexive and problem-oriented variant of interdisciplinarity at its core.

BLUEPRINT OF A NEW APPROACH

In our opinion, the first milestone of Schmidt's thoughts on philosophy *of* interdisciplinarity is his article entitled "Towards a philosophy of interdisciplinarity. An attempt to provide a classification and clarification" (published online in 2007 but printed in 2008) [14]. It stemmed from his unconcealed intellectual irritation by the widespread and often perverted usage of the term *interdisciplinarity*, and the frivolous characterization of projects, as well as research and education programs as being *interdisciplinary*, which often reduce the term to a mere fund-acquiring catchword, a vague concept deprived of meaning. In order to 'right the wrong,' Schmidt reached towards distinctions established in philosophy of science in approaching interdisciplinarity as a multi-faceted phenomenon with regard to four dimensions: (a) *ontological dimension*, (b) *epistemological dimension*, (c) *methodological dimension*, and (d) *problem framing* and *problem perception dimension* (*problem-oriented dimension*).

Yet the birth of Schmidt's considerations on these four dimensions can be traced back to the early 2000s. Namely, he applied them in the context of an inherently interdisciplinary scientific field of bionics [15], used them to pave a new way in the jungle of interdisciplinarity [16], then to address questions of technological reductionism in another interdisciplinary scientific field, i.e. nanotechnology [17], and his considerations culminated in an article entitled "Dimensionen der Interdisziplinarität. Wege zur einer Wissenschaftstheorie der Interdisziplinarität" in which he evoked *Interdisziplinaritätsphilosophie* for the first time [18].

Each of the four dimensions, according to Schmidt [14], could be matched with corresponding traditional philosophical stances. The ontological dimension of interdisciplinarity would therefore refer to objects and entities, hence being advocated by (a) *realists* who mainly deal with "given or constructed objects of a human-independent reality"; the epistemological one refers to knowledge, theories and concepts, so the corresponding philosophical stance would be that of (b) *rationalists*; the methodological dimension, i.e., the one which refers to knowledge production, to the research process, the rule-based action of scientists, and to the languages in use, thus matched with (c) *methodological constructivists* and *pragmatists*; the problem framing, problem perception or problem-oriented dimension, hence the one which includes considerations on "how to handle and solve problems pragmatically; the impact, effect and outcome of knowledge is of utmost relevance"; thereupon resembling the stance supported by (d) *instrumentalists*, *utilitarians* and *critical theorists* [14; pp.59-62]. After identifying the four dimensions and their respective philosophical stances, Schmidt illustrated them by using some examples of popular research programs which are labelled as interdisciplinary: (a) nanoresearch and neurosciences (object-oriented – realism); (b) complex systems and chaos theory (theory-oriented – rationalism); (c) biomimicry/bionics and econophysics (method-oriented – methodological constructivism and pragmatism); (d) technology assessment and sustainability research (problem-oriented – instrumentalism, utilitarianism, and critical theory) [14; pp.62-66]. Finally, Schmidt concluded that "*a minimal philosophy of science* is the prerequisite in order to understand (and probably to promote) 'interdisciplinarity' ". Even though Schmidt claimed that philosophy is "effectively helpful in analyzing and classifying interdisciplinarity", he emphasized that "*philosophy of interdisciplinarity* still remains a desideratum" [14; p.66].

Inappropriate use of *interdisciplinarity* led Schmidt to writing another article or, as we called it earlier, a textual addendum on the topic. The addendum was published in Frodeman's 2010 edition of *The Oxford Handbook of Interdisciplinarity* in the form of a box entitled "Prospects for a philosophy of interdisciplinarity." Even though it does not offer anything new in comparison to the article from 2008, Schmidt's box fills its purpose "to foster the debate on ID," since it "presents elements of pluralist *philosophy of interdisciplinarity*," and in it Schmidt exclaims once again that he may have proposed "some elements for a philosophy of ID" [9; p.39; p.41]. More importantly, this box is significant on a symbolical level, being the only textual contribution devoted to the relationship between philosophy and interdisciplinarity in Frodeman's handbook, therefore indicating an ongoing change.

A STEP CLOSER TOWARDS A PHILOSOPHY OF INTERDISCIPLINARITY

After elucidating the plurality of different dimensions of philosophical approach to interdisciplinarity in the earlier phase, thus offering a conceptual framework for its analysis, the focal point of this section of our article will be what we consider the second milestone of Schmidt's theory which contains his thoughts on problem-oriented interdisciplinarity, i.e., its fourth type.

The most detailed and thus exemplary instance of Schmidt's reflections on problem-oriented interdisciplinarity is undoubtedly the article entitled "What is a problem? On problem-oriented interdisciplinarity" published in 2011. Schmidt's urge for writing such an article came out of the same source as his article we discussed in the first section of our article. Namely, it again came out of intellectual irritation, which was caused this time by the buzzword *problem*. The term itself, according to Schmidt, "plays a major role in the various attempts to characterize interdisciplinarity or transdisciplinarity", and it seems that the discourse and practice of interdisciplinarity have "problems with the 'problem'," since they can "also be found in traditional disciplinary sciences as well as in the life world," which made him exclaim that: "Problems seem to be everywhere and nowhere!" [19; p.249; pp.251].

Recognizing the vagueness of the notion of *problem* as the cause of misunderstanding of problem-oriented interdisciplinarity, Schmidt insisted on clarifying the terms *problem* and *interdisciplinarity*, and on finding demarcation lines between problem-oriented and other types of interdisciplinarity. In order to clarify the notion of *problem*, he reached for and combined integrative approaches of Dietrich Dörner (an *undesired* or *initial state*; *desired* or *final state*; *barriers* between the two) and Roland W. Scholz (*target*, *system*, and *transformation knowledge*), concluding that the notion of *problem* includes "(i) the assessment of the actual or future state – from the angle of an anticipated target state – as being undesired or negative (*negativity thesis*) and (ii) the barrier to reaching or avoiding the target or anticipated state (*barrier thesis*)" [19; pp.259-260]. From that emanates his definition of problem-oriented interdisciplinarity, which offers "system, target, and transformation knowledge, including a time-sensitive, temporal dimension, and an *ex ante* reflection on prospective future states," and which produces *problem knowledge* that is "intrinsically interlaced with action knowledge." [19; p.260] Therefore, the role of problem-oriented interdisciplinarity is threefold: to constitute, frame and clarify a problem, and to anticipate it and prevent it, or to suggest actions for its solution.

When it comes to Schmidt's differentiation between problem-oriented and three other iterations of interdisciplinarity, he drew demarcation lines as follows: (1) object-oriented interdisciplinarity does not "mainly refer to knowledge, methods, or problems, but to an external, human-independent reality;" (2) theory-oriented interdisciplinarity refers to "meta-disciplinary – or at least non-disciplinary – abstract knowledge;" (3) method-oriented interdisciplinarity refers to answering the question of "whether there are special canons or methods, rules, empirical settings, and hermeneutic forms which typify ID and positively determine it." [19; pp.254-255] Therefore, these iterations of interdisciplinarity are insufficient, since they do not "cover the whole breadth of the notions of ID" [19; p.256]. On the other hand, problem-oriented interdisciplinarity, or as it is sometimes called *transdisciplinarity*, focuses "on the starting points, goals, and purposes of interdisciplinary research activities – in other words, on the constitution, identification, and framing of problems," and interdisciplinary problems are considered as "being external to disciplines or to academia. They are primarily societal ones that are (pre-) defined by society, e.g., lay people, politicians, and stakeholders" [19; pp.256-257]. From a methodological standpoint, this type of interdisciplinarity tries to transgress the existing boundaries between science and society. It does that in two ways: it takes up "*external* (to science) societal problems, works on them *internally*, and transfers the results to the societal domain in order to contribute to *extra*-scientific societal problem solving" [19; p.261]. Seen from an epistemological perspective, this type of interdisciplinarity is the place in which constructivism and realism converge, asking for an epistemological position Schmidt calls *constructivist realism*, in which "based on real situations and matters of fact, problems are constituted according to normative criteria" [19; p.263]. Accordingly, Schmidt deemed that it was not enough to describe reality and the criteria of its

cognition, but that both reality and the criteria should rather be normatively defined or, to be more precise, constructed in accordance with the interdependence of natural objects, humans, and technology. Thus, he criticized previous tendencies in science, i.e., inclinations towards conducting a unilateral analysis of these three constituents from a non-dynamic perspective.

SCHMIDT'S PHILOSOPHY OF INTERDISCIPLINARITY

Schmidt's blueprint for a new, philosophic approach towards interdisciplinarity in 2008 and commitment to its problem-oriented version in 2011 enabled him to construct the desired *philosophy of interdisciplinarity*. His thoughts on the matter have undoubtedly reached their (current) peak in his monograph *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability* published in 2022. It is the outcome of his long-lasting intellectual endeavor, his scientific venture through the wastelands of the interdisciplinary jungle.

Once again portraying his reluctance to accept the current state in academia which is depriving *interdisciplinarity* of its semantic core, Schmidt opens the book with a reminder to the roots of interdisciplinary discourse which dates back to 1960s and 1970s, and which emerged from discussions on environmental issues. By recognizing the weaknesses of a widespread *instrumentalist* or *strategic* approach to interdisciplinarity, he advocated one which would complement and upgrade it, namely its *critical-reflexive* variant. Schmidt clearly expressed his intention of departing from the Baconian, Cartesian and Kantian philosophical heritage regarding the human-nature relationship, aligning his thought with the critical theory and cultural critique of the Frankfurt School, especially with that of Theodor W. Adorno, Max Horkheimer, and Jürgen Habermas. The essence of Schmidt's understanding of the relationship between philosophy and interdisciplinarity in the form of *philosophy of interdisciplinarity*, as well as his clarification of both of its constituents, is best shown in the following lines: The *Philosophy of Interdisciplinarity* is thus interdisciplinary *and* genuinely philosophical: "In comparison with the disciplinary mainstream of 20th-century philosophy with its subdisciplines, its reductionist approaches and regional ontologies (Frodeman 2014), the *Philosophy of Interdisciplinarity* can be characterized as truly interdisciplinary. Furthermore, it is genuinely philosophic because it is based on the rich and colourful intellectual tradition of philosophy that addresses fundamental metaphysical questions and develops frameworks of orientation. In other words, the *Philosophy of Interdisciplinarity* aims to (re)open the academic discipline of philosophy towards other disciplines and, beyond that, to society at large. It resonates with an interdisciplinary-oriented philosophy and therefore could also be called *interdisciplinary philosophy"* [20; pp.7-8].

Therefore, Schmidt made it clear that his *philosophy of interdisciplinarity* is not another philosophical subdiscipline, merely a "philosophy of X" as was the trend during the 20th century due to overspecialization. It is rather an overarching critical-reflexive variant of a problem-oriented interdisciplinary framework which is deeply rooted in philosophical heritage.

It is worth noting that chapter 2 of his book on philosophy of interdisciplinarity relies upon in two of his articles which we have previously discussed [14, 19], but it also provides proof of the further advancement of his considerations on the matter. Novelties presented in the chapter, when compared to the abovementioned articles, largely contribute to the constitution of *philosophy of interdisciplinarity*, so we shall focus only on the points of divergence.

Before constituting his *philosophy of interdisciplinarity*, Schmidt pointed out the plurality and diversity of the views on knowledge and (inter-)disciplinarity taken by different philosophic traditions who

deemed knowledge unity and integration of disciplines as an overall aim of academic inquiry, starting from Ancient Greek philosophy to German Idealism up to the 20th century philosophy of science and analytical tradition. Furthermore, Schmidt tackled another plurality. Namely, the one of motives, values, or underlying goals of interdisciplinary research, which were often misinterpreted, and which resulted in viewing interdisciplinarity merely as a means for technological innovation and for achieving economic growth, thus being exclusively instrumentalist in nature. That lead Schmidt to the conclusion that interdisciplinarity is a "double-edged sword," because it can serve "as a point of access and key catalyst for recognizing and reflecting on goals and motives of science and research in society," but it can simultaneously conceal these goals and motives [20; p.22]. He recognized four motives pursued by interdisciplinarians and their respective values: (1) *epistemic motive* stems from the attitude that science is guided by the value of truth; (2) *economic motive* comes from the belief that utility is the base value of scientific research; (3) *ethical-societal motive* centers on the value of the human and nature's well-being; (4) *personal motive* is driven by the value of sense-making and self-understanding. The task of *philosophy of interdisciplinarity* is, in Schmidt's words, to consider and reflect upon that ambivalence, because interdisciplinarity has "the potential to spark deeper reflection on science and research in society," thus creating its guiding idea to put that potential into practice [20; p.22].

However, classification of motives and values can lead to a limited, mainly descriptive understanding of interdisciplinarity. That is why Schmidt proposed that *philosophy of interdisciplinarity* aims "to critique, complement, and widen the view," while one of its central objectives is to "reveal underlying philosophical assumptions and fundamental convictions regarding the notion of 'interdisciplinarity' – and on this basis it advances a critical perspective that opens up avenues towards sustainable knowledge within the academy" [20; p.24]. Acknowledging the fact that the existence of disciplines is a *conditio sine qua non* of interdisciplinarity, Schmidt presented the unavoidable dilemma that arises from such a situation. At the core of interdisciplinary endeavors there is the so-called *boundary paradox*, i.e., the simultaneous tendency to conserve and eliminate disciplinary boundaries. Schmidt suggested a philosophic view of that paradox, naming it the *boundary dialectic*, which would include both separation *and* integration of disciplines, and which would enable us to reject dominant conception of interdisciplinarity as being solely integrative to the extent of dissolving disciplinary boundaries, hence dissolving its own roots [19; pp.252-253, 20; p.25]. The dialectic view of disciplinary boundaries is offered by *philosophy of interdisciplinarity* which possesses the ability to, as Schmidt concludes, "explicitly address boundaries and provide a conceptual framework encompassing both (a) separation or differentiation and (b) transgression, transcendence, or integration" [20; p.26]. As we have already mentioned in an earlier chapter, he designed that conceptual framework in the early 2000s, and it consisted of four interchangeable views of a multifaceted phenomenon of interdisciplinarity: object-oriented, theory-oriented, method-oriented, and problem-oriented interdisciplinarity.

The whole of Schmidt's monograph is interwoven with his bias towards problem-oriented interdisciplinarity, since he was convinced that it transcends the other three views of interdisciplinarity. That can be seen from his statement that problem-oriented interdisciplinarity, compared with the other three types, "frames science and research from a more comprehensive perspective," and that it "centres on problems and issues, and it includes the goals, purposes, initial conditions, and research agendas of scientific activities" [20; p.29]. As we mentioned earlier, Schmidt [19; p.256] wrote that that type of interdisciplinarity is sometimes called transdisciplinarity, because the two share many common features, e.g., they both deal with societal, ethical, real-world, extra- and trans-scientific problems. That is why it was of utmost importance

to him to distinguish between them in his monograph. As is shown in a figure and elaborated upon in the text, transdisciplinarity is a comprehensive concept which encompasses all four forms of interdisciplinarity but only its problem-oriented type in its entirety. Namely, certain interdisciplinary objects, methods and theories fall out of the transdisciplinary scope. Therefore, problem-oriented ID (including its critical-reflexive subtype) is a subset of transdisciplinarity, and thus always transdisciplinary.

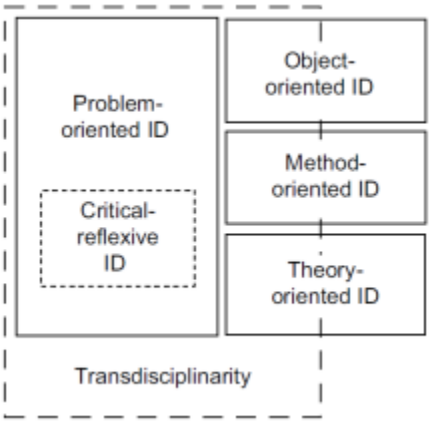

Figure 1. The four types or dimensions of interdisciplinarity, including transdisciplinarity and a central subtype, namely critical-reflexive interdisciplinarity [20; p.30].

When he discussed knowledge politics and research programs in his book, Schmidt further developed his thoughts on the topic he previously expressed in a article entitled "Knowledge Politics of Interdisciplinarity. Specifying the Type of Interdisciplinarity in the NSF's NBIC Scenario" [21]. In both cases he challenged the prevalent understanding of interdisciplinarity advocated in the NSF's (*National Science Foundation*) NBIC (*Nanotechnology, Biotechnology, Information Technology and Cognitive Science*) report from 2002. He did so by analyzing the report from the perspective of the four types of interdisciplinarity, recognizing that it advocates a weak type of interdisciplinarity: techno-object interdisciplinarity [20; pp.50-51, 21; p.322]. Given the fact that he criticized the report because of the lack of the other three types of interdisciplinarity and taking the nature of his critique into consideration, it is, in our opinion, justified to conclude that Schmidt would like the report to contain each of the four types with an emphasis on the problem-oriented one, more precisely on its critical-reflexive subtype. The conclusion we put forward is based upon Schmidt's critique of today's *knowledge society* which does not take consequences of technological advancement and its impact on humanity and environment into consideration. Schmidt's vision of *philosophy of interdisciplinarity* provides a conceptual framework, based on the *minimal* philosophy of science, which should be used to consider and judge interdisciplinarity present in the dominant *knowledge politics*, which largely impacts and builds the society of the future. Therefore, the role of *philosophy of interdisciplinarity* is to encourage criticism and foster reflection on interdisciplinarity, thus creating a *reflexive society* [20; p.53].

Besides detecting the state of interdisciplinarity studies which dominates today's scientific discourse and suggesting how we can improve it in the chapter on NSF's NBIC report, Schmidt went to determine the historical roots of such a view on science. He found them in the work of Francis Bacon, the early Modern philosopher and the founding father of modern science, recognizing him as the precursor of today's technoscience which does not reflect on the implications produced by scientific progress and technological advancement. Schmidt already did

so in 2011 in two articles entitled "The Renaissance of Francis Bacon" [22] and "Toward an epistemology of nano-technosciences" [23], in which he postulated that Bacon's program is now experiencing a rebirth (renaissance), reaching its full potential and nominally being put into action in various research programs: "*Bacon-I* in the 17th century is now followed by *Bacon-II*, supporting the well-known vision or fiction of an epochal break" [22; p.38]. Both in his articles and his monograph, Schmidt claimed that Bacon's vision of science, and consequently the one that is present in today's technoscience (object-oriented interdisciplinarity), was mostly instrumentalist, since it only dealt with means of achieving progress, and not on its consequences. In Schmidt's words, Bacon's instrumentalism and his materialist real-constructivist epistemology are "now, in essence, more powerful than ever before, especially in the growing field of interdisciplinarity and interdisciplinary technosciences" [20; p.72]. In order to overcome such a situation, *philosophy of interdisciplinarity* comes into play. According to Schmidt, it should be put to use in the sense of acknowledgment and awareness of the subsiding Baconian elements of modern technoscience, and the predominant type of interdisciplinarity, which enables us to assess it critically especially from the perspective of the relationship between humans, technology, and nature. Put succinctly, *philosophy of interdisciplinarity* helps us "to go through Bacon and deal with his program – in order to go beyond him" [20; pp.72-73].

Unlike object-oriented interdisciplinarity which dominates the technoscientific neo-liberal era we live in, Schmidt expectedly advocated interdisciplinarity which would be oriented towards wicked societal problems and their resolvement. That can be seen in the chapter entitled "Society and Societal Problems" of Schmidt's monograph, which has a lot in common with the theses he presented in a article we discussed earlier, namely "What is a problem?" published in 2011. Since we have already analyzed that article in detail, we shall focus on the differences between it and the book chapter. Special emphasis will be put on *philosophy of interdisciplinarity*'s contribution to the discussion on problems in general, and societal problems in particular. The first difference between the article and the chapter lies in the involvement of *philosophy of interdisciplinarity* in recognizing types of interdisciplinarity present in two reports: NSF's NBIC report from 2002 and the European Commission's CTEKS (*Converging Technologies for the European Knowledge Society*) report. The CTEKS report, in Schmidt's opinion, "shifts the perspective away from object-oriented interdisciplinarity [advocated by NSF's report] towards problem-oriented interdisciplinarity, which, by means of detailed specification of each component, aims to achieve a framing of the problem, a convergence of goals, and critical reflection on and the potential revision on purposes" [20; p.88]. Furthermore, the second difference lies in the central place *philosophy of interdisciplinarity* should hold in correct understanding of and orientation on a problem, since it is "a key term in both the political and epistemological discourse and the practice of interdisciplinarity," and therefore *philosophy of interdisciplinarity* becomes indispensable for giving substance to problem-oriented interdisciplinarity [20; p.90].

Although an advocate of problem-oriented interdisciplinarity, Schmidt saw that today, scarce as it is, even such an approach to interdisciplinarity has many shortcomings. He recognized that it is most often characterized by instrumentalism, which is oriented exclusively on solutions to problems, rather than on their roots and prevention, and he called such an approach *solutionism*. That caused him to devote an interlude in his monograph to the clarification of what problem-oriented interdisciplinarity should be and, to be more precise, he promoted its critical-reflexive subtype. That subtype, in Schmidt's words, contributes to "thwarting new problems at their very root," since it "scrutinizes the underlying dynamics of scientific/technological advancement,"

having both the emerging problems and, even more so, the prevention of problems in the early phases of scientific progress in focus [20; p.93].

The interlude actually reveals the direction and the main message Schmidt tried to send in next three chapters in which he presented three case studies from a critical-reflexive perspective on the following topics: ethics and environment, nature and the sciences, technology and the future.
When he dealt with ethics and environment, Schmidt largely relied on the philosophical approach taken by the German philosopher Hans Jonas. His inclination towards Jonas' thought is apparent in an article "Die Aktualität der Ethik von Hans Jonas. Eine Kritik der Kritik des Prinzips Verantwortung" [24], and in an article "Defending Hans Jonas' Environmental Ethics: On the Relation between Philosophy of Nature and Ethics" [25], as well as in the sixth chapter of his monograph on *philosophy of interdisciplinarity*. In all three cases, Schmidt approached Jonas' philosophy in a similar fashion. He aspired to critically assess the applicability and actuality of Jonas' philosophy in the 21st century, in order to find out whether his philosophy can prove useful in a critical analysis of the current state of affairs and the relation between society and environment. Schmidt used scholastic precision in analyzing the four objections (*diagnosis objection*, *origin analysis objection*, *argumentation and justification objection*, and *practice objection*) and arguments put forward by Jonas' critics in an effort to repudiate his theses. His defense of Jonas and his theses can be brought down to the following two conclusions Schmidt expressed in the introductory part of the chapter: (1) "Jonas is a pioneer in driving the idea of critical-reflexive interdisciplinarity […] in order to shift the direction of scientific advancement onto an environmentally friendly path" [20; p.103]; (2) Jonas' public philosophy "can be can be regarded as interdisciplinary in a (self-)critical-reflexive sense – an interdisciplinary philosophy that is part of any good reflexive and reflective practice" [20; p.104]. So, Jonas' philosophy served Schmidt as an illustrative example of how critical-reflexive *philosophy of interdisciplinarity* should look like, since Jonas considered philosophy of nature and ethics twin sisters, therefore being requisite for facing life-world problems. In line with Jonas' thought, Schmidt's practically relevant environmental *philosophy of interdisciplinarity* would be the one "in which ethics, anthropology, metaphysics, philosophy of nature, philosophy of science, as well as politics and the life-world are conceptualized as a converging domain in a critical-reflexive fashion" [20; p.119]. He concluded his considerations on the relation between ethics and environment by first taking an *ex negativo* approach in showing what philosophy in general, and *philosophy of interdisciplinarity* in particular should be like. He is convinced that it should not be "apathetic or indifferent about the world," since it should concern "the world's state of affairs – especially environmental issues and global change problems," hence it should not be "value-free." It should, in Schmidt's opinion, rather be "engaged in changing the situation," and should achieve it by "fostering people's awareness, the responsibility of scientists or, in general, humans' stewardship for nature," by providing "a reflexive fundament for the betterment of societal praxis – and for a good life." However, in order to achieve such a philosophy, it is necessary for humans to develop a different mindset towards nature, a mindset which would "govern our approach to the natural environment and change our societal relations to nature." [20; p.120] In conclusion, Schmidt was a strong supporter of Jonas' philosophy and therefore a proponent of an ethically responsible human approach towards nature. Schmidt deemed a critical-reflexive *philosophy of interdisciplinarity*, which should be problem- and future-oriented, as key for achieving such an approach.

The contents of Schmidt's chapter on the relation between nature and the sciences can be reformulated in a question: What kind of science do we need in a world marked by instability and complexity? The topics of instability and complexity occupied a large part of his scientific

endeavors from the early 2000s. His thoughts on the matter reached their peaks in two of his previous monographs: *Instabilität in Natur und Wissenschaft: Eine Wissenschaftsphilosophie der nachmodernen Physik* [26] and *Das Andere der Natur. Neue Wege zur Naturphilosophie* [27]. Science of the second half of the 20th century has challenged the perspective in which the world was considered as being stable and static. It had shown that the world around us is mainly characterized by instabilities and complexities which stem out of them. Schmidt's view on the matter was, of course, a critical-reflexive one. In his opinion, such a view "opens avenues for exploring new directions within the sciences and for fostering a change in the way sciences conceptualize (*ex ante* and *ex post*) nature and our societal relations to nature," and it can also "encourage scientists (and all of us) to question what counts as legitimate science, entailing a cultural critique of present-day fragmented knowledge production, the institutionalized research system, and the related (Cartesian dualistic) worldviews." [20; p.123] He advocated and used it in order to find an alternative to the mainstream sciences by means of critical-reflexive interdisciplinarity. That type of interdisciplinarity involves four aspects: (1) *self-enlightenment* which encompasses a critical stance towards one's own approach to the world and to the boundaries of our framing of the world's objects; (2) *synthesis* or *synopsis* of disciplinary and non-disciplinary knowledge which would be used for creating a new and comprehensive understanding of nature and societal relation between humans and nature; (3) *change* or *transformation* in the orientation of science and scientific advancement; and (4) *problem orientation*, since it is related to grand societal changes. [20; pp.123-124] Accordingly, Schmidt's analysis concerned the fact that the sciences of the second half of the 20th century recognized instabilities, which was followed by the emergence of self-organization theories and shook the foundations of thus known science. In turn, Schmidt saw instabilities as an opportunity for a new synthetic-synoptic view on scientific findings which would shed a different light on nature, and he did so with the help of *philosophy of interdisciplinarity* which aims to unify various perspectives and create a scientific common ground [20; p.130].

In Schmidt's opinion, despite offering a new view on nature, instabilities simultaneously reveal limitations of and in the sciences. This dialectic relation is central to critical-reflexive interdisciplinarity. Instabilities have posed new methodological challenges to sciences by deconstructing the methodological dogma of reproducibility, predictability, testability, and describability which arose out of the Baconian scientific program. Hence a critique of the Baconian program is indispensable for a problem-oriented perspective. Instabilities turn out to be paradigmatic for a critical-reflexive orientation in interdisciplinarity and philosophy as an academic discipline [20; p.143]. In given circumstances, quantitative methodology became insufficient and had to be complemented by its qualitative counterpart, which involves methods such as processuality, modelling and contextualism. Schmidt deemed self-organization theories a prominent example of a new methodological orientation which produces and tests holistic models and offers explanations rather than (re)producing rigorous scientific laws. The dominant instrumentalist approach to science, according to Schmidt, addresses problems only at a superficial level, whereas late-modern science requires it to be complemented by a critical-reflexive dimension which would facilitate problem prevention. Moreover, Schmidt is convinced that late-modern sciences "open pathways to a more contextual and democratic understanding of sciences" [20; p.151]. In his opinion, self-organization theories, as a form of problem-oriented late-modern scientific paradigms, deal with problems on a deeper level. He argues that the emergence and wide recognition of instabilities do not "drive sciences into a dead end and render scientific inquiry impossible," but they rather "engender a different concept of science and a change of view regarding what counts legitimately as science" [20; p.152]. Finally, the new, appropriate scientific approach to phenomena in the

world of instabilities and complexity is the one which is critical-reflexive, problem-oriented, future-oriented, synthetic, synoptic, holistic, and methodologically contextual.

Schmidt concluded his monograph on *philosophy of interdisciplinarity* with a chapter on technology and the future. It is a topic on which he wrote in, for example, the article "Towards a prospective technology assessment: challenges and requirements for technology assessment in the age of technoscience" [28] and in the article "Prospective Technology Assessment of Synthetic Biology: Fundamental and Propaedeutic Reflections in Order to Enable an Early Assessment" [29].

Due to challenges related to environment, sustainability and global change, and since they are mostly caused by reckless use of technology, in the 1960s in the USA and in 1980s in Europe a new interdisciplinary approach to dealing with these challenges emerged: Technology Assessment (TA). The main goal of TA is to foster and facilitate societal and political shaping of technoscientific advancement by politicians and legislation, with its basic purpose being early identification and assessment of new technologies, as well as influencing their development. However, TA faced criticism. Schmidt was one of the authors who criticized the current state of TA. His remarks aimed at TA's lateness in reacting to problems produced by emerging new technologies, urging it to address "underlying technoscientific knowledge dynamics with its inherent tendency to continuously produce new problems," as well as at TA's lack of criticality in considering "the background of the issues we face today" [20; p.158]. Besides being critical towards it, Schmidt and his colleague Wolfgang Liebert [28] created a new concept of a critical-reflexive interdisciplinary approach in TA which should diminish TA's shortcomings: *Prospective Technology Assessment* (ProTA). Such a concept encompasses self-enlightenment "in the sciences and engineering, in the academy and the research system, and furthermore in science politics and society at large," which intends to "hinder the creation of new problems" and which "matches perfectly with the concept of critical-reflexive interdisciplinarity". Schmidt considered ProTA paradigmatic for his *philosophy of interdisciplinarity*, since he perceived it as a "normative-descriptive hybrid at the interface between science, society, and politics," moreover he was convinced that it can be "deemed to truly epitomize the concept of critical-reflexive interdisciplinarity" [20; p.158; p.178].

Schmidt's vision of ProTA involves four dimensions or orientations which sets it apart from TA: 1) *early-stage orientation* or timeliness in addressing emerging novel kinds of technology and in acquiring technoscientific knowledge; 2) consideration of purposes and options for realizing technoscientific potentials; 3) *shaping orientation*, since it aims to shape technoscientific knowledge production; 4) examination of technoscientific knowledge produced at the technoscientific core [20; pp.158-160]. ProTA turns out to be crucial because "technical systems, devices, things, and objects based on instabilities and showing self-organizing phenomena are beginning to populate our life-world," and from it stems the necessity to address "instability-based, late-modern type of technology and undertake the task of developing procedures either to restrict and contain or to shape and deal with it" from an ethical perspective [20; p.177]. In order to illustrate the applicability of ProTA, Schmidt used the example of synthetic biology which he considered to be a key technoscience of the future. The major essence of its technoscientific core being the "idea(l) of harnessing self-organization – including the ability to set off complex dynamical phenomena – for technical purposes" [20; p.177]. Being a relatively new technoscientific field, Schmidt claimed that societally relevant ethical issues arise from synthetic biology and that they should be addressed as early as possible, especially due to the fact that its further development and realization would cause us to enter "a new technological era in which

technical systems possessed high levels of autonomy and agency properties" [20; p.163]. Therefore, critical-reflexive approach which would facilitate early prevention, consideration of purposes, shaping and examination of technoscientific knowledge is of the essence. Furthermore, Schmidt's conception of ProTA needs to be founded on solid ethical basis, similar to the one put forward by Jonas in his seminal work *The Imperative of Responsibility* [30]. Schmidt argued that if ProTA would be "in alignment with Jonas's ethics," it could truly offer "an interdisciplinary, critical-reflexive approach that enables us to analyse and assess the technoscientific core of this new wave of emerging technologies" [20; p.177].

CONCLUSION

Philosophy was often criticized for not being involved in the discourse on interdisciplinarity. However, discussions on the relationship between philosophy and interdisciplinarity have intensified in the last two decades. Moreover, two levels of that relationship have been established in 2009: philosophy *of* interdisciplinarity and philosophy *as* interdisciplinarity. While philosophy *of* interdisciplinarity refers to a philosophical approach towards interdisciplinarity in the manner of philosophy of science, philosophy *as* interdisciplinarity encourages philosophical practice characterized by both reflective and reflexive engagement in the life-world, investigating and transcending academic philosophy's disciplinary boundaries and doing integrative fieldwork with scientists, engineers, and decision makers. Scholars have thus far shown more interest towards the first level, that is towards philosophy *of* interdisciplinarity.

The aim of our article was to thoroughly investigate the development of a specific *philosophy of interdisciplinarity* conceptualized by Jan Cornelius Schmidt, who devoted the past two decades to reflection on the first level of the relationship between philosophy and interdisciplinarity. We have traced the evolution of his *philosophy of interdisciplinarity* from a conceptual blueprint to its (current) peak, i.e., from his first utterance of the notion *Interdisziplinaritätsphilosophie* in 2005 to his monograph on the matter in 2022. We have recognized and emphasized two milestones in the evolutionary trajectory of Schmidt's *philosophy of interdisciplinarity*.

The first of them was his article "Towards a philosophy of interdisciplinarity. An attempt to provide a classification and clarification" from 2008. Schmidt was convinced that the first step towards a *philosophy of interdisciplinarity* is to approach the complex phenomenon of interdisciplinarity using a four-dimensional framework stemming from philosophy of science. The second milestone was his article "What is a problem? On problem-oriented interdisciplinarity." Inspired by Dörner and Scholz, Schmidt defined problem-oriented interdisciplinarity as the one which serves for constituting, framing, and clarifying a problem, anticipating and preventing it, as well as suggesting actions for its solution. Besides naming the problems of today and identifying the lack of answers provided by contemporary science's selective and incomplete, theoretical and practical understanding and use of interdisciplinarity, Schmidt gave priority to its problem-oriented type with the corresponding philosophical stance immersed in the critical theory of the Frankfurt school.

The development of Schmidt's *philosophy of interdisciplinarity* has reached its (current) peak in 2022 in the form of a monograph entitled *Philosophy of Interdisciplinarity. Studies in Science, Society and Sustainability*. As we have shown, it is a theory he has been meticulously building for two decades and gradually exposing in numerous articles and books published in that period. The leitmotif of the whole monograph is Schmidt's criticism aimed at mainstream science, which is unaware of or ignores the true meaning of interdisciplinarity, from an ontological, epistemological, methodological, and problem-oriented perspective. His criticism was founded and done with the

help of *philosophy of interdisciplinarity*, which he saw as a possible catalyst for improving the current relationship between philosophy, science, technology, society, and nature, as well as a possible pathway towards constituting new science for the future. In his opinion, the nanotechnoscience we witness today originates from and still largely resembles the thought of Francis Bacon. Such science promotes instrumentalism, neglecting negative implications and consequences of technological advancement. Schmidt's response to that is the critical-reflexive subtype of problem-oriented interdisciplinarity, which aims to prevent problems from emerging, thus being future-oriented. He recognized Hans Jonas as the precursor of such an approach, since Jonas promoted the imperative of responsibility in human conduct towards nature – their scientific endeavors included. Accordingly, Schmidt's *philosophy of interdisciplinarity* should be involved in the world's state of affairs, offering a critical-reflexive fundament for a responsible, value-laden, practically relevant philosophical consideration of the life-world. That implies the adaptation to the new science largely characterized by complexity, dynamics, and instability. Schmidt considered ProTA to be the embodiment of a responsible relationship towards technological advancement, involving problem prevention and critical reflection on the purpose of technology and science.

Schmidt's monograph represents the realization of one of two capital tendencies exposed at the Atlanta *Philosophy of/as Interdisciplinarity* workshop in 2009, the fulfilment of Schmidt's *desideratum* he evoked in many of his articles. However, Stephan Lingner rightfully noticed that Schmidt's monograph does not explicate "how its critical reflexive ambition might be carried-out in practice and how it could *effectively* enter research policies and related techno-scientific innovation," and that it opens the following question: "which incentives or organizational changes could nudge the actors in a competitive world to more responsible innovation beyond volatile appellative considerations." [31; p.79] But that was not the aim of Schmidt's monograph. From our point of view, his *philosophy of interdisciplinarity* presented in his monograph is the prerequisite for constructing a philosophy *as* interdisciplinarity which would practically tackle the problems of life-world and thus answer Lingner's questions. While Schmidt's monograph covered the missing theoretical *of* gap, philosophy *as* interdisciplinarity is still a practical *desideratum*.

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MARCUSE'S BRAND OF CRITICAL THEORY AND POST-COLONIALISM

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ABSTRACT

Studies discussing critical theory and post-colonialism consider only the works of Horkheimer and Adorno and are largely focused on revealing disparities between the two approaches. Writings of Herbert Marcuse in which we discover the same themes and issues as in postcolonial studies are totally disregarded, which makes the argument about disparities between critical theory and post-colonialism false to a certain extent. This article argues that critical theory and post-colonialism are not two mutually opposed projects, at least not with Marcuse's version of critical theory. Both approaches are critical of the established reality, both reject positivism, both are interdisciplinary, both are dedicated to the radical *praxis* and, both offer a blueprint of a new socialist society. At the outset, I discuss critical theory and post-colonialism arguing that postcolonial theory can function as a global critical theory. Subsequently, I analyse the theoretical closeness of Marcuse and Fanon while attempting to show how Marcuse's form of activist critical theory influenced not only Fanon but other subaltern liberation movements too. In the closing part, I explore visions of socialism that in Marcuse's and Fanon's works serve both as a critical concept and as the point at which goals of postcolonial and critical theory are realised.

KEY WORDS

critical theory, Marcuse, Fanon, decolonisation, post-colonialism

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INTRODUCTION

Several of the studies dealing with the differences (although similarities would be a more appropriate term) between critical theory and post-colonialism are mainly focused on the works of Horkheimer and Adorno [1-5]. The works of Herbert Marcuse, a full-fledged member of the pioneering generation of the Frankfurt School, are only referenced briefly or totally disregarded. This omission results in a misplaced critique of the Frankfurt School which was put forward by Edward Said and repeated more or less in a similar tone to this day: "Frankfurt School critical theory, despite its seminal insights into the relationships between domination, modern society, and the opportunities for redemption through art as critique, is stunningly silent on racist theory, anti-imperialist resistance, and oppositional practice in the empire" [6; p.386]. There is some truth in that but Said overstates his argument in Marcuse's case[1]. During the late 1960s and early 1970s, Marcuse played an important role in encouraging intellectuals to speak out against racism and against the Vietnam War. He emphasised the important role of intellectuals within oppositional movements which led more intellectuals to frame their work in relation to these movements than would otherwise have done so [16; p.xii]. In his famous essay Repressive Tolerance Marcuse argues for intolerance towards established society, its racism and imperialism. His vision was the creation of a global humane society where violence, aggression and cruelty against all living beings are eliminated [17; p.82], a race-blind and classless society of true equality "… in which Blacks and Puerto Ricans are no longer treated as second-class citizens (…) and in which a good education is granted to all, not merely to the children of the wealthy" [14; p.70]. He criticised racism, imperialism, communism, police brutality, neo-colonial massacres asserting that racist and imperialist policies "should not be tolerated because they are impeding, if not destroying, the chances of creating an existence without fear and misery" [17; p.82].

Hence, leaving out Marcuse's works is a crude methodological mistake because they contain recurring themes of repression, violence, toleration, revolution and counterrevolution, subjectivity, wars outside European soil, feminism, and oppositional *praxis* - themes that resonate with postcolonial writings. In this article I attempt to illustrate that postcolonial theory has more in common with Marcuse's version of activist critical theory than with Horkheimer's and Adorno's. This becomes clearer after Horkheimer's and Adorno's return to West Germany around 1950. Tensions between them started with a mild disagreement about the Cold War that took a more serious tone with the Vietnam War. A pivotal moment in their relationship was the events with the students' movements in Germany when on January 31, 1969, Adorno called the police and arrested 76 students in an attempt of occupying the re-established Institute of Social Research. Marcuse condemned Adorno's move and sided with the students. This event started the question of the partisanship of theory and praxis, which was *differentia specifica* of critical theory. While Marcuse remained committed to the revolution and supported students, Adorno was perceived as having resigned from praxis in favour of theory [18; pp.221-233, 19]. This clearly reveals what a radical form of activism meant for Marcuse: being at the barricades when it matters and allowing theory to be pushed further by *praxis* [18-19, 16]. The student protests were a form of "great refusal", a resolute "no" to multiple forms of oppression and domination[2]. It should not come as a surprise that Marcuse's activist critical theory attracted social movements more than what seemed to be Adorno's and Horkheimer's rather conservative turnabout. The newspapers of the time proclaimed Marcuse as the only remaining member of the Frankfurt School, supporting those movements who seek to realize the goals of critical theory [19; p.314, 20; p.432]. Even Said, who in his remark on critical theory shows ignorance of Marcuse's works, still singles out Marcuse's contribution in explaining the mechanisms of repression and domination: "Some of the work done by critical theorists – in particular, Herbert Marcuse's notion of one-dimensional society (…) has clarified the nature

of the mix of repression and tolerance used as instruments of social pacification in Western societies…" [6; p.404]. To the fact that Marcuse's activist version of critical theory appealed to and guided social movements from the West hub to the colonial periphery testifies Bolívar Echeverría, a philosopher from subaltern Latin America. He clarifies that his resistance was inspired by Lukács and Marcuse and he does not accept the prevailing view among post-colonialists that critical theory, because of its Eurocentrism, had nothing to give to postcolonial theory and to postcolonial struggles. In a conversation about the time he spent studying in Berlin, Echevarria recalls: "[T]here I connected a lot with Rudi Dutschke, but in a kind of dialogue between the Third World and the European center (…) some Latin American compañeros and I, started the Association of Latin American Students in Germany (…) We had meetings where we read literature, like (…) Fanon's *The Wretched of the Earth* or works by Marcuse presented by Rudi Dutschke or Bernd Rabehl…" [21; p.331].

The first part discusses the foundations and scope of critical theory and post-colonialism. The argument is that post-colonialism and critical theory are not competing but mutually complementing projects. In the next section, I focus on the theoretical closeness between Fanon and Marcuse. One thing that links Fanon to Marcuse is that his theoretical legacy transcends the geographical and temporal constraints of Algeria and the anti-colonial struggles [22; p.90]. And so does Marcuse's whose legacy of uncompromised critique and radicalism break with one-dimensionality and continues to inspire various contemporary social movements. Postcolonial theory has much more in common with Marcuse's critical theory than is the case with Horkheimer and Adorno. The scope of postcolonial studies comprises the entire globe, and Marcuse's critical theory deals with global issues and issues concerning the wretched ones. Thus, granted the argument that postcolonial theory today can function as global critical theories and that Marcuse's version of activist critical theory still inspires liberation movements worldwide and is useful for developing global perspectives on domination and resistance. Finally, I discuss the concept of (future) socialism that, in Marcuse's and Fanon's works, serves both as a critical concept and as the point at which goals of critical theory and decolonisation are realised.

CRITICAL THEORY AND POST-COLONIALISM

Critical theory originated in Germany in the writings of the members of the Frankfurt Institute of Social Research (a.k.a. the Frankfurt School) and later continued to develop in the USA. Critical theory is founded on a tension that necessitates sublation. In fact, the concept of necessity is itself a critical concept that presupposes even non-existent freedom [7; p.230]. Tension is a defining feature that characterises the relationship between the critical theorist and society, but also the critical theory in relation to traditional theory[3]. A critical theorist uses the same categories as a "traditional" theorist but in interpreting those categories critical theorist applies the dialectical method by searching for internal contradictions and the way of overcoming them [23; p.208]. Thus, critical thinking becomes a specific mode of activity that is in inseparable connection with society. It becomes a radical transformative praxis hostile to the established reality. Horkheimer captures the transformative character of critical theory: "Critical thinking (...) is motivated (...) by the effort (…) to abolish the opposition between the individual's purposefulness, spontaneity, and rationality, and those work-process relationships on which society is built. Critical thought has a concept of man as in conflict with himself until this opposition is removed (...) Its subject is rather a definite individual in his real relation to other individuals and groups, in his conflict with a particular class, and, finally, in the resultant web of relationships with the social totality and with nature" [23; pp.210-211]. In the same year, Marcuse published his essay *Philosophy and Critical Theory* supporting and taking further much of Horkheimer's arguments. The practical realisation of freedom, happiness and rights of all individuals are goals of critical theory, and these issues permeate all of its analysis.

For the theory, these are only potentialities of the concrete social situation that become relevant as political and economic issues [24; pp.105-107]. Critical theory distinguishes itself from philosophy because philosophy delegated freedom to the spiritual realm without encroaching on the material basis of society. Thus, freedom in critical theory means: "a real potentiality, a social relationship on whose realisation human destiny depends (...) The obstinacy that comes from adhering to truth against all appearances has given way in contemporary philosophy to whimsy and uninhibited opportunism. Critical theory preserves obstinacy as a genuine quality of philosophical thought" [24; pp.105-106]. Marcuse's understanding of critical theory shows that its focus is not so much on the class but on the individual[4]. The programmatic task of critical theory does not end with the liberation and happiness of a particular oppressed social class but with the liberation and happiness of all the wretched of the earth.

The subject of critical theory is a definite historical individual in the totality and concrete existence. Hence, Mignolo's remark that the subject of critical theory is some de-contextualised and de-historicized individual is completely out of context: "The problem with Horkheimer's argument is that his subject is a modern subject, de-racialized, de-sexualized, gender-neutral, and unaware that such a subject dwells in Europe, better yet, Germany, and not in the City of Singapore, Tehran, or La Paz, where the issues, problems, and knowledge-making have different needs, genealogies of thoughts, affects, and problems. It is from the body, not the mind, that questions arise, and answers are explored" [26; p.xxiv]. Quite the contrary, Marcuse's subject is rebellious, bodily, erotic, gendered, social, and aestheticist, has overcome mind-body dualism. It faces the challenge of reconstruction and emancipation from oppressive forms [27-28].

Unlike critical theory, post-colonialism never had a geographical, or intellectual centre[5]. It has developed not as a philosophical school of thought but as the convergence of different intellectual currents. The very notion of post-colonialism is ambiguous and insufficiently strictly defined. There are at least two meanings of post-colonialism: 1) as the forcible takeover of land and goods, something that has been a recurrent and widespread feature not only of European but of human history and 2), this is like critical theory, as an academic form of activist engagement. In the former, post-colonialism denotes the part of the globe which used to be colonised directly by political means and then underwent a bloody process of decolonisation[6] only to be "re-colonised" afterwards by other, mostly economic, means[7] [31; p.25, 23; pp.8-23]. In the latter, post-colonialism refers to critical studies that aim to make sense of the enduring legacy of Western imperialism and colonialism. These studies comprise heterogeneous and different writings that critically explore how Western domination has shaped socio-political and economic structures on the global level from 1492 to the present day [2; p.500, 33; p.3]. Hence, post-colonialism seems to be a one-size-fits all approach. It can apply to colonial countries and regions and to those countries that do not have a colonial history (i.e., Switzerland) but have Western modes of historical development and thus show colonial modes of thought. This makes post-colonialism an empty shell, or as Kerner argues: "…the scope of postcolonial studies comprises the entire globe"[8] [33; p.3]. Given the ambiguity, the term should not be applied generously but stringently. As a rule of thumb, Loomba proposes using the feminist concept of "patriarchy", which describes the relationship of inequality that in practice varies because it always works alongside other social structures. This is a good suggestion on how to use the term [32; p.21]. Marcuse used it similarly, equating various forms of oppression with the masculine values of a patriarchal society [35].

Post-colonialism is an umbrella term for a body of literature that, using Western theoretical concepts, analyses a true state of affairs. It favours concepts of hybridity, non-exclusivity, multiplicity, transgressions, openness to others, the dissemination of difference, etc. It is hostile to any essentialism, which means, rejecting the idea of a universal humanity, or human nature[9], as a liberal humanist stratagem for suppressing cultural difference [31; p.25]. This position is

justified to the extent because humanism as a historical movement has collapsed [36; p.109] and postcolonial theorists are right in rejecting "hypocritical humanism" of Europe and in justifying the necessity of using violence[10] in the process of decolonisation [10, 37, 38]. Humanism will remain an ideology if society depends on poverty, mass media prevented birth control, the creation and recreation of the precariat, pollution, planned obsolesce and waste and military rearmament [17]. Thus, Marcuse advocates and this puts favoured concepts of post-colonialism close to his version of critical theory, "Marxist humanism", a humanism of all-inclusive equality where everyone can choose their way of life, their own needs and the way of satisfying them, and so exist as free human beings. In this new humanism, equality is understood in non-exclusive terms as equality of *Otherness*: "To the degree that society becomes humane, it makes the equality of all people (as expressed in humanism) into a reality. This means equality of every human face and person, not just among those of a particular nation, race, or tribe, but above and beyond, and in opposition to, the division of humanity into different nations, races, or tribes. Equality, because every human being has all the qualities and capacities that define humans as human (…) Equality in its humanist sense (…) did not involve people being all the same, but rather the direct opposite" [36; p.108]. For this to happen, the new humanism must become political and face the unpleasant and dangerous challenge of first recognising the bad and then denouncing it. This is a hard task because humanism today implies an incompressible and unparallel critique of the contemporary global world [36; pp.110-111].

Regardless of similarities (at least in Marcuse's case), the relationship between critical theory and post-colonialism is, to phrase it in the jargon of critical and postcolonial theory, marked by *tension*. Initially, they seem to have much in common. Both reject claims to produce ahistorical knowledge as that would be "incompatible with a theory which attributes a temporal core to truth instead of contrasting truth as something invariable to the movement of history" [7; p.xi]. Both are progressive and emancipatory projects. Both are self-reflexive in subjecting to the scrutiny of their own standpoints [2; p.500]. To achieve an inclusive view, both approaches transcend the boundaries of academic disciplines and integrate methods that challenge and stretch the limitations of those disciplines[11]. Postcolonial theories are transdisciplinary as they cover a wide field of the humanities and social sciences ranging from epistemic and cultural to political and socioeconomic issues [2; p.500, 33; p.8]. Post-colonialism shares this encompassing orientation with critical theory. Hence, critical theory, like postcolonial theory, draws arguments and empirical data from various disciplines such as philosophy, economy, sociology, psychology, literature and arts. This interdisciplinary approach to humanities and social sciences is a core feature of Marcuse's version of critical theory, whose numerous ideas and concepts are tacitly present in contemporary liberation movements [28; p.660]. From the initial trio, it was Marcuse who had remained committed to the radical version of critical theory even to the point when the Marxist project failed to deliver. Instead of abandoning Marxism, he turns to its' revisions and restorations [41, 42]. Marcuse's ceaseless interventions into Marx's theory helped him acquire a more accurate insight into the ways capitalism (re)adapts, expands, conquers new territories, and becomes global. In effect, Marcuse's open and unorthodox version of Marxism applies to the colonial condition where Marxist analysis, as Fanon remarks, must be stretched because in the colonies the economic substructure is also a superstructure, the cause is the consequence; one is rich because one is white and vice versa [10; p.40]. In the same effort, postcolonial theory underwent a materialist turn and thus gained more followers among social scientists. The interdisciplinarity of critical theory and post-colonialism is an attempt of avoiding any form of (methodological) dogmatism[12]. Allen argues that critical theory should take postcolonial studies into account and adjust its programmatic basis to incorporate "struggles around decolonisation and postcolonial politics that are among the most significant struggles of our own age" [42; p.185]. But it is vice versa. Postcolonial theory can function as global critical theories [33].

THE "GREAT REFUSAL" OF THE WRETCHED OF THE EARTH

Enrique Dussel, a prominent figure of Latin America's philosophical movement known as the "philosophy of liberation", acknowledges that from the very beginning, the movement maintained the constant dialogue with Critical Theory and especially Marcuse's *One-Dimensional Man*, which had some influence on their movement. Next in importance to Marcuse, he places Fanon [43; p.16]. Both authors offered different but complementary perspectives and were read alongside filling each other's gaps: "…*One-Dimensional Man* – came to influence us within a context that was like the totalitarian horror under which the first Frankfurt School was born (…) The "dirty war" which led to the murder, torture, and disappearance of thousands would last almost two decades (as in Brazil, for example). But along with Marcuse, we read (…) Fanon's *The Wretched of the Earth* since our reflections were in the post-colonial periphery, in the global South" [43; p.16].

From the very beginning liberation for Marcuse meant the *praxis* of "radical act", later known as the "Great Refusal". The "Great Refusal" is a protest against the unnecessary surplus of repression and the struggle for the ultimate form of freedom. Thus, the "Great Refusal" is not tied to a particular time or place (i.e., Europe or the USA) or specific nationalities; instead, it is the universal struggle of humanity for liberation that may assume different forms[13]. Marcuse is even more specific and goes beyond the class category: "[T]he need for liberation exists: it exists as universal need far beyond that of one particular class…" [45; p.187]. Although they have the same underlying existentialist impulse, Marcuse knows fully that the models of a *praxis* of liberation differ at the socioeconomically and technologically developed *centre* and the underdeveloped *periphery* and cannot be exported to other communities. That is why the "Great Refusal" takes a variety of forms: "In Vietnam, in Cuba, in China, a revolution is being defended and driven forward which struggles to eschew the bureaucratic administration of socialism. The guerrilla forces in Latin America seem to be animated by that same subversive impulse: liberation" [15; pp.vii-viii]. Marcuse reminds us that theorising from the perspective of the Western, bourgeoise class do not give us the right to speak on behalf of the wretched of the earth. Since the "Great Refusals" are decentred by multiple non-European struggles, they cannot be identified with bourgeoise individualism or are only tied to Western capitalist societies [46; pp.315-316].

The historical task of liberation falls onto the peripheral subject. Marcuse's preoccupation with the peripheral subject as a revolutionary one is clear in his 1922 thesis *The German Artist Novel* where this subject is revealed as an artist and poet who by his way of life practice the "Great Refusal". From 1922 until the end of his life, Marcuse continued to nurture his sympathies for those non-integrated strata of society. This becomes fully apparent in his later works in which Marcuse localises the revolutionary subject precisely in those marginalised and alienated groups or individuals, the ones who failed to integrate into society successfully and completely [47; pp.292-294]. In *One-Dimensional Man* Marcuse depicts this subject: "… underneath the conservative popular base is the substratum of the outcasts and outsiders, the exploited and persecuted of other races and other colours, the unemployed and the unemployable. They exist outside the democratic process; their life is the most immediate and the most real need for ending intolerable conditions and institutions. Thus, their opposition is revolutionary even if their consciousness is not" [48; p.260]. These are the groups that represent the negation of the system or in Fanon's words the fellah, the unemployed, and the starving native do not represent the truth, they are the truth and in fulfilling their historical task they embody history[14] [10; pp.40-49]. Hence, liberation, if it is to happen, must come from the periphery whether the periphery is understood in social, gender, or racial terms or more in a geographical meaning[15]. In *An Essay on Liberation* Marcuse is unequivocal in his assessment that the "Great Refusal" starts from the margins and the struggle for liberation is waged by the wretched of the earth [15; p.7]. Fanon

reiterates what Marcuse has already grasped: “A white man in a colony has never felt inferior in any respect (…) The colonial, even though he is ‘in the minority’, does not feel that this makes him inferior (…) For the Negro who works on a sugar plantation in Le Robert, there is only one solution: to fight. He will embark on this struggle, and he will pursue it, not as the result of a Marxist or idealistic analysis but quite simply because he cannot conceive of life otherwise than in the form of a battle against exploitation, misery, and hunger” [49; pp.92-224].

Fanon’s project of liberation is perfectly in line with Marcuse’s critical theory and his project of liberation that ends with the creation of a qualitatively different society: “The colonised man who writes for his people ought to use the past with the intention of opening the future, as an invitation to action and a basis for hope. But to ensure that hope and to give it form, he must take part in the action and throw himself body and soul into the national struggle. You may speak about everything under the sun; but when you decide to speak of that unique thing in man's life that is represented by the fact of opening new horizons, by bringing light to your own country, and by raising yourself and your people to their feet, then you must collaborate on the physical plane” [10; p.232]. The “Great Refusals” are what unite revolutionary subjects both from the centre and margins of the world in their struggle for liberation. Effective revolutionary force is possible only if the opposition forces from Third World countries unite with the forces of developed countries [14; p.66]. This unity is an essential prerequisite because indigenous progress presupposes a change in the policy – abandonment of neo-colonialism [48; p.51]. Fanon disdainfully speaks about intellectual alienation of the western writers, a term that he uses to describe rigidity, fixation on the predetermined forms, non-openness to evolution, progress, discovery and different ideas and experiences that characterises Western philosophical thought [49; pp.223-225]. However, this is not the case of Marcuse’s critical theory, which is characterised by openness to various experiences. This may be a key to understanding the “Great Refusal” from the Fanonian perspective: existential rebellions within the colonial empires to the material struggles of the colonised [46; p.318].

The process of decolonisation process ends with the creation of a qualitatively different society and people: “Decolonisation never takes place unnoticed, for it influences individuals and modifies them fundamentally. It transforms spectators crushed with their inessentiality into privileged actors... It brings a natural rhythm into existence, introduced by new men, and with it a new language and a new humanity. Decolonisation is the veritable creation of new men” [10; p.36]. Fanon’s vision is almost like Marcuse’s vision of a society of aesthetic ethos freed from exploitation and toil and in which a completely different human sensibility prevails. Such a society is only a step further in the historical movement and can be achieved by reorganising the technological basis of the existing society: “For freedom indeed depends largely on technical progress, on the advancement of science. But this easily obscures the essential precondition: to become vehicles of freedom, science and technology would have to change their present direction and goals; they would have to be reconstructed in accord with a new sensibility – the demands of life instincts. Then one could speak of a technology of liberation, product of a scientific imagination free to project and design the forms of a human universe without exploitation and toil” [15; p.19]. Just as in Fanon's vision of a decolonised society of new people with different humanity who speak a new language, so Marcuse's aesthetic society presupposes new anthropology of man expressed in terms of “new sensibility” and “new rationality”[16] that oppose any aggression towards humans, nature and other living beings. The “new sensibility” includes new verbal and body language to communicate new values. It also marks a radical rupture with the vocabulary of domination. The cultivation of a new sensibility would transform the relationship between human beings and nature and the relationships among human beings. The new sensibility is the medium of social change that mediates between the political practice of changing the world and one’s own drive for personal liberation [15; p.33, 50; p.152].

Fanon's "real leap that introduces invention into existence" [49; p.229] corresponds to Marcuse's "Great Refusal" and when Marcuse invokes the wretched of the earth, this brings him closer to Fanon and his existential leap. Marcuse's critical theory engages both Western and non-Western liberation struggles and envisions a society free from any form of cultural, racial, gender, economic, etc. oppression – a multiculturalist society in the full meaning of the term. Marcuse's "great refusals" and Fanon's "leaps" can link transgressive singularities with personal and global agencies of liberation. Contemporary critical theory of liberation gathers refusing voices from multiple peripheries. And this thought can deliver on the promise of Marcuse's critical theory: new aesthetic society must be morally and socio-politically anticolonial and ethically postcolonial [46; p.320]. Global justice movements from 2005 remind us of the continued importance of Marcuse's activist version of critical theory. His critical theory is useful for explaining global domination and resistance. It can also provide a platform from which is possible to critique existing system of domination, (re)evaluate movements of resistance and project radical alternatives to the current society [34].

CRITICAL THEORY AND POST-COLONIALISM: SKETCHES OF FUTURE SOCIALISM

In the writings of Fanon and Marcuse there are outlines of new socialist societies. Since Fanon was principally preoccupied with universal human liberation, then it is no surprise that after his treatment of racism, colonialism, and exploitation, he maintained that liberation could only be accomplished through socialism and democracy [51; p.90]. Turning to socialism in search of solutions was an unusual move, as many other postcolonial thinkers rejected to invoke socialist alternatives. This is part of a more general reluctance amongst postcolonial authors to make political claims from an armchair[17] [52; p.8]. For Fanon socialism is the antithesis of the colonial order and it emerges during the struggle for liberation[18]: "Individualism is the first to disappear (…) The colonialist bourgeoisie had hammered into the native's mind the idea of a society of individuals where each person shuts himself up in his own subjectivity, and whose only wealth is individual thought. Now the native who has the opportunity to return to the people during the struggle for freedom will discover the falseness of this theory. The very forms of organisation of the struggle will suggest to him a different vocabulary. Brother, sister, friend (…) a colonised intellectual (…) will in the same way discover the substance of village assemblies, the cohesion of people's committees, and the extraordinary fruitfulness of local meetings and groupments" [10; p.47]. In his socialist vision, Fanon advocates a complete spatial and otherwise decentralisation of political authority. He rejects the bourgeoise idea that the masses are incapable of governing themselves. Instead of being a controlling device, the party should function as a medium between people and the government: "The party should be the direct expression of the masses" [10; p.187]. Political power if it is to be effective in tackling local issues should be decentralised, i.e., party members should not all live in the capital city "… from the capital city they will 'parachute' organisers into the villages who are unknown or too young, and who, armed with instructions from the central authority, mean to treat the douar or village like a factory cell" [10; p.113]. Fanon advocates a strict separation of governmental and party functions as a remedy for corruption: "The party is not an administration responsible for transmitting government orders; it is the energetic spokesman and the incorruptible defender of the masses" [10; p.187-188]. Public services should live up to their name and deal not with numbers but with people by servicing their needs: "The native civil servants and technicians ought not to bury themselves in diagrams and statistics, but rather in the hearts of the people" [10; p.187]. There is something liberal and democratic in Fanon's insistence on the separation of powers, even though he was deeply disgusted by Western hypocrisy, i.e., the gap between theory (proclaimed principles) and *praxis*. There is no mistake that Fanon was influenced by Western

ideas and disappointed with their realisation. In the same tone as Marcuse, Fanon lamentingly refers to European humanism: "All the elements of a solution to the great problems of humanity has, at different times, existed in European thought. But the action of European men has not carried out the mission which fell to them, and which comprised bringing their whole weight violently to bear upon these elements, of modifying their arrangement and their nature, of changing them and finally of bringing the problem of mankind to an infinitely higher plane" [10; p.314]. In Fanon's socialist vision, people are those who rule and govern themselves, who can deal with simple and complicated problems, and who can make tough decisions. It is precisely in this part of Fanon's socialist vision that proximity to Marx[19] and Marcuse once again reveals itself: "Everything can be explained to the people, on the single condition that you really want them to understand. And if you think you do not need them, and that on the contrary, they may hinder the smooth running of the many limited liability companies whose aim it is to make the people even poorer, then the problem is quite clear" [10; p.189]. In Luxemburgian[20] fashion, Fanon dismisses the argument that only the selected few know the way to (post)socialism: "… experience proves that the important thing is not that three hundred people form a plan and decide upon carrying it out, but that the whole people plan and decide even if it takes them twice or three times as long" [10; p.193].

Future socialism is a recurrent theme in Marcuse's works. There is no evidence to support that Fanon shared the same opinion as Marcuse although Geismar and Hansen argue, that during his stay in the USSR to treat leukaemia Fanon recognised the larger similarities between Russian state capitalism and American one [55; p.178, 22; p.179]. Geismar and Hansen may be on the right track, but a more accurate and documented argument is that Fanon rejected the positions of the French and Algerian Communist Parties and proved suspicious of Soviet international politics [56; p.215]. However, there is some evidence that Fanon was difference-blind regarding which side the help for the anti-colonial cause came from: "The colonial peoples are not communistic, but they are irreducibly anti-colonialist. They will not choose the United States because they are afraid of communism, but because their attitude in the great problems that shake the world-in this case the problems of decolonisation-will conform to a spirit of solidarity, of equity, and of authentic justice" [49; p.94]. Back to Marcuse. Unity between progress and destruction, productivity and oppression is deeply rooted in the structures of both societies and can be broken only in a not-yet-existent form of socialism. In the existing socialism, temporary subjugation is justified by the lag in competition with capitalism. But once this form of domination is established, it is prolonged indefinitely into the future. The qualitative difference of a socialist society is lost as it adapts faster and faster to the consumption model of capitalist countries [57; pp.396-398]. For Marcuse, the realisation of a new socialist society becomes even more tangible after he perceived that modern technology can be used for liberation. Thus, not only that the qualitative change in the usage of technology can liberate individuals in capitalist societies, but it can also go beyond Marx's vision of socialism rendering this version of socialism historically obsolete.

Marcuse's critical theory was marked by a lifelong search for a revolutionary subject capable of making a leap to socialism[21]. One of the social movements he turns to is the feminist movement which Marcuse believed to be the most important and potentially the most radical political movement [35; p.165]. The feminist movement represented everything that is wrong with rotten capitalism. It was a revolt against decaying capitalism and its historically obsolete mode of production [35; p.171]. Hence, the feminist movement was important for the liberation of all oppressed individuals because "beneath and beyond the male–female dichotomy is the human being, common to male and female: the human being whose liberation, whose realisation is still at stake" [35; p.166]. On the larger scale feminine qualities of receptivity, sensitivity, non-violence, and tenderness, that came to the fore, represented negation and

antithesis not only of the dominant masculine qualities of capitalism and its male-dominated culture but of the existing socialism as well [35; pp.167-168]. Marcuse argued that Marx's socialism needed modifications because it had remnants of the old "performance principle"[22]. Marcuse was highly critical of the Soviet version of socialism for its serious deviations from Marx's theory and shared commonalities with capitalist societies[23] [62]. That is why in the feminist movement Marcuse saw features that transcend both capitalism and socialism labelling it as "feminist socialism" [35]. Being equal in the spheres of economics and politics, women can take a leading role in the radical change of society. The liberation of women would subvert established values, norms, and needs and would create a new performance principle and aid in cultivating a new sensibility. That is certain feminine qualities would replace masculine ones and become constitutive traits of the new socialist society[24]: "feminine characteristics would activate aggressive energy against domination and exploitation. They would operate as needs and eventual goals in the socialist organisation of production, in the social division of labour, and in the setting of priorities once scarcity has been conquered. And thus, entering the reconstruction of society as a whole, the feminine characteristics would cease to be specifically feminine, to the degree to which they would be universalised in socialist culture, material and intellectual. Primary aggressiveness would persist, as it would in any form of society, but it may well lose the specifically masculine quality of domination and exploitation" [35; p.170]. Marcuse also sketches the anthropology of socialist humans whose different structure of needs and values manifest in an instinctual revulsion against aggression and destruction, allergy against the functioning of the body as an instrument of alienated labour, the need for privacy and quietness and the need for autonomous self-development [12; p.247].

CONCLUDING REMARKS

Marcuse's version of critical theory and post-colonialism have many similarities. A survey of the literature revealed that studies discussing the relationship between critical theory and post-colonialism consider only the works of Horkheimer and Adorno while completely neglecting Marcuse's works. That makes the debate over the alleged differences seriously flawed. Hence, I tried to demonstrate that Marcuse's critical theory and postcolonial theory are of the same breed. Postcolonial theory can be employed as a global critical theory. Even Mignolo, although hesitantly, acknowledged that "de-colonial thinking is a particular critical theory" - and here are his hesitation - "assuming (…) that critical theory (…) as articulated by Max Horkheimer, is also a particular kind of critical theory and not the norm or the master paradigm against which all other projects should be compared, measured, evaluated and judged" [64; p.155]. Had Mignolo read Marcuse's works, he would know the particular critical theory that has something to offer to postcolonial studies is not that of Horkheimer and Adorno but of Marcuse. Marcuse's critical theory and Fanon's post-colonialism offer a glance into novel socialist perspectives. Undoubtedly, their works do not hold ready-made solutions but can help shape contemporary debates in critical theory and post-colonialism.

REMARKS

[1]This is partly true for Adorno and Horkheimer (cf. [5]), but completely untrue for Marcuse. Adorno and Horkheimer addressed anti-Semitism in several writings (*The Jews of Europe (1939), Research Project on anti-Semitism: Idea of the Project (1941), Dialectic of Enlightenment (1947) and The Authoritarian Personality (1950)*) regarding it as an extreme form of racism. For them, race is an ideological construction and not a pre-given fundamental difference between human beings: "race is not, as the racial nationalists claim, an immediate, natural peculiarity (…) [I]t is a regression to nature as mere violence, to the hidebound particularism which, in the existing order, constitutes precisely the universal. Race today is the

self-assertion of the bourgeois individual, integrated into the barbaric collective" [7; p.138]. Anti-Semitism, racism and other -isms are not epiphenomenon of capitalism but the modus operandi of a system whose spinning wheel oppresses one minority today and another tomorrow: "Rage is vented on those who are both conspicuous and unprotected. And just as, depending on the constellation, the victims are interchangeable: vagrants, Jews, Protestants, Catholics, so each of them can replace the murderer, in the same blind lust for killing, as soon as he feels the power of representing the norm" [7; p.40]. To this Adorno added: "Tomorrow a group other than the Jews may come along, say the elderly (…) or the intellectuals, or simply deviant groups" [8; p.203]. No group is ever safe from pogrom: "Indignation over cruelty diminishes in proportion as the victims are less like normal readers, the more they swarthy, 'dirty', dago-like (…) the social schematization of perception in anti-Semites is such that they do not see Jews as human beings at all. The constantly encountered assertion that savages, blacks, Japanese are like animals (…) is the key to the pogrom" [9; p.105] The settlers described the natives in the same zoological terms [10; p.42]. Respecting and celebrating diversities that make humanity, Adorno remarked: "To assure the black that he is exactly like the white man, while he obviously is not, is secretly to wrong him still further" [9; p.103]. True humanity comes with recognizing others as human beings. This makes up Adorno's vision of a "truly human state": "… a step away from the anti-Semitic society, which drives both Jews and others into sickness, and toward the human one. Such a step would fulfil the fascist lie by contradicting it: the Jewish question would indeed prove the turning-point of history" [7; p.165].

Marcuse was more open and vociferous on the oppositional practice and anti-imperialist resistance both within the empire's internal and distant "outer borders". Since the mid-1960s, Marcuse vigorously opposed and condemned the U.S. intervention in Vietnam as imperialist. For Marcuse the same aggressive forces lead from death on the highways and streets of the USA to bombings, torture, and burnings in Vietnam. Victory for the Vietcong could trigger a domino effect: liberation movements would be activated in other colonies or even at home. The triumph would mean the global mobilization of the exploited coloured races. That is why the stability in those areas is vital to the West [11; p.2]. From this perspective, Vietnam policy is not an isolated event but a continuation of colonial policies that extends from West Germany to Indonesia, and from Turkey to Japan [12; p.243, 13; p.39, 14; p.60]. Thus, imperialism and colonialism for Marcuse were a global phenomenon. He refuses to accept bombings and killings in Vietnam as "legitimate violence" while revolts and uprisings in the West are viewed as "illegitimate violence". This wording discriminates against opposition and protects the establishment [15; pp.76-77].

[2]Reflecting on the wider significance of student revolts for all of humanity Marcuse says: "In proclaiming the 'permanent challenge,' (…) the 'permanent education,' the Great Refusal, they recognized the mark of social repression (…) even in the most spectacular manifestations of technical progress. They have again raised a spectre (…) of a revolution which subordinates the development of productive forces and higher standards of living to the requirements of creating solidarity for the human species, abolishing poverty and misery beyond all national frontiers and spheres of interest, for the attainment of peace" [15; pp.ix–x].

[3]Term "traditional theory" is used generically for those theories that are suitable or serve the existing dominant paradigm.

[4]However, this is not Marcuse's first statement in which we discern his preoccupation with the liberation and happiness of the individual. In an essay *On Concrete Philosophy (OCP) (1929)* one can detect the beginning of this lifelong preoccupation: "Concrete philosophy can (…) approach existence if it seeks out Dasein in the sphere in which its existence is based: as it acts in its world in accordance with its historical situation (...) Concrete philosophy will exist in the public realm, because only by so doing can it truly approach existence (...) In such cases

the individual is no longer the point of departure, but rather the goal of philosophy, because individuality itself must first be made possible again" [25; pp.47-51].

[5]Geographical difference is overly emphasized in the postcolonial critique of critical theory based on its European and Western centricity.

[6]The process of decolonization can be roughly divided into three periods: 1) during the first twenty years after the Second World War a large number of sovereign states emerged in Asia and Africa. The Chinese Revolution of 1949 had an enormous influence on anti-colonial struggles throughout this period and up to the mid-1970s. The issue of socialism was the one with which both imperialism and the national bourgeoisie had to deal with as a great many sovereign states of Asia and Africa liberated themselves from the colonial yoke; 2) revolutionary wars of the national liberation marked the period from 1965-1975. These wars had a distinctly socialist trajectory, but socialism was never a viable alternative because the productive forces were at a low level of development. However, these wars left colonial questions in South Africa and Israel unresolved. In South Africa (SA) the indigenous population had not been evicted, the proletariat class was consolidated and the alliance between the African National Congress (ANC) and the Communist Party survived enabling ANC to expand its political influence among the majority of the population. In contrast to SA, the imperialist stakes were greater in Israel where Zionism has succeeded in becoming a powerful ideology of the advanced capitalist countries. Anti-colonial nationalism in the form of nationalist ideologies and in the form of revolutionary wars remained a key constitutive element up until the late 1970s. Revolutions in Iran, Ethiopia and Afghanistan – countries that had not been directly colonized helped in toppling *ancién regime*. The Iranian Revolution offered a glimpse of hope but it was soon shattered after it had become clear that under Khomeini Iran is moving toward more clerical state, and 3) the 1980s marked a new phase in which imperialist structures won over socialism. The post-revolutionary states which grew out of the mix of socialist ideas and anti-colonial nationalism had been contained. Anti-communist ideology grew stronger and succeeded in proving that socialism does not work [29; pp.30-34].

Marcuse was aware that socialist and communist countries were interconnected with capitalist countries. Hence, national liberation movements in Third World countries were not in themselves a strong enough revolutionary force to overthrow capitalism. Such a revolutionary force can be expected only if the forces from the centre of advanced capitalism unite with those in the Third World [14; p.66]. A radical change in the imperialistic metropoles would have a huge impact around the globe. It would trigger the collapse of the lackey regimes in the Third World [30; p.143]. However, unification is the most challenging task that puts forward problems not only of bridging spatial distance but of cultural differences and language barriers.

[7]Imperialism is the driving force of capitalism. And this marks the next stage of imperialism in its most vigorous form of neo-colonialism through which the imperialist powers will once again divide up the world but this time without military conflict [14; p.175].

[8]This is another shared feature of postcolonial studies with Marcuse's critical theory that "is especially useful for developing global perspectives on domination and resistance, radically criticizing the existing system of domination, valorising movements of resistance, and projecting radical alternatives to the current organization of society and mode of life" [34; p.3].

[9]One must ask himself then: is it wrong to oppress immigrants because they are human beings (this means accepting the universality of human nature) or is it wrong to oppress them because they are Turks, Pakistani, Syrians, Afghans, etc. (this argument avoids accepting common human nature but is absurd).

[10]Both Marcuse and Fanon are *pro-revolutionary* violence. They justify the use of violence for liberating purposes. Marcuse argues: "... I believe that there is a 'natural right' of resistance for oppressed and overpowered minorities to use extra-legal means if the legal ones have proved to be inadequate. Law and order are always and everywhere the law and order which protect the established hierarchy (...) If they use violence, they do not start a new chain of violence but try to break an established one" [17; pp.116-117]. Fanon feels the same way that counter-violence is morally and politically justifiable: "This assumed responsibility for violence allows both strayed and outlawed members of the group to come back again and to find their place once more, to become integrated. Violence is thus seen as comparable to a royal pardon. The colonized man finds his freedom in and through violence (…) The violence of the colonial regime and the counter-violence of the native balance each other and respond to each other in an extraordinary reciprocal homogeneity" [10; pp.85-88].

[11]In a study *Secularizing Islamists*, influenced by postcolonial theory, Iqtidar uses anthropological methods in political science arguing that political processes and categories would be enriched by a deeper engagement with human beings [39; pp.24-25].
Sousa Santos introduces "diatopical hermeneutics", a methodological approach based on the idea that all cultures are incomplete. Using this approach raises awareness of cultural diversity and the need for intercultural dialogue and exchange [40].

[12]Critical theory does not have a single ideological-methodological basis: "Critical theory does not have one doctrinal substance today, another tomorrow. The changes in it do not mean a shift to a wholly new outlook, as long as the age itself does not radically change" [7; p.234]. The transdisciplinary focus of postcolonial theory has helped shape the debates in social sciences on discursive aspects of global power relations [33; p.9].

[13]We can observe the traces of the "Great Refusal" even today in the alternative community economies, radical education initiatives and recuperated spaces of production [44].

[14]For Marcuse colonial subjects are an "'absolute negation' of the blessings of the affluent society" [12; p.238].

[15]Marcuse uses the term underprivileged to account for those groups that suffer some form of oppression but do not fall strictly into the Marxian category of class. In the USA underprivileged are those national and racial minorities which do not occupy a decisive place in the productive process and thus cannot be considered potentially revolutionary forces from the viewpoint of Marxian theory. In the colonies underprivileged are those who bear the entire weight of the system and make the mass basis of the national liberation struggle against neo-colonialism in the Third World and against colonialism in the USA [14; p.58].

[16]A "new sensibility" is another attempt for going beyond orthodox Marxism insofar as it requires much more than a change in power relations. It requires the cultivation of new subjectivity. Human subjectivity in its present form is the product of systems of domination. This is why Marcuse was interested in the feminist movement as he saw in it the potential for radical social change.

[17]Or as in Adorno's case theorize from the "ivory tower".

[18]The only class capable of a socialist revolution were the semi-rural *lumpenproletariat* who were the most exploited of the colonized peoples and who still had a sense of "nation" [22; p.96].

[19]Fanon almost retells Marx's vision of socialism: "… while in communist society (…) each can become accomplished in any branch (…), society regulates the general production and thus makes it possible for me to (…) to hunt in the morning, fish in the afternoon, rear cattle in the evening, criticise after dinner…" [53; p.53].

[20]Rosa Luxemburg rebuked Lenin's argument about the fallacy of the central committee: "… errors made by a truly revolutionary labour movement are historically infinitely more fruitful and more valuable than the infallibility of the best of all possible 'central committees' " [54; p.306].

[21]Marcuse was adamant that no particular class can be the subject of universal emancipation. The identity between the proletariat and the interest of all humanity has been superseded. Universal emancipation today moves beyond securing the material basis of existence, although this remains the starting point of emancipation [57; p.402]. On this account, Marcuse was criticized by Horkheimer and Adorno. This leads MacIntyre to call Marcuse a "pre-Marxist" thinker: "He sometimes speaks not of Marxist materialism but of 'the critical theory of society [and] is endlessly willing to talk of 'man' rather than of men, of what 'man' desires or does or suffers" [58; p.21]. However, the term "pre-Marxist" corroborates my argument that postcolonial theory has much in common with Marcuse's critical theory which focused not only on the class but also on other individuals and groups that suffered some form of oppression.

Fanon shared a similar fate of being accused by Hannah Arendt for being un-Marxist [59]. Fanon did not consider it necessary to pass through the stage of fully developed capitalism prior to socialism [51; p.92]. But this hardly makes him un-Marxist as he time and again reveals his appreciation of Marx: "How can one then be deaf to that voice rolling down the stages of history: 'What matters is not to know the world but to change it' " [60; p.17]. A more appropriate characterization is the one that says that Fanon was neither an orthodox nor a traditional Marxist [61; pp.61-70]. Fanon represented the "new Left" and became a communist by joining a revolution and not the party [55; p.19].

[22]"Reality principle" describes norms and values which govern behaviour in society and are embodied in its institutions and relationships. "Performance principle" is a "reality principle" based on the efficiency and fulfilment of competitive and acquisitive functions.

[23]In the postcolonial periphery and in Latin America the widespread poverty resulting from three decades of neoliberal colonial policies has been exacerbated in the aftermath of the collapse of existing socialism in 1989 [43; p.25].

[24]Burcar claims that the transition from socialism to capitalism brought the renewal of precisely the same oppressive and patriarchal practices that Marcuse has described and from which he saw the potential for liberation in the feminist movement: "… the so-called transition from socialism to capitalism is a euphemism for regression (...) The re-installment of capitalist social relations rests on the processes of re-patriarchalization, most clearly evident in the dismantling of the Socialist welfare system" [63; p.12].

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SPECIFICS OF RISK MANAGEMENT PROCESS IN SPORT ORGANIZATIONS

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ABSTRACT

Sport organizations, like economic sectors, are currently particularly affected by the COVID-19 pandemic. The ban on the organization of mass events of a sporting nature and subsequently also the operation of physical education and sports facilities significantly affected the activities of sport organizations or, to be precise, paralyzed their activities in almost all countries. One of the tools for improving the readiness to manage negative events affecting the existence of sport organizations is the creation of a job position of a risk manager and the implementation of the risk management process in the management of sport organizations. The aim of the article is to evaluate the current state of sport organizations during the COVID-19 pandemic in Slovakia and abroad, to highlight the importance of including the position of a risk manager in sport organizations and to present the various stages of the risk management implementation process in sport organizations.

KEY WORDS

sport organization, risk, risk manager, pandemic, risk treatment

CLASSIFICATION

JEL: Z2, Z23, Z28, Z29

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INTRODUCTION

Sport has now become a special social phenomenon fulfilling several tasks. Sport as a means of personality development plays an educational, training and social role. Sports activities performed in an appropriate way strengthen health, sport increases national awareness and patriotism, it is a cultivated means of spending free time and the commercial role of sport is not negligible. Sport is of particular importance in developing a healthy lifestyle among children and young people [1]. Based on the important role of sports in the life of society, it is necessary to pay attention to this area from the managerial side. In general, management can be understood as the process of leading a group of people, an organization, or even oneself, in order to achieve a predetermined goal. Management ensures order in an organization. With good management, managers eliminate the possibility of chaos, which can cause problems in achieving goals.

The management of sport can be defined as the application of managerial principles, methods, techniques and procedures in a sport environment [2]. The sport environment is created by various types of sport organizations and activities that need to be managed and organized, coordinated by the activities of other persons who would not achieve the same or better results, by their individual actions than by a joint action. Changes in the internal and external environment are sources of risks and opportunities for sport organizations. The unstable and uncertain environment of a sport organization is influenced by the complexity of economic relations, political and international influences, human behaviour, scientific and technical progress, the pandemic situation, etc. Recent events confirm that risks need to be given increased attention, as ignoring them, underestimating them or incorrectly assessing and managing them can lead to a threat to the operation or even to a dissolution of a sport organization. The need to create a position of a risk manager in a sport organization comes to the fore.

The aim of the article is to assess the current state of sport organizations during the Covid-19 pandemic in Slovakia and abroad and to propose the inclusion of the position of a risk manager in the management of sport organizations. The article also describes the basic steps of the risk management process for application in sport organizations.

CURRENT STATE OF SPORT ORGANIZATIONS DURING THE PANDEMIC IN SLOVAKIA

The term sport refers to a variety of activities, so it is not possible to uniquely define it. The current legal order of the Slovak Republic (hereinafter referred to as the SR) does not provide a legal definition of sport. Sport is a social activity that is regulated to some extent by law. Even in the field of sport, such social relations that are regulated by legal norms are established, changed or terminated. In most cases, sport is an organized activity that is governed by certain rules, which are not legal rules, are not enforceable by the state, but represent the defining aspect of a sports game or competition [3].

The central body of state administration for sports in the Slovak Republic is the Ministry of Education, Science, Research and Sports of the Slovak Republic (hereinafter referred to as the MEScRS of the SR). The relevant department is the State Care for Sport Section. The role of the Ministry is mainly legislative activity, financing and coordination of entities operating in sports. The Ministry also issues accreditations to educational institutions in the field of sport and ensures activities and fulfilment of obligations related to the membership of the Slovak Republic in the EU and international organizations in the field of sport.

Over the last decade, the Slovak Republic has experienced significant changes in the organization of the sport environment, the management of sport organizations and the system of financing sport. The adoption of the Act on Sport (No. 440/2015 Coll.) contributed to it. The Act [4]:

- clearly defines the roles of individual entities in the field of sports;
- determines rules to ensure a more transparent distribution of public funds to those active in the field of sport;
- establishes a system to control the efficient use of public funds.

Sport organizations are defined as legal entities whose object or purpose of activity is the sporting activity. It is mandatory for all sport organizations to be registered in the register of legal entities in sport and, insofar as they are recipients of public funds, they are obliged to create the conditions for the independent exercise of internal control [5].

Sport organizations operating in Slovakia can be divided into three main categories:

- the Slovak Olympic Committee, the Slovak Paralympic Committee and other sport organizations that are members of international sport organizations with worldwide scope belong to the group of national sport organizations,
- national sports associations recognised by the Ministry of Education,
- sports clubs.

According to the Act on Sport (No. 440/2015 Coll.), it is "the public interest in sport to support and develop youth sport, to ensure the preparation and participation of the Slovak Republic's sports representation in major competitions, to protect the integrity of sport and to promote a healthy way of life for the population" [4]. The Act No. 335/2017 amending the Act No. 440/2015 Coll. on Sport was adopted with effect from December, 30, 2017. Through this Act, the activities of athletes and sports professionals were defined, which was also reflected in the classification of income earned for tax purposes [6].

The Act No. 416/2001 Coll. on the transfer of certain competences from state administration bodies to municipalities and higher territorial units transferred public sports from the competence of the MEScRS of the SR to local government bodies [7].

The following legal entities are under the jurisdiction of the State Care for Sport Section [8]:

- The National Sport Centre of Slovakia (hereinafter referred to as the NSC) as an allowance organization with legal subjectivity under the jurisdiction of the MEScRS of the SR. The role of the NSC is to provide all-round care for selected sport representatives of the Slovak Republic and selected sports talented athletes, administration of the sport information system, provision of sports competitions for pupils and students outside school hours and provision of educational activities in sport. In the field of education, the priority is to raise the knowledge level of the target group, which is athletes, coaches, referees, sports officials, doctors and members of support teams.
- The Slovak Anti-Doping Agency, which focuses on the implementation of tasks in the field of combating doping in sport in the Slovak Republic.
- The Ministry of the Interior of the Slovak Republic and the Ministry of Defence of the Slovak Republic are the founders of the training centres for selected athletes, where they provide above-standard conditions for the preparation of the best athletes in individual sports. These are the Centre of State Sports Representation of the Ministry of Interior of the SR and the Military Sport Centre Banská Bystrica (The Ministry of Defence of the SR).

Non-governmental sport organizations in the SR consist of [8]:

- Sports federations – they are the representatives of sport sectors and natural monopoly organizations, as they are the only ones representing sport sectors towards the international

sports federation. Sports federations are the partners of the state administration in the field of sport representation of the SR and development of sport sectors.

- Non-governmental sport organizations with a special mission – these are the Slovak Olympic Committee, the Slovak Paralympic Committee and the Slovak University Sports Association. They are responsible for the representation of Slovakia at the Olympic Games, Paralympic Games and World Universiade and Academic World Championships. Like the sports federations, they are natural monopoly organizations as they are the only ones in Slovakia that are members of international organizations – the International Olympic Committee, the International Paralympic Committee and the International University Sport Federation. They are partners of the state administration in the field of representation of Slovakia at official international Olympic, Paralympic and university events.
- Other non-governmental sport organizations with a nationwide scope – these are professional and umbrella organizations with a nationwide scope. These organizations primarily serve their own members and are formed and dissolved according to their needs.

In 2019-2021, research was conducted in the SR focused on Slovak NGOs in the sport sector, which yielded the following results [9]:

- out of the total number of NGOs that were included in the research, 200 organizations identified sport as their primary area of activity. Of these, 45 % of organizations operate at the local level (district), 22 % at the regional level, 18 % at the national level, 4 % at the European level and 2 % at the global level,
- 43 % of the organizations operating in the sphere of sport are registered members of a Slovak association/platform/interest association,
- regarding the activities of individual organizations operating in the field of sport, the most frequent (67 %) organizations surveyed organise various (social, cultural, sporting) events, and these events are performed by unpaid staff. Among the least developed activities was publishing (1 %),
- among the most significant obstacles in achieving the goals of the organization, they ranked the lack of finances, material and technical support, time (in addition to the main occupational activity), staff and volunteers as well as administrative and legislative burdens,
- the leaders of the organization and the board of directors are mainly involved in deciding the direction of the organization and its objectives. Regarding the presence of management elements with paid staff, in the field of sport, organizations most frequently use the element "clearly defined rights and responsibilities of the organization's staff" (17,9 %). However, only 11,3 % have job descriptions and staff profiles defined for each position, and only 10,4 % of organizations implement health and safety protection for workers in the performance of their activities,
- all elements of management are used significantly less in the sport sector compared to other sectors.

Sport organizations in the SR, like in other countries, are currently particularly visibly affected by the SARS-CoV-2 pandemic. One of the first measures, at the beginning of the pandemic, to prevent the spread of the COVID-19 communicable disease was an explicit ban on sporting events in Slovakia. At the beginning of the first wave of the pandemic, in March 2020, the Central Crisis Staff of the Slovak Republic issued an immediate ban on all sporting events. On the initiative of the Slovak Olympic and Sports Committee (hereinafter referred to as SOSC), a crisis headquarters for sport was established, which represents a platform for the transmission of real and relevant information and opinions between the sport movement on the one hand and the Public Health Authority of the Slovak Republic (hereinafter referred to as PHA of the SR) or The MEScRS of the SR on the other hand [10]. Only in the first week after the announcement

of the ban on sporting events in Slovakia, 44 matches of the highest competitions of the most important collective sports were not held, while major events in individual sports were cancelled or postponed [11].

The broadly formulated ban on sporting events did not only affect sporting events, but also extended to training. Athletes of collective sports could not engage in sports training in the form of joint training (in numbers of more than three persons), but only in the form of individual training. Existing sports infrastructure could only be used for the purpose of individual training [11]. Clubs tried to retain their members mainly by online training or recommendations for outdoor exercise. An exception for training in sports facilities was, for example, granted to the holders of the decree of the candidate for the start at the Olympic and Paralympic Games in Tokyo, which was approved by the Public Health Authority of the SR back in January 2021. As of May 3, 2021, the Public Health Authority of the SR amended the decree on spectators in the stands: Vaccinated persons and those who had overcome the coronavirus did not have to undergo a control antigen test before the event. Despite allowing spectators, the decree was criticized mainly by football fans, as unlike hockey fans, football fans as well as others fans had to pay for the tests. Eventually, however, spectators appeared in the stands in small numbers not only for hockey or football, but also for handball and basketball [12].

In Slovakia there are over 100 recognised sports and over 200 different sport sectors, dozens of unrecognised sports and hundreds of different physical activities. It is extremely complicated to regulate such a huge and diverse group of activities with measures. In addition, for many sports, the individual sports or disciplines may be completely different in terms of risk, e.g. swimming, long-distance swimming, synchronised swimming, water polo, diving. Therefore, the philosophy was to categorise sports according to risk, and for each category to propose a set of measures that eliminate risk and allow the sport to be performed in a safe manner. Each of these 7 categories contains 10 parameters that define it in more detail. In practice, this means that low-risk sports such as tennis, table tennis, athletics, etc. will not have to take major measures to be able to practice their sport at the earliest release stage. High-risk sports will have to take measures to change the organization, content and forms of their training activities, e.g. non-contact exercises, only practice of individual game activities, no sparring, etc. [13]. Apart from the possible effects of the ban on joint training on the performance of athletes in collective sports, equally significant, and sometimes even existential, are the economic effects associated with the ban and the subsequent cancellation of sporting events and training. These equally affect the athletes themselves, as well as sport organizations, coaches, sports professionals, other employees in sport and people working in the sector in general.

Athletes and sport organizations may face existential problems as a result of the ban on sporting events. In addition to the loss of profit – the loss of revenue associated with public sporting events (ticket sales, merchandising, and other related goods and services), there is also direct damage in relation to the costs already incurred in preparing for the cancelled events. There is also a negative impact from the loss of sponsorship, funding from transfers or membership income. In particular, the last shortfall in finances has affected clubs that are dedicated to children and youth, as training sessions and matches are not held as a result of the ban [11].

Recent events have highlighted the vulnerability of global sport as well as its sustainability for the future. The COVID-19 pandemic has been added to long-standing climate change and other social and economic challenges that have further amplified the urgency of the issue of sustainable development. Sport and physical activity should have an unquestionable place in the framework of sustainable development in Slovakia. This is further emphasised by the recent call by 118 UN member governments to all countries of the world to include sport and physical activity in their recovery plans after the COVID-19 pandemic [14].

THE CURRENT STATE OF SPORT ORGANIZATIONS DURING THE PANDEMIC ABROAD

The outbreak of the Covid-19 communicable disease in 2019 has created an international public health emergency. Covid-19 has had a major impact on elite sport. The impact of the coronavirus crisis varies depending on the area being analysed in the sporting world. In professional sport, talking of large stadiums, television rights, sponsorships, there has currently been a significant impact of the pandemic. Elite sports teams and organizations have seen an immediate financial impact due to the loss of spectators in stadiums. The Rugby Football Union (hereinafter referred to as RFU) has calculated that they would lose nearly 60 million dollars due to spectator non-attendance at events such as the Nations Cup or Six Nations [15].

Even though it is not very safe to open sports stadiums nowadays, some clubs are in such a bad shape economically that another league shutdown would lead to their definite collapse. Many foreign institutions have been working on strategies to bring as many spectators as possible into the stands again. Although solutions have been found to resume competitions and allow the slow return of fans to stadiums, both federations and clubs will need time to recover from the serious losses suffered during the 2019/2020 season [16].

The global value of the sports industry is estimated at 756 billion US dollars. Facing COVID-19 millions of jobs are therefore at risk globally, not only of sports professionals, but also jobs of those working in the related industries such as retail and sporting services associated with leagues and events, which include, but are not limited to, tourism, infrastructure, transport, catering and media broadcasting [17].

According to the New York Times (2020: The Year in Sports When Everybody Lost), the global economic impact of the Covid-19 pandemic in sport is huge. It described losses of 13 billion US dollars in American sports leagues, another 28.6 billion US dollars as losses of sport organizations, and nearly 1.5 million sports employees have lost their jobs. Other continents are similarly in a bad condition, where, for example, some of Europe's largest football clubs have estimated a loss of more than 1 billion euros [18].

Similar terrible results have been experienced by all sectors of sport when major events and competitions have been cancelled, postponed or shortened, including Wimbledon and the Olympic Games, which have polarized the people of Tokyo. The reason was the vaccination rate in Japan, which was relatively low at the time and raised concerns about the possible spread of Covid-19 [17].

Across Europe, sports football clubs have been hit the hardest. In major league countries such as Italy, the football sector has lost about 50 % of its total turnover. As the blocking measures taken during the first wave of the pandemic suspended most football competitions, the 2019/2020 season and the order had to be adjusted. The main scenarios adopted by the national federations were either to end the season and announce the winner based on current results (Belgium, France, Scotland), to postpone the season (Spain, Germany, England, Italy) or to stop it altogether without awarding the winner (The Netherlands). As the first wave ended, the general focus shifted to ensuring a smooth start to the 2020/2021 season. Similar approaches were applied in other team sports where competitions had to be interrupted, such as basketball, handball or ice hockey [15].

A sport organization is a living ecosystem consisting of governing bodies, owners / investors, athletes, sponsors, suppliers and fans. The current pillars of the Covid-19 pandemic impact on sport organizations abroad are as follows [19]:

- calendar of competitions – postponement and cancellation of matches, while there are problems related not only to financial loss for the organization but also problems with planning competition matches,
- operating models – the disruption has forced organizations to move to different business models that need to adapt to the current situation,
- business relations – loss of important sponsors and partners due to the financial consequences of a sudden shutdown,
- non-participation of fans – the loss of funds due to the non-participation of spectators in the stands has especially been important for large sport organizations,
- television rights – the most significant impact of the Covid-19 pandemic for sport organizations; the funds that come to clubs from broadcasting rights constitute a significant part of the financial budget in most clubs,
- investments – Many investors, due to exposure and liquidity problems due to league suspension, diversify their investment portfolios in other areas. Various investment acquisitions of organizations have also been suspended, such as construction of stadiums or training centres,
- sponsorship – by keeping matches behind closed doors, sponsors have reduced their investment in traditional forms of advertising. Media partnerships have also adapted to these turbulent times.

Covid-19 has had a significant negative impact on the entire sport industry in Australia. Among the most serious negatives were the loss of income of sports clubs from sponsorship, admission and broadcasting rights, which led to the massive dismissal of employees, not only athletes in sports clubs. Sport Australia has developed the Return to Sport Toolkit, which contains a set of resources to help sport organizations prepare for the resumption of training, competitions and programs in a safe, responsible and low-risk manner. This toolkit contains four elements of a safe return to sport [18]:

- plan – implementation of plans, processes and systems to meet government and health requirements and provide safe sport environments,
- prepare – ensuring safe facility and participant practices, such as hygiene procedures, attendance registers at training and limiting shared equipment as much as possible,
- respond – organizations must be prepared to deal with the outbreak of other Covid-19 waves and must recognize that circumstances in the field of sport can change quickly,
- recover – consideration of protocols to optimize the good health of the public and participants into the future.

While the hygiene protocols and guidelines governing training and competitions have made it possible to restore professional sport, national measures preventing or restricting gatherings of persons prevent the sports industry from fully recovering. The 2020/2021 season began for the most part on time and lasted during the pandemic. At the same time, traditional revenue streams such as ticketing and merchandising have fallen sharply [19].

According to the WHO, the main goal is to deal with the very specific and exceptional circumstances related to the COVID-19 pandemic. The European Commission has adopted a specialized instrument – Temporary Framework for State Aid Measures to Support the Economy in the Current Covid-19 Outbreak. The purpose of this legal instrument is to enable Member States to intervene in the economy in an unprecedented way in order to help companies facing liquidity shortages. Member States can assist companies in need, inter alia, through state guarantees, subsidized loans and recapitalization. Sport organizations may also benefit from national support in accordance with the provisions of the Temporary Framework [16].

This Temporary Framework refers to two different provisions of the Treaty on the Functioning of the European Union, namely Article 107(2)(b) and Article 107(3)(b). These provisions allow certain types of state aid in emergency situations and are based on two completely different approaches:

1. Article 107(2)(b) is compensatory in nature and requires a case-by-case assessment to establish a causal link with the actual damage to be compensated. It deals with damages related to COVID-19. It usually covers compensation for sport organizations that have had to cancel events as a direct result of measures imposed as a result of COVID-19. In order to assist Member States and facilitate the approval of pandemic compensation schemes, the European Commission has published a template setting out the information and general procedure. It follows that sports clubs could claim compensation for the loss they have suffered as a result of blocking or suspending, but not for the losses associated with a general drop in attendance due to social distancing measures [16].

   Several Member States have announced a concept to compensate for pandemic losses for sport organizations. The Czech Republic announced a compensation scheme aimed at sports facility operators, sports organizers and sport organizations who had to pay rent for the use of sports facilities, all of whom faced an almost complete loss of income. In France, sports clubs and organizers can receive compensation for losses resulting from the absence of ticket, food and beverage sales caused by hygiene restrictions. Norway has adopted a similar scheme to compensate for the cancellation or postponement of sporting and volunteering events by compensating for the loss of ticket revenue caused by the event, the lost participation fees and the additional costs caused by the cancellation or postponement of the event [20].
2. Article 107(2)(b) enables the implementation of broader support instruments to help organizations or the whole sector overcome difficulties, such as covering operating costs. It is the more widely used legal basis for state aid in relation to Covid-19 disease. Under this provision, the aid will be built as a support tool to overcome difficulties in covering operating costs or making the necessary investments. An example of such a measure is a state guarantee scheme which gives companies facing liquidity shortages access to credit including direct grants, state loan guarantees, subsidized interest rates, wage subsidies, tax deferrals and even support for uncovered fixed costs [16].

Since the beginning of the pandemic, most aid measures have been taken under Article 107(3)(b). In this category, we can distinguish two types of support schemes relevant to the field of sport [16]:

1. schemes relating specifically to sport organizations,
2. schemes applicable to all sectors of the economy (from which the sport sector may also benefit).

As sport is one of the hardest hit sectors, several schemes have focused on allowing clubs not to go bankrupt during the pandemic. Member States have taken measures to ensure that businesses operating in the sport sector will continue to operate and face liquidity shortages. In the Czech Republic, professional sports clubs could claim support from the state in the form of direct grants. Slovakia has taken similar measures for professional clubs across a wide range of sports, including football, basketball, handball and also one of the most popular sports in the country, ice hockey [20].

While some Member States have focused specifically on professional sport, support has also been provided to companies that are generally active in the sport sector. In July 2020, Italy, a country in which the sport sector generates 1.8 % of national GDP and employs more than one million people, announced aid in the form of loan guarantees and subsidized interest rates.

Similar examples can be found in other Member States, such as Croatia or the Czech Republic, which have provided support to the sport sector as a whole [20].

PROPOSAL FOR INCLUSION OF A RISK MANAGER IN SPORT ORGANIZATIONS

Sport organizations also pursue their mission and objectives in a particular environment from which they draw resources and to which they transfer the results of their activities. The environment is a condition for the existence of any organization, which currently receives the attribute as unstable, uncertain, turbulent and with constantly changing conditions. This uncertainty and dynamism of various environmental factors affects the long-term goals, objectives, strategies, decision-making processes that influence the management process of sport organizations [21].

In sport organizations, it is possible to assess the internal factors as well as external environmental factors that affect their success or overall existence [22, 23]:

1. External factors:

- factors from the macro environment may not have a direct impact on the operations and activities in a sport organization, but they do have an impact on the decision making of club managers. These are mainly factors from the economic, social, technological, legislative and political environments, etc., which influence sport organizations,
- in Slovakia, the influence of legislation on the functioning of a sport organization is very significant, especially from the perspective of financing (the aforementioned amended Act on Sport No. 335/2017 Coll.),
- factors from the sport industry environment have a direct impact on sport organizations or the achievement of their objectives, e.g. the influence of competitors, club members, suppliers, legal agencies, athletes' groups, etc.

2. Internal factors from the internal environment are considered to be important from the perspective of sport organizations. They include:

- club documents – e.g. policies, processes, regulations, sport club guidelines,
- resources – e.g. human, financial, physical, information, etc,
- culture and tradition – they include leadership style, communication, values, symbols, parental involvement, etc. These factors have a strong influence on the functioning of sport organizations also from the perspective of the external environment.

Given the goals of sport organizations, sport organizations need to select a relevant strategy and set priorities within the stakeholder management, so there can often be a leak of profit and success. In the management of sport organizations in Slovakia, there is an intersection of American and European culture. They differ to a large extent in their understanding of the mission or in the primary objectives set. These objectives are divided in terms of either profit (commercial purposes) or attaining of sporting achievements (performance sport) or profit and achievements (commercial purposes and performance sport) [23].

The goals of sport organizations are pursued in an environment that, in addition to providing many opportunities for success and profitability, is also a source of threats, risks, uncertainty, and ambiguity. The manifestations of uncertainty increase the risks to which the organization is exposed. Risk is most often considered to be the uncertainty of the impact of environmental factors on the functioning of the organization, on the achievement of its objectives. It is a risk that implies the possibility of a negative or positive deviation. The size of the possible threat is not only determined by the existence or size of the threat but also by the vulnerability of the

organization, its weaknesses and the extent of possible damage [21]. Hence, the most serious risks to sport organizations include:

- lack of profit security of the sports club,
- insufficient assurance of sporting success.

These risks are based on a determination of the likelihood of injury, damage or loss. For a sport organization, the characterization may be extended to the possibility of injury to members or participants, damage to the organization's property or the property of others for which they may be liable, or other losses to the organization, management, volunteers, members, or other stakeholders. Ultimately, the effect of risk is a financial effect: injury, damage, or loss. These costs are often due to the fact that the risk has resulted in some form of legal action or litigation [24, 25].

If sport organizations want to meet their objectives and face the external as well as internal factors of their environment, they should pay attention to prevention and create space for risk management, performed by a risk manager, see Figure 1. Prevention should be part of the management of sport organizations, approaches that focus on analysing failure, financial losses and other negative events and prevent their recurrence. Risks should therefore be assessed continuously, holistically, proactively and systematically. The previous experience of sport organization managers and the need to respect the following principles play an important role in the implementation of the risk management process [26]:

- applying a broader view of risk (positive and negative side),
- establishing the responsibility of the sport organization management (persons) for the risk management process and the creation of control mechanisms,
- ensuring that risk management is fully integrated into the structure of the organization.

Effective management of a sport organization (club) and their stakeholders is key to securing financial resources, success, building community (tribe) and strengthening peer connections. The strength of these bonds also depends on the stated goals of the sport organization. The primary role in enforcing risk management should be sufficient support from the sport organization's leadership (owners, board of directors, board of trusties). The next step is to develop a risk management strategy as part of the development of the long-term goals of the organization. The strategy should address the allocation of resources, tools and risk management tasks. It is the basis for risk decision-making and greatly influences the status and expected development of the financial side of the organization. Depending on the specific situation, the financial strength and the amount of estimated potential losses, management should define an adequate risk management policy that supports the selected strategy with a positive impact on the achievement of the set objectives. It should also review and discuss, at least on a one-year basis, the risk management documents (directives) and guidelines, assessing the overall risk position and the evolution of the most serious risks in the sport organization.

The responsible risk manager should periodically update data, indicators, identify risks, monitor their development, issue early warnings (according to the established tolerance limit). He / she should suggest measures to reduce them, prepare periodic risk report (especially monitor deviations from the past) for the management of the sport organization. He / she should struggle to improve the procedures, methods used in risk management, e.g. risk assessment in line with the risk management strategy. The list of powers and responsibilities for risk management will depend on how risk management is implemented in the sport organization's conditions.

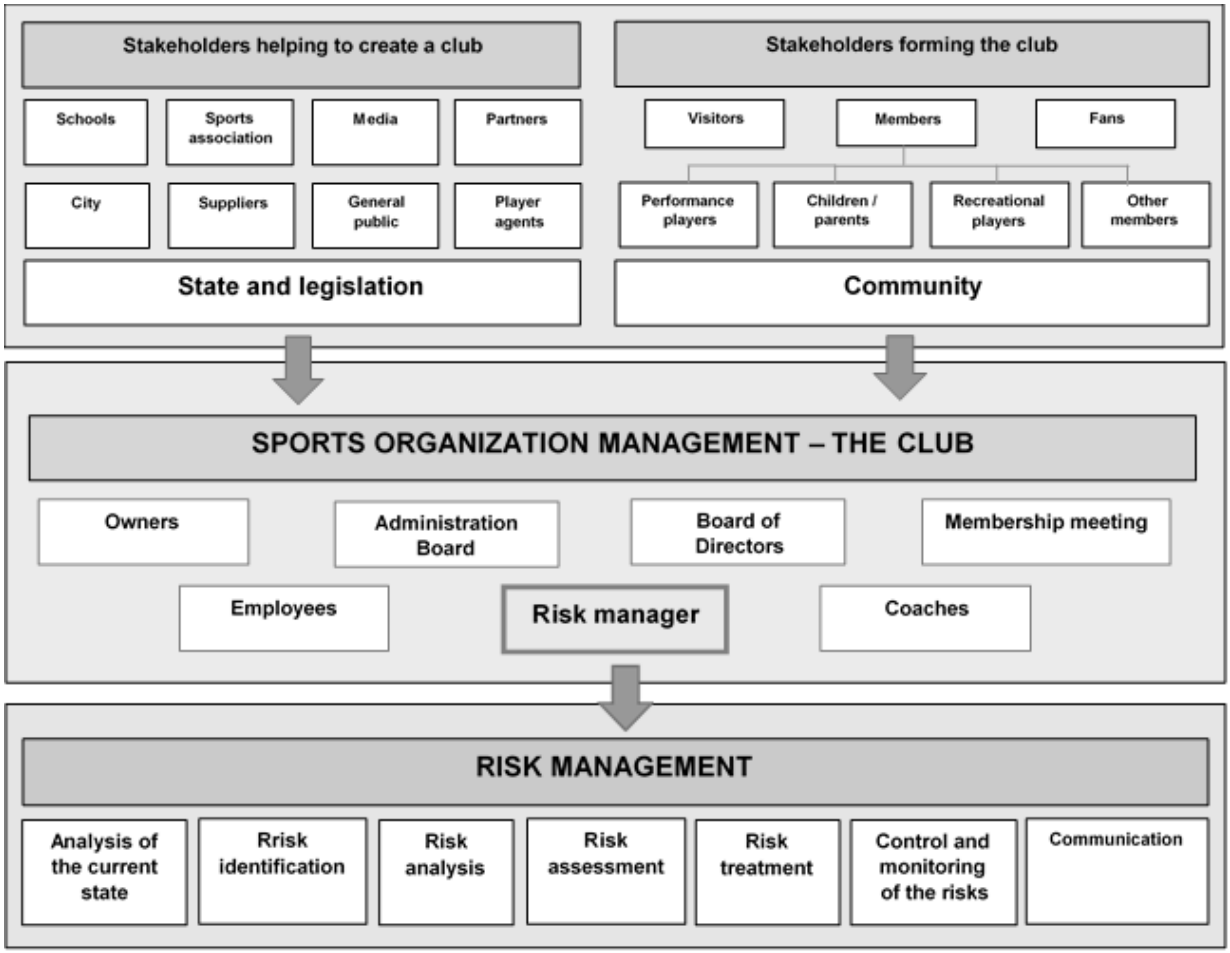

Figure 1. Involvement of the risk manager in the management of a sport organization with stakeholder influence in the sport environment (adjusted according to [23]).

The risk management process in a sport organization should be based on the systematic application of policies and procedures during risk assessment and mitigation, communication with affected parties and monitoring of changes in the environment. Risk management should aim to reduce the likelihood of harm (injury) or financial loss by taking steps to assess (identify, analyse and evaluate) and reduce risks as well as monitoring, reporting and communicating them effectively. The stages of the risk management process in sport organizations should be cyclical in nature and logically sequenced and tailored to the nature of the sport organization's activities.

The implementation of risk management in the conditions of a sport organization requires a detailed analysis of the current state of the organization. Through analyses of the external environment (political, economic, socio-technical, cultural, competitive, etc.) and the internal environment (organizational structure, objectives, strategies, employees, culture, resources used, etc.), managers should obtain the necessary evidence to identify risks. It is important to set up an internal risk management framework in terms of defining the roles and responsibilities of individuals and departments within the sport organization. On the basis of the identified facts, risk assessment criteria should be proposed and the structure of the risk management system of the sport organization should be defined [26]. The search and description of risks and opportunities, based on the processed analyses and internal documents, which is conducted periodically and on a continuous basis, is part of the risk identification stage. Thorough identification is a prerequisite for successful risk management because the unknown cannot be managed. Therefore, this stage of the risk management process is very important and challenging for sport organizations, not only in terms of time but also in terms of availability

of information. Important areas that a risk manager should focus on when identifying risks of a sport organization are e.g. environmental safety, stakeholder safety, safety of the organization's operations (business activity) etc., in order to prevent injuries, conflicts, losses and overall financial and legal implications. The specific risks involved in the overall risk assessment process will vary depending on the sport discipline, the nature of the sport organization and its structure [27].

Risk analysis is an important part of risk assessment. It is used to assess the nature of the risk and determine its level. Its purpose is to determine the likelihood of risks occurring and the size of their negative consequences. Risk analysis procedures and tools vary according to the area and activities under consideration, as well as the laws, norms, standards and approaches to risk management of sport organizations. The analysis can take place in two phases. In the first phase, a preliminary analysis is conducted in order to exclude similar or very low impact risks from the list of identified risks. The excluded risks shall also be recorded to demonstrate the completeness of the risk analysis. It also provides a basis for subsequent decision-making on the selection of a method for the actual risk analysis of the sport organization. In the second phase, a detailed risk analysis is conducted using the risk analysis methods (qualitative, semi-quantitative and quantitative). If a combination of the above methods were used, this would be the most appropriate, but at the same time more time-consuming and costly. Several authors have reported the following basic methods of quantification of individual risks [27, 28]:

- quantification in the form of probability (P) and consequence (N), which is the simplest case of a discrete probability distribution;
- quantification in the form of a probability distribution, where a triangular probability distribution is preferred.

Risk analysis can only be effectively implemented if existing controls are implemented effectively. To do this, documentation of the controls and risk management process needs to be developed so that the documented processes can be verified in order to improve the effectiveness of risk management. This is followed by a process of identifying the most significant risks and comparing the results of the risk analysis with the risk assessment criteria. The purpose of the risk assessment is to determine whether the risk to the sport organization is acceptable or whether mitigating measures need to be put in place. For this stage, it is very important that realistic acceptability (tolerance) limits are established at the stage of assessing the context and significance of the activity under consideration. The assessment can be greatly influenced by the subjective approach of the risk manager or assessor, therefore the use of collective methods for decision making is preferred. The risk assessment procedure is as follows [29]:

1. determination of the tolerance level (reasonableness of cost, delay, etc.),
2. assigning a probability of occurrence and consequences to each risk (cost, loss, profit reduction, time loss, quality reduction). This step is based on the risk analysis phase,
3. prioritization of the risk based on the tolerance level, potential cost of the risk and the probability of the risk occurring (becoming a reality). If the cost of the risk exceeds the tolerance level and the risk is highly likely to occur – the risk will have a high solution priority).

The boundaries among small risks with low solution priority, medium risks and large risks with high solution priority will be determined by the sport organization based on experience and the level of risk acceptability. Both enterprise risk management and project risk management apply the Pareto Principle (80:20), which states that the 20 % of most significant risks will result in 80 % of the losses or costs. These risks have the highest priority for elimination.

The most common form of risk assessment is the Risk matrix or Opportunity matrix (see Figure 2). The basis is an expert risk assessment by staff (external consultants, experts) who have the

necessary knowledge and experience in the areas where the individual risk factors fall. A risk is more significant the more likely it is to occur and the greater the intensity of the impact (consequences) of that risk.

		Impacts ***Intensity of negative impacts***					**Impacts** ***Intensity of positive impacts***						
Likelihood of risk occurrence		1	2	3	4	5	5	4	3	2	1	**Likelihood of opportunity occurrence**	
		VS	**S**	**M**	**H**	**VH**	**VH**	**V**	**S**	**M**	**VH**		
5	**VH**	5	10	15	20	25	25	20	15	10	5	**VH**	5
4	**H**	4	8	12	16	20	20	16	12	8	4	**H**	4
3	**M**	3	6	9	12	15	15	12	9	6	3	**M**	3
2	**S**	2	4	6	8	10	10	8	6	4	2	**S**	2
1	**VS**	1	2	3	4	5	5	4	3	2	1	**VS**	1

VH (5) – very high, H (4) - high, M (3) – middle, S (2) – small VS (1) – very small.

Figure 2. Matrix of risk assessment (threats) and opportunities.

The risk level under this method is given by the product of a probability rating and a consequence (impact) rating. This method is based on the dependencies established in the previous steps of the risk analysis. The risk level is then a specific output on the basis of which risk treatment measures are implemented with a certain priority. The risk distribution intervals from acceptable to critical can be determined by the sport organization on the basis of experience and capabilities (personnel, financial, material), when implementing risk reduction measures. Opportunities can be evaluated in a similar way to risks (threats). If they reach the level of 15 – 25, they should be an incentive for the elaboration of a project to exploit the opportunity in terms of the company's development strategy.

The attitude (relation) of the manager (management, organization) towards risk has a great influence on the setting of boundaries in determining the level of risk. This attitude is influenced by their personality characteristics and past experience. It is also influenced by the management system of the sport organization, e.g. the willingness to take risks is encouraged by a good incentive system, tolerance of minor setbacks and a focus on longer-term results, etc. Managers of sport organizations can feature:

- risk taking, in this case, on the contrary, they look for risky activities and projects that have the ambition to achieve very good results but are associated with a high risk of negative consequences or losses for the company;
- risk neutrality, where risk aversion and risk taking are in balance with each other;

- risk aversion: Managers with significant risk aversion usually cannot be successful in business. Reluctance to make difficult business decisions and a preference for low-risk decisions is often associated with a failure to seize opportunities, avoiding necessary technical, technological, product, organizational and other innovations, which can have a negative impact on the economic efficiency of a sport organization.

On the basis of the processed documents, the management proceeds to the proposals for risk treatment. It is clear that the existence of risk must be taken into account, both in business and in the management of any other more complex entities with non-deterministic or less predictable behaviour. Some risks can be transferred; some can be held. In certain situations, risk can be avoided, while other risks can be reduced. The different options for dealing with risk are not necessarily mutually exclusive or may not always be appropriate. In the case of sport organizations, there are several approaches to managing (reducing) the risks of a sport organization. If the risk is small and inherent to the sport activity and the sport manager is therefore willing to accept the consequences, it is possible to retain (tolerate) the risk. Risk mitigation is appropriate if the risk is significant enough that measures are taken to reduce the likelihood of occurrence or the consequences if they do occur, through careful planning and organization, preparation of staff and volunteers, control and monitoring of the facility and equipment, etc. If the risk is significant enough that the sport organization does not want to take it on, it transfers it to other sub-entities through contracts, e.g. insurance or waivers of rights. A risk that appears potentially very significant should be avoided. Control and monitoring of the risks are aimed at verifying the effectiveness of the measures put in place, as well as examining the effect of changes in the environment on the set prioritised risks. Feedback should be conducted periodically by risk managers in order to ensure that resources are not wasted on ineffective practices. Risk management communication is important to ensure that those responsible for establishing and implementing the sport organization's risk management processes understand the rationale behind decisions and the reasons for taking specific actions. These activities also affect all stakeholders, as their perception of risk can bring new perspectives on risk management to the sport organization. Last but not least, residual risks and their evolution need to be the focus of the risk manager's attention [27].

The introduction of risk management in a sport organization brings several benefits such as more efficient management of the organization, sporting events and processes, higher revenues, higher attendance at sporting events, higher safety for athletes, visitors, sponsors and employees, etc. The intent is that the risk manager in a sport organization should be able to communicate effectively within and outside teams in the context of risk management and build positive relationships, high team performance and the ability to assess the financial implications.

CONCLUSION

Underestimation of risk often stems from a lack of theoretical knowledge and practical experience of the sport organization management. Too much focus on only one type of risk to the detriment of others, e.g. financial risks, often means that risks from other areas can cause major problems for the organization. Weaknesses are also evident in the ability to describe, articulate or define risks. There is no uniform approach to risk management in a sport organization. A risk manager in a sport organization must have knowledge of risk management issues, should have experience of the sport in question, basic legal knowledge and good judgement. Importantly, the risk management process is cyclical and although all stages of the process are the same, the assessment and management of risk takes place in different circumstances. A prerequisite for effective risk management is to identify all types of risk, to analyse and assess them using adequate methods and mitigate them using appropriate and

affordable practices and strategies that are appropriate to the needs, circumstances and available resources of the respective sport organization.

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SOCIAL MEDIA AS A DRIVER FOR SOCIETAL VALUE DEGRADATION: THE NIGERIAN PERSPECTIVE

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ABSTRACT

Social Media facilitates the creation and sharing of information, ideas, interests to virtual communities and networks using interactive technologies. The benefits of such seamless communication are immense and critical to national growth and development. However national growth and development cannot be achieved without a sound value and moral system guiding the conducts of its people. This article investigates the role social media plays in eroding the value system of Nigerian youths. It highlights problematic areas and concludes by making suggestions for the regulation of social media content through content filtering based on generally acceptable cultural values.

KEY WORDS

social media, value, Nigerian

CLASSIFICATION

APA: 2960, 3020

JEL: I39

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INTRODUCTION

Social media has come to stay whether we like it or not, and it has become a critical part of daily life, and of recent in business life. It has gone beyond being a means of entertainment and exposure to a critical aspect of brand building for both individuals and corporate bodies alike. Globally it is estimated that in 2021, there are 7,8 billion people existing on earth at 56,4 % urbanization, 5,22 billion unique mobile phone users comprising 66,6 % of the population, 4,66 billion internet users comprising 59,5 % of the population, and 4,20 billion social media users comprising of 53,6 % of the population [1]. This implies that half of the world's population lives in urban areas with nearly all of that population being unique mobile phone users, internet users, and social media users. Tylor [2] defined culture as an umbrella term that encompasses the social behavior and norms found in human societies as well as the knowledge, beliefs, arts, laws and customs, capabilities, and habits of the individuals in these groups. Culture as a critical facet of human living has been the yardstick via which morality has been measured in many communal societies. The metrics that define the yardstick are generally agreed-upon rules, conducts and methodologies of action, thought, and living which might be existing formally or informally, written or in oral form. This important metric is otherwise called values. Where values as defined in [3] denote the degree of importance of something or action, with the aim of determining what actions are best to do, or what way is best to live as described by the significance of different actions. The importance or significance placed on an action is collectively agreed upon in society either formally or informally and this guides the behavior of individuals in that society. Societal values are critical to the sustenance of moral standards and what classifies a societal value is dependent on the homogeneity of populations within a geographical area who share the same or similar cultures. Cultural values in the western world are a lot different than cultural values in African societies albeit with some similarities. Diverse studies such as [4-7] have demonstrated the impact of western cultures in African societies, whereas [7] suggests that well before the advent of colonialism, a pattern of homegrown political systems, governance processes and generally acceptable institutional rule making arrangement existed, he further suggested that Africa would have exhibited the same sustained level of development, evolution, and civilization without the retrogressive contact with imperial forces. The existence of laid down processes and procedures prior to western contact further highlights the earlier suggestion that culture and values exist amongst homogenous people within a geographical location.

Societal values as defined by [8] are standards, that individuals and social groups employ to define personal goals and essentially shape the nature and form of social order in a collective, by virtue of what is acceptable and what is unacceptable, what ought to be and what not ought to be, what is desirable and what isn't desirable. Societal values are critical metrics for acceptable moral conduct in cultural studies, whether being investigated under the lens of cultural ethnocentrism or cultural relativism. Cultural ethnocentrism and relativism are different from each other as defined by [9], where ethnocentrism involves looking at another culture from the perspective of one's own culture, and relativism is looking at another culture from its own perspective rather than another culture. Societal values in a cultural study could be similar in an ethnocentric perspective as within a relativist perspective, and other times could be dissimilar. It is a generally accepted standard irrespective of culture, that it is wrong to commit an act of murder no matter the reason or justification for it, this will represent a situation where societal values are similar irrespective of culture. Abortion has been made legal in countries such as Ireland, Iceland, Cuba, Cyprus, etc., and is illegal in countries such as El Salvador, Madagascar, Malta, etc. [10]). This represents a scenario where societal values are dissimilar. The similarity or dissimilarity between societal values amongst cultures is an expanding continuum, where values can change as new information is passed across cultures,

thus resulting in a change in beliefs and ideals. A lot of societal value changes have been observed in Africa due to western cultural impact as discussed in [7], which holistically looked at changes in the African perspective due to neocolonialism, neoliberalism, liberal democracy, and missionaries. Chulu [11] describes changing perspectives in relation to imported economic development models in the African space, with suggestions that no culture is superior to another culture development wise, and that what matters should be the ability of people of any nation or culture to trigger off development in order to meet their immediate and future needs. Onwuachi [4] describes the impacts on African culture due to western education, the role of detribalization, paradoxical primitivism and the integrated learned behavior patterns on cultural change was explored. The results of each of the previous studies implies that even in situations of transference of societal values across cultural divides, it is of importance that the aim of morality entrenched in good societal values are maintained.

This article thus investigates the value creation system within Nigerian societies with a view of estimating how the degradation of societal values due to social media adoption and usage within the Nigerian context plays a role in poor youth education and cultural immersion. It is understood that societal values can change when cultures meet and social media offers a platform for cultural immersion. An investigation of societal values in Nigeria's pre-social media area will be examined as also post the social media era, in order to determine if the degradation of social values is prevalent and by what yardstick can a social value be adjudged to have degraded.

NIGERIA CULTURE AND VALUES EVALUATION

Nigeria as seen in Figure 1, is officially recognized as the federal republic of Nigeria, and is also the most populous nation in Africa with an estimated population of over 208 million people [1].

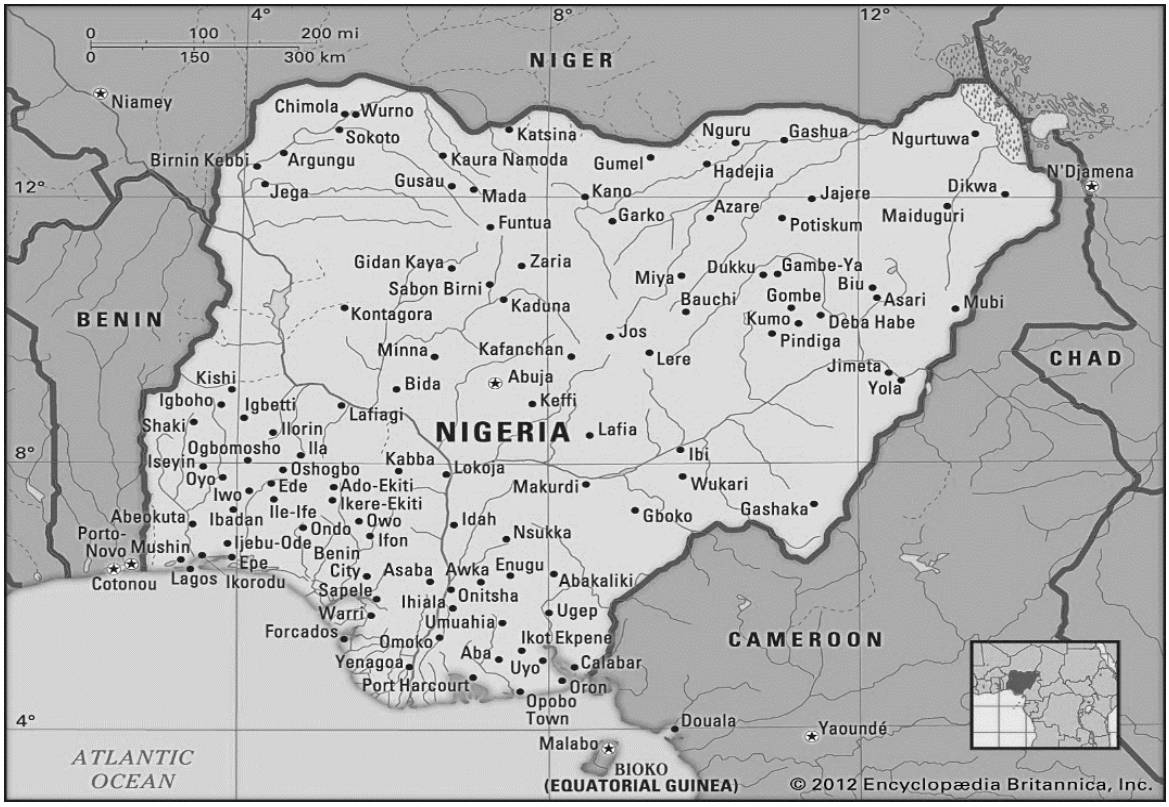

Figure 1. Nigerian Map [12].

Nigeria has a rich culture of diverse people united together under a single geographical entity. It is estimated that 250 ethnic groups exist, with each group inhabiting a territory that it assumes to be its own by right of inheritance and first occupancy. Three major religions of Islam, Christianity and Traditional belief are predominantly followed, with majority in the northern part dominated by the Hausa/Fulani being Muslims, the majority of the southern part dominated by the Yoruba, and Igbos being mainly Christians and traditionalists. Nigerian culture derives from the mixture of its ethnic groups with Arabic and western European influences [12] with diverse customs relating to marriage, funerals, birth, rites of passage into manhood, and womanhood. Whether in a rural or urban setting, the family unit is a central institution and is integral in every culture or tribe, this centralized family unit goes beyond the nuclear setting, but also to the extended family. It isn't unheard of for a child to be disciplined by an extended family member and to the approval of members of the nuclear family unit.

Nigeria's core values as identified by [13] respect for elders, honesty and accountability, cooperation, industry, discipline, self-confidence, and moral courage. [14] identified that there are core moral values that every nation must teach its citizens such as respect for constituted authority, the sanctity of human life, responsibility, the value of honesty, fairness, tolerance, prudence, self-discipline, helpfulness, compassion, cooperation, and courage, respect of rule of law, respect to equal opportunity, respect of due process, representative government, etc. The list of values encouraged in Nigeria is in-exhaustive and ever-changing to meet changes in society. The societal values are in-line with the teachings of all cultures and religions represented in Nigeria. Religion is of great importance in Nigeria and plays a key role in setting standards relating to societal values. [15] opines that man cannot exist without religion and that religion cannot be extricated from life situations. Thus, religion promotes a disciplined and purified life aimed at the betterment of the soul, which is synonymous with the needs and values of a moral society. Despite the clearly stated values ascribed to the Nigerian state and its citizens, [16] summarized that Nigeria is a country with a decayed value system. From a political point of view, the author described the failure of the government over 40 years to address the issues relating to huge infrastructure deficits, insecurity of lives and property, and poor educational and agricultural capacity. Since it is believed that good values and moral education promote critical thinking and moral development [14] it is expected that people of diverse cultures within Nigeria make concise efforts to address the ever-decaying value system. The negative effects of a poor value system as stated in [17] is exemplified by the huge quest for money, age cheating as applicable in sports, patriotism, ethnic-tribal sentiments, examination malpractice, time unconsciousness or "Nigerian Time", mediocrity syndrome, etc. The level of economic decadence that permeates all sectors of Nigeria, starting from government officials to civil servants and even to the common man on the street can be ascribed to poor moral education, and fueled by a decayed value system. In order to make any change as promoted in [14], there must be a systemic address of the value system and the factors which promote its current decay.

NIGERIA, INTERNET AND SOCIAL MEDIA

As of 2021, Nigeria has 187,9 million active mobile connections, representing 90 % of the population, 104,4 million internet users, representing 50 % of its population and 33,3 million social media users, representing 15,8 % or its population [1]. Annual digital growth between active mobile connections, mobile internet users and social media users is estimated to grow at 10 %, 22,1 % and 22,2 % respectively [1]. Key metrics relating to age distribution of users of three (3) popular internet and social media applications are represented in figure 2, 3 and 4, respectively.

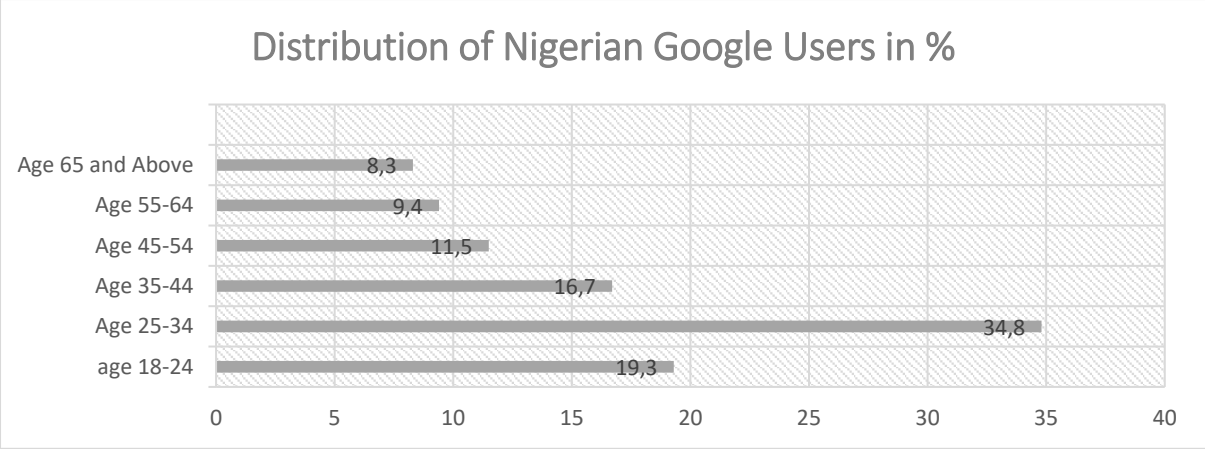

Figure 2. Age Distributions of Google Users in Nigeria [1].

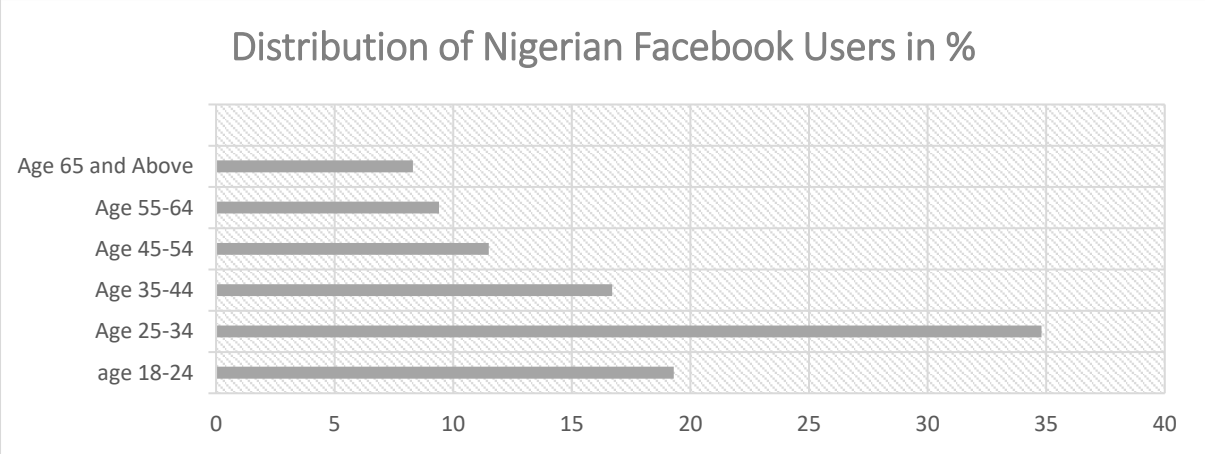

Figure 3. Age Distribution of Facebook Users in Nigeria [1].

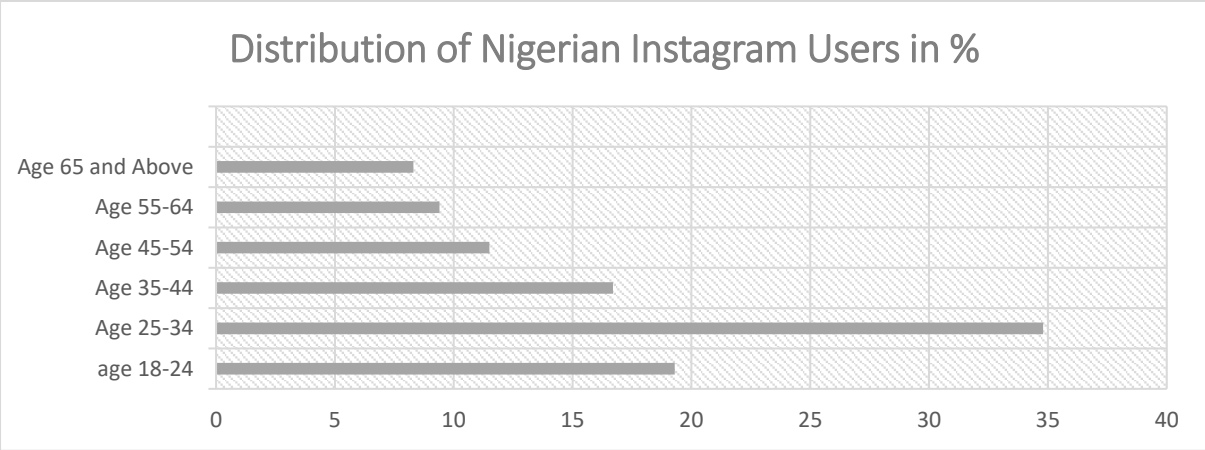

Figure 4. Age Distribution of Instagram Users in Nigeria [1]

Where it is observed that for the three social media and internet platforms, Nigerians aged between (25 -34) represented the highest consumers of internet content, followed closely by ages (18-24) and lastly (35-44) years of age. The three identify age groups represent the youth population of Nigeria, where it is estimated that 50 % of the general population can be classified within the youth age group [18]. The age ranges which represent the older part of the general population were consumers of social media content, but to a lower degree. Figure 5, depicts the user share of the ten most popular social media service in Nigeria.

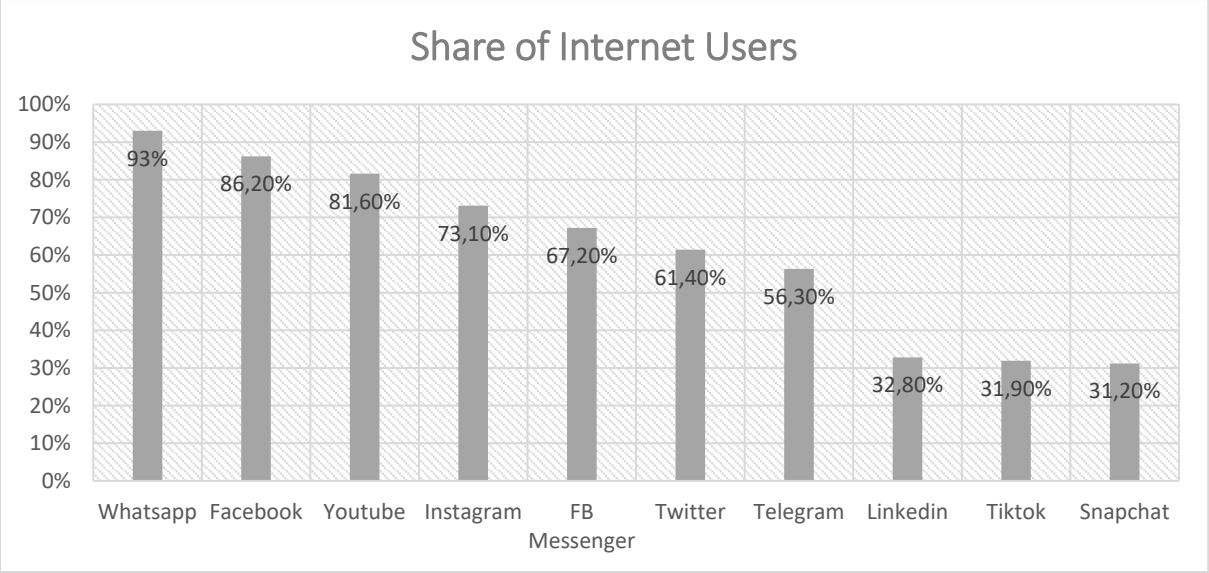

Figure 5. Percentage User Share of Major Social Media Service by Nigerians [19].

Other popular websites used by Nigerians range from social dating websites, pornography websites, betting websites, online shopping websites, Gossip blogs and daily news websites.

DISCUSSION

It is no surprise that new technologies and features appeal more to the youth than to older members of the population. Social media platforms such as those represented in figure 5 are mainly used for communication and content sharing. The question then is who controls the content that is shared on these platforms, how does the communication and content shared on this platform foster good values and overall moral education. Are there benefits to the adoption of social media as a communication platform in Nigeria? Many proponents of social media growth indicate that it helps people connect, encourages donations and charities, education of the populace [20], and encourages business growth and advertising [20, 21]. They also agree that its proliferation can cause cyberbullying, trolling, and false sense of connection [20]. Cybercrime, social media addiction are also other negative effects of its usage. Yet these all do not translate to a loss in values. Therefore, how does social media cause value degradation amongst Nigerian youths, who make up a large portion of users? We must first look at the global image of the typical Nigerian youth. The term “Nigerian Prince Scam” is a well-known alias for describing email scams and has been around for a long time, even predating the digital era [22], where an illegal user sends malicious emails to potential victims claiming to need help in accessing some amount of money, after which he steals money from his victims through unfounded stories and other social engineering methods. Dating back to the early 2000’s when the internet became mainstream in Nigeria, it was almost impossible for a parent to be comfortable with a child who has no source of verifiable income, and yet drives the latest cars and lives in the choice's accommodations. People looked down on people identified to be involved in internet fraud otherwise called “yahoo yahoo” or “419”, however this was observed to change from 2010 upwards, when social media platforms became mainstream. It created an avenue for people who otherwise hid from the public for fear of criticism of their unexplained wealth to now flaunt it openly. This public display of wealth through social platforms especially Instagram to poor youths of a badly governed country like Nigeria, where the common man lacks access to basic amenities, began the process of value erosion. People began to see that internet fraud could be a way to wealth and survival as evidenced in the submission by a

Nigerian youth who stated that "cyber fraud is the reason people are able to feed their parents and sponsor their children in school" [23]. The same person further argued that those against cybercrime are only doing it because they are able to feed their own families. Another Nigerian Youth claimed that "Government and churches should encourage youths to get involved in cybercrime in order to generate foreign exchange for the government, since jobs and affordable quality education are lacking" [24]. This value erosion has seen a situation where majority of youths in Nigeria are now enrolled in cybercrime schools [25, 26], where youths as young as ten (10) years old are now enrolled and taught the nitty gritty being cybercrime, what is most harrowing about this is that a lot of these kids were enrolled by their own parents. It is extremely difficult to convince youths against opting for cybercrime as a path out of poverty, because every day they get to consume social media content from successful fraudsters, who flaunt their ill-gotten wealth. To better understand the level of decadence of the value system with respect to economic wealth. Okhuevbie [27], Clifton and Abumere [28] and Adepegba [29] described the notorious Instagram internet fraudster known as "Ramon Abass "or as his alias "Hushpuppy" as well as other notorious internet fraudsters serving jail sentences in the US, who lived the hard and fast life with their ill-gotten wealth and flaunted same on social media. He was known to have heavily influenced a lot of youths to take a career in cybercrime due to his success stories, even his arrest and subsequent indictment did nothing to change the mindset of youths as evidenced in [30, 31], where many took sides with the criminal and justified his actions, which speaks of a society with decayed values. Cybercrime, as bad as it might appear isn't even the worst of it all, the rising trend of ritual killings has also shown that the sanctity of human life which all the major religions in Nigeria eschew has also taken a back seat. Social media has driven the culture of "fake it till you make it" and also that "the end justifies the means". People openly sell human ritual services for free on Facebook, where people are encouraged to bring human parts in the exchange of unending wealth [32, 33]. Whatsapp has been used in the transmitting of fake news targeted for political, economic and personal gain [34], Telegram is popular for crypto-currency scams [35], Facebook has served as a platform for sexual violence against women and men etc.

The Value system degradation isn't only limited to areas where people can get unmerited advantage economically but to many other areas too numerous to mention, the education sector in Nigeria is also an area of grave concern as it has been a shadow of its former self as described in [14]. It has also suffered a value erosion thanks to social media. Platforms like Facebook, Whatsapp have been used to facilitate mass exam malpractices [36] and this is causing a general degradation of the human capital potential of the nation [37].

CONCLUSION

The value system of any nation or people provides the standards by which actions and inactions are adjudged to be right or wrong. Social media offers immense benefits with respect to its ability to connect people globally and encourage branding initiatives, it cannot be allowed to serve as a medium for cultural value erosion. Without sound cultural values, crime, laziness and bad practice will be pervasive and thus this is undesirable. The rights of every human to freedom of expression must not be trampled upon through repression, in the guise of social media regulation. However social media providers should be encouraged to invest more into understanding the value system applicable to the areas their systems are utilized, this will aid the appropriate usage of efficient content filtering algorithms that can ensure negative vices and their subsequent narratives are not promoted. Social media should also be a proponent for value building by encouraging the dissemination of value building content to user feeds.

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SMART SOLUTIONS FOR SUSTAINABLE TOURISM PEARLS: HOW TO LIVE BETWEEN CULTURE AND TOURISM IN DUBROVNIK

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ABSTRACT

Dubrovnik is one of the most visited destinations on the Adriatic coast. However, the large number of visits is affecting the heritage area of the city, and since the Old City of Dubrovnik have been under the UNESCO protection from 1979 it is important to achieve the balance between tourism and sustainability of the heritage site. The use of smart and open data can improve tourism flow management in cultural heritage sites.

The aim of this article is to identify innovative solutions, with the support of new technologies and big data, in order to reduce negative impacts of tourism on cultural heritage sites. The set of indicators are defined and a holistic model is proposed to analyse these data and use them in sustainable management of cultural heritage cities. The newly developed smart holistic models are presented in the case of the City of Dubrovnik since it is largely dedicated to tourism. The analysis of tourist flows in the City of Dubrovnik has been done following a system of indicators developed by the Agency for sustainable Mediterranean cities and territories in the framework of Interreg Mediterranean project HERIT-DATA that consists of 21 indicators divided into 6 groups. A large number of tourists are affecting not only space and infrastructure, but also the life of residents. Therefore, it is of the greatest importance to manage tourism in a more holistic and sustainable way and to find the balance between tourism and its economic contributions and sustainability.

The proposed set of indicators and a new smart holistic model will help policy makers, destination managers, cities and sites to anticipate and manage the tourism flows in a smarter way. The results of the analysis showed that the overtourism in Dubrovnik has still not affected the infrastructure and environmental conditions, but it greatly affects the residents of the city and their quality of life. Also, the smart solution for managing the tourism flows in the Old City of Dubrovnik already exists, in the form of Application for the prediction of the number of visitors, but it should be used in a way that helps better manage the tourist flows.

KEY WORDS

sustainable tourism, Dubrovnik, cultural heritage, smart solutions, big data

CLASSIFICATION

JEL: C53, C55, O18, O21, Q54, R58, Z18, Z32

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INTRODUCTION

Dubrovnik, also known as the "pearl of the Adriatic" is one of the most visited destinations on the Adriatic coast. In 2021, it was the third most visited Croatian city with the total of 518 000 tourist arrivals. However, as large number of visits is affecting the heritage area of the city, and since the Old City has been under the UNESCO protection since 1979, it is important to achieve balance between tourism and sustainability of the heritage site. In order to do so, first steps have been taken when UNESCO recommended the maximum number of 8000 tourists daily. But, the City of Dubrovnik is still facing the problem of overtourism, which is defined as "the excessive growth of visitors leading to overcrowding in areas where residents suffer the consequences of temporary and seasonal tourism peaks, which have caused permanent changes to their lifestyles, denied access to amenities and damaged their general well-being" [1].

The aim of this article is to identify innovative solutions, with the support of new technologies and big data, in order to reduce negative impacts of tourism on cultural heritage sites. In order to deal with the problem of overtourism, first it is necessary to analyse management of tourism flows to observe the sustainability of different heritage sites under the pressure of tourism. The set of indicators has been developed with aim to analyse data on the tourism flows and to use them in sustainable management of cultural heritage cities. These indicators analyse not only the tourist overcrowding, but also environmental and economic conditions, perception of overcrowded places, quality of services and residential quality of life, since the overtourism affects not only space and infrastructure, but also the life of residents. To avoid the negative effects of overtourism, it is of the greatest importance to manage tourism in a sustainable way and to find balance between tourism and its economic contributions, and sustainability. A way to improve the tourism flow management is the use of smart and open data. This article tries to answer the question whether the smart solutions introduced in the Old City of Dubrovnik, i.e. the cameras that count the number of people in the historic centre, affect the number of visitors, and if not, what other digital solutions can help dealing with overtourism in Dubrovnik.

PREVIOUS RESEARCH

In the past forty years, the tourism has grown rapidly, mainly due to increased demand for mobility, leisure and unique experiences. The consequences of the tourism growth are pressures not only to cultural and natural heritage, but also pressure on life of residents. Debates concerning the pressure from tourism activity and dependence on tourism sector have helped tourism practitioners to shape policies and plan interventions. However, in most cases, policies and interventions were made to help solving problems associated with tourism, rather than addressing the underlying root causes to reach a long-term solution. Over time new terms "overtourism" and "tourismphobia" have emerged to describe rapid unfolding of unsustainable mass tourism practices and the responses that these have generated amongst academics, practitioners and social movements concerned with the use of urban, rural and coastal spaces for tourism purposes in a damaging and harmful manner [1]. According to Milano, Cheer and Novelli the term overtourism implies loss of sense of belonging, diminishment of sense of place, increased congestion and privatisation of public spaces, explosive growth of cruise tourism, rapid growth of tourism and day visitors, the rise in tourism induced real estate speculation and associated decline in power parity of local residents compared to visitors, dismantling of socio-cultural connectivity and the mainstream of special niche tourism practices in vulnerable places such as national parks, small islands and critical cultural heritage places [2].

Overtourism can have an impact in multiple ways – it is harming the landscape, damaging beaches, putting infrastructure under strain and pricing residents out of property market. One of the examples is the cruise industry that delivers thousands of passengers daily, while little is returned to

communities. Impact of overtourism on local residents is huge – cities transform to cater for tourists, while property speculations and costs of living for local communities increase. However, there are several measures to limit the effects of overtourism some cities have taken, such as revised taxation arrangements, fines linked to new local laws, and "demarketing" – focusing of the destination on attracting fewer, high-spending and low impact tourists, rather than large groups [3].

Overtourism causes tourismphobia, which is defined as "a feeling of rejection towards tourism that manifests in the form of assaults to restaurants, businesses and yachts; attacks on tourist buses, bikes damaged in tourist spots, and other acts of vandalism" [4]. According to Veríssimo, Breda, Guizi and Costa most of those host-tourist conflicts arise when host communities feel some economic impacts, such as loss of purchasing power, rising prices, overvaluation of rents, as well as those of a social and cultural nature, namely increasing poverty, loss of local cultural identity, gentrification and the feeling of urban alienation, noise and tourist incivility, and other issues [5].

In order to solve overtourism-related problems, it is necessary to determine its degree and ensure its effective measurement and monitoring, which is essential for effective tourism management. Overtourism monitoring has also been a topic of several research studies. For example, Khomsi, Fernendez-Aubin and Rabier analysed overtourism in Monteral using the number of tourists in comparison with the number of inhabitants, tourism carrying capacity and tourism pressure as core indicators [6]. The results of their research showed that deseasoning deludes negative perception of tourism since the problems such as road congestion is not therefore felt throughout the year. Also, the degree of negative views on tourism remains localized in only one area and perception of overtourism is subjective. Due to the stated factors, the authors of the study concluded that Montreal does not suffer from overtourism as do other famous destinations like Venice and Dubrovnik.

The study of Pikkemaat, Bichler and Peters is focused on skiing as a tourism activity and estimates satisfaction of tourists in ski resorts in Austria [7]. Authors show that certain demographic factors, such as age, have an impact on perceived crowding and satisfaction. The authors also highlight the importance of tourist-to-tourist encounters to gain a better understanding of crowding effects and to propose appropriate visitor management measures.

Cakar and Uzut analysed the case study of Istanbul to investigate the role of sustainable degrowth as a strategy to deal with overtourism [8]. Authors found that demarketing and applying localhood tourism activities are key drivers behind the degrowth response. Degrowth solution required sustainable destination governance, prudent management and stakeholder involvement.

Camatti, Bertocchi, Carić and van der Borg proposed a tourism carrying capacity (TCC) calculation model and applied it to the case of Dubrovnik [9]. This real-time response helps monitor overtourism in Dubrovnik using the support of current mobile technology. The study suggests the ways in which a heritage tourism destination can determine the sustainable limit of tourists and visitors to different types by considering the maximum capacities of various subsystems including accommodation sector, food and beverage sector, mobility and transportation facilities, environmental issues and waste management, and cultural site. The model enables the authors to stimulate the maximum number of visitors and the composition of visitors. It enables researchers to estimate potential revenues and provides real-time intervention to mitigate potential overtourism, facilitate decongestion policies and promote destination sustainability.

The use of technology and big data in tourism is also analysed by Wang, Ban and Kim who showed that big data analyses can create social and environmental values and financial and economic sustainability [10]. The tourism sector must adopt new competitive strategies and enhance organizational dynamism by incorporating big data analytics and business models into their operations. According to authors, the influence of big data on the creation of social value

in tourism sector is based on creating employee value through encouraging development of good working conditions, improving employee capacity, improvement of work-life balance and happiness, and fostering a harmonious work environment.

Finally, Hawkins, Chang and Warnes who compared experts' and stakeholders' ratings of 33 World Heritage destinations, state that local stakeholders need to be recognized for their essential role on tourism planning and development [11]. The research showed that local stakeholders and experts have similar views on the sustainability of the World Heritage destinations. In some cases, experts did state problems that were not mentioned by stakeholders that were about safety concerns and environmental issues, especially concerning trash and litter. In the rest of the cases, stakeholders' comments echoed experts' views. The most concerning problems are environmental concerns, loss of cultural integrity and damage to the built heritage. According to experts, high involvement of government sectors in management of tourism sites through means of financial support and enforcement of regulations result in higher level of sustainability of the tourist destination and sites.

METHODOLOGY

The analysis of tourist flows in the City of Dubrovnik has been done following a system of indicators developed by the Agency for sustainable Mediterranean cities and territories in the framework of Interreg Mediterranean project HERIT-DATA. The system of indicators is defined as a set of information that observes the sustainability of different heritage sites under the pressure of tourism. The developed set of indicators consists of 21 indicators divided into 6 groups. However, in this article indicators have been adapted to the tourism in the City of Dubrovnik.

The set of indicators analysed in this article also consists of 6 groups. First group of indicators analyses basic characteristics of tourism in the City of Dubrovnik. The second group of indicators analyses cultural heritage preservation level of – the Old City. Third group of indicators is dedicated to tourist flows in the Old City, while fourth group deals with the perception of local residents and tourists. Fifth group of indicators analyses quality of services and security in the City of Dubrovnik and the last, sixth, group analyses the quality of residents' life.

The list of indicators analysed in this article have been presented in Table 1.

Methods used in the analysis of the tourist flows include desk research, big data, comparative analysis and deduction. Several sources of information have been used in analysis of the tourist flows, including tourist agencies in Dubrovnik for the recognition of areas and sites of tourist values, Institute for tourism research for the identification of tourism profiles, Dubrovnik Port Authority database for the number of cruise ships and passengers, Croatian Chamber of Commerce database for indicators related to companies and employment. Additionally, the City of Dubrovnik Tourist Board provided data related to the number of arrivals and number of overnight stays, while the Croatian Bureau of Statistics database was used for analysis of the accommodation facilities. For the analysis of capacity and quality of services provided, the Waste management service in Dubrovnik, Dubrovnik Police Department, the public transport company and public parking spaces management company have been contacted. Additionally, databases provided by the Ministry of Economy and Sustainable Development of the Republic of Croatia have been used in the analysis of air pollution and databases provided by the Ministry of Finance of the Republic of Croatia have been used in the analysis of prices of houses and apartments in Dubrovnik. The Dubrovnik Development Agency (DURA) provided the data collected by way of cameras in the historic centre that count the number of visitors. Finally, for the analysis of personal perception, i.e. the social net analysis, the Social searcher platform was used, which uses key word Twitter, Facebook, Vkontakte, YouTube, Flickr, Instagram, Reddit and Dailymotion. Also, for s to search through 11 sources, including Web, Tumblr, Vimeo, the

Table 1. List of indicators.

Group of indicators	Indicators
Characterisation of areas of heritage value	Characterisation areas/sites of tourist value and tourism profiles
	Access capacity charge (heritage area from port)
	Capacity charge of the heritage area
Site capacity overcrowded	Preservation level in optimal conditions (environmental and architectural) of sites of cultural value
Tourist city flows	Optimal levels of overcrowding of people transit
	Optimal levels of tourists overnight
Perception of overcrowded places	Tourists perception about adequacy of overcrowded site experience
	Residents perception about adequacy of overcrowded site experience
	Personal perception about adequacy of security site experience
	Personal perception about hygiene, sanitation and cleaning conditions site experience
	Personal perception about cultural heritage preservation site experience
Capacity and quality of services access (heritage area)	Optimal capacity of the urban cleaning service and décor
	Capacity to maintain optimal citizen security
	Capacity to ensure permitted ranges of contamination – basic environmental conditions in heritage areas
	Fluid access to public transport in heritage areas
	Fluid access to parking spaces around heritage areas
Residential quality site	Optimal levels of access to housing in tourist areas by local population
	Optimal levels of access to employment quality in tourist areas by local population
	Optimal levels of access to local stores and products in tourist areas by residential population
	Higher prices in target areas
	Lack of identity of the traditional activities within the UNESCO area

comparation of costs of living in Dubrovnik with other cities, the NUMBEO platform was used, which is the world's largest cost of living database.

DISCUSSION/RESULTS

As mentioned above, the developed indicator system is divided into 6 indicator groups. First indicator group – Characterisation of areas of heritage value describes the Old City of Dubrovnik – the areas of tourist value, tourist profiles, cruise tourism and capacities of the heritage area. Second group of indicators – Site Capacity Overcrowded analyses the preservation level of heritage site, optimal level of number of tourists at the site and optimal level of tourist overnight stays. Indicator group Tourist City Flows analyses the number of

people at the heritage site, while the group People perception of overcrowded places analyses both residents' and tourists' perception of overcrowdedness, security, hygiene, cleanliness, etc. Group of indicators Capacity and quality to services access (heritage area) analyses urban cleaning services, security, environmental conditions and public and private transport. Finally, the last group, Residential quality site, consists of indicators that analyse access to housing, employment quality and costs of living in the heritage area.

CHARACTERISATION OF AREAS OF HERITAGE VALUE

The first group of indicators gives the basic information of the heritage site – the Old City of Dubrovnik. According to the data and the records kept by the Ministry of Culture and Media of the Republic of Croatia Directorate for the Protection of Cultural Heritage and the Conservation Department in Dubrovnik, there is a total of 535 immovable cultural assets under protection and under preventive protection in the Region, 486 of which are protected and 49 are under preventive protection. According to the data provided by the Conservation Department in Dubrovnik and the Physical Planning Institute of the Dubrovnik-Neretva County, there are 1968 registered cultural assets in the Region's area. The total number of immovable cultural assets that are under regular and preventive protection and registered in the Dubrovnik-Neretva County is 2503.

The main tourist attractions in the City of Dubrovnik and its hinterland are the Dubrovnik City Walls, Fort Lovrijenac, The Franciscan Church and Monastery, Stradun, Cavtat Cemetery, Minčeta Fortress, Church of St. Ignatius of Loyola, Church of Saint Blaise, Dominican Monastery, St. John's Fortress, Fort Bokar, Synagogue, Cathedral Treasury, Brsalje Street, and the Ston Old Town.

Tourist profile in the City of Dubrovnik was analysed by Marušić, Horak and Čorak in the framework of TOMAS research [12]. According to this study, the average age of Dubrovnik guests is 42 years. Half of the guests in 2018 (51 %) were between 30 and 49 years old. Slightly older guests (45 years on average) come from the UK and Italy, while the younger guests come from Spain (39 years), Ireland (40 years) and Scandinavian countries (40 years). Guests in hotels, as more solvent guests, were older than guests in family accommodation (46 years in hotels vs 38 years in family accommodation). Slightly less than two thirds of guests who visited Dubrovnik were accompanied by a partner (63 %), while a fifth of them come accompanied by other family members. While family arrival is the most common among Italians (24 %), arrival with a partner was above average for guests from the UK (78 %), France (78 %) and Ireland (76 %). In hotels, guests from the USA came with their families more often than the average (32 %).

Economic contribution of tourism to an area is mostly analysed by tourist consumption. According to the TOMAS research, the average daily tourist consumption in 2018 in Dubrovnik was EUR 170 per day [12]. The largest share of this consumption was spent on accommodation (51 %), on food and beverage in restaurants and bars (25 %), which was followed by expenditures on culture and entertainment (8 %), purchase (7 %) and expenditures for local transport (6 %). During their stay in Dubrovnik, visitors from ships on international cruises spend an average of EUR 51 (EUR 59 spent by passengers and EUR 26 spent by the crew). Most of it, over a half of the total consumption, is spent on food and beverage in catering establishments (32 %) and on purchases (26 %). In Dubrovnik, crew members spend almost 90 % of their average consumption on food and beverage as well as on shopping.

Dubrovnik is also a world-famous port with a huge number of disembarkations. According to the data of the Dubrovnik Port Authority, the total number of cruise ships in Dubrovnik in 2019 was 486 and the total number of passengers was 768 924, which represents the increase of 5 % compared to 2018 (732 431 passengers) and the increase of 8 % compared to 2017 (709 517 passengers). The total number of cruisers in 2019 increased for 11 % compared to 2018 (438 cruisers) and for 10 % compared to 2017 (443 cruisers).

On a monthly basis, the largest number of cruise ships arriving is between May and October, with the peak in October 2019 and in August 2018. In 2020, due to the COVID-19 pandemic, the total number of cruise ships was 47, which is way less than in the usual peak months. Cruising tourism has recovered a little bit in 2021 and 2022, but it is not yet on pre-pandemic levels. The number of disembarkations on monthly basis is presented in Figure 1.

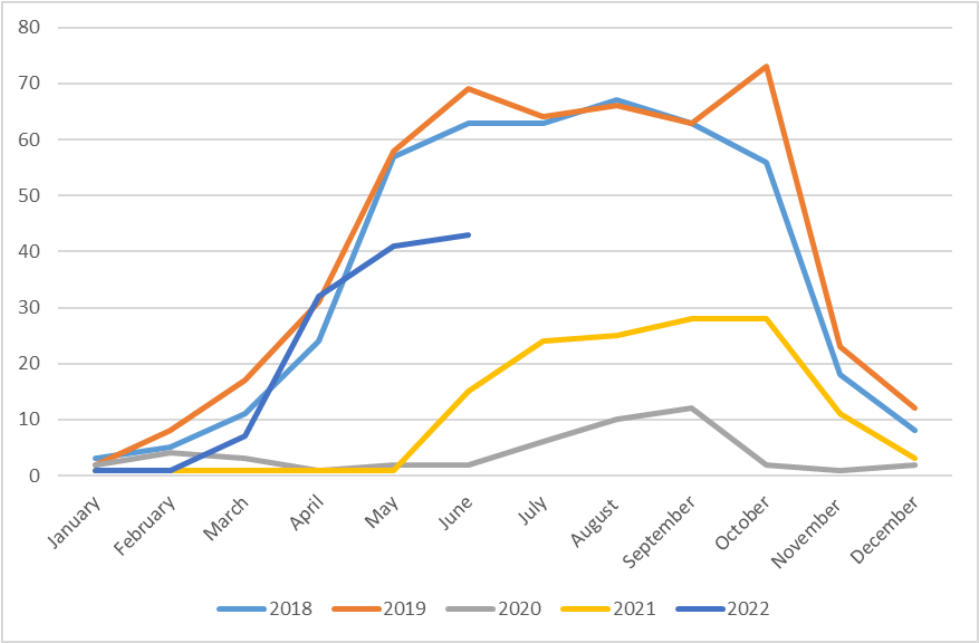

Figure 1. Number of cruise ships by months (Dubrovnik Port Authority).

Finally, the indicator Capacity charge heritage area analyses capacities of the area in the field of saturation sites, accommodation and restoration. Capacity of saturation sites analyses permitted capacity of historic centres, heritage area and cultural heritage business. According to the UNESCO recommendation, the maximum number of tourists allowed in the Old City of Dubrovnik is 8000 per day and according to travel agencies, the recommended duration of the visit to the Old City of Dubrovnik is 6 hours.

The total number of accommodation facilities in the Old City of Dubrovnik is 34 – 2 hotels, 1 Bed and Breakfast (B&B), 2 hostels and 29 private accommodation facilities. The total number of rooms and suites in hotels is 27 and in hostels 18 rooms. The number of rooms in B&B is not available. The total number of apartments and rooms in private accommodation facilities in the Old City of Dubrovnik is 137.

The total number of companies engaged in tourism in Dubrovnik is 636, out of which 206 in the Accommodation sector, 266 in Food and beverage service activities and 164 in Travel agency, tour operator and other reservation services and related activities. Also, there are 6 Official tourism information centres in the heritage area of Dubrovnik.

Since official data on the number of restaurants and bars is not available, the analysis was carried out by Google Maps research. The analysis showed that there are 63 restaurants in the Old City of Dubrovnik, 6 fast food restaurants and 3 ice cream shops. The number of bars in the Old City of Dubrovnik is 22.

SITE CAPACITY OVERCROWDED

The Old City of Dubrovnik as a heritage site is characterised as uncovered outdoor space, therefore the meteorological conditions are pretty important for its preservation. The average temperature in the period 1961-2020 in Dubrovnik was 16,7°C. The coldest month in

Dubrovnik was January with approximately 9,1°C and the warmest was August with 25,3°C. The average environmental parameters for 2022 in Dubrovnik are temperature 24,9°C, relative humidity 47 %, air pressure 1019,0 hPa and wind NNE 4,4 m/s. These environmental parameters can be described as optimal for the heritage preservation.

Materials used in the heritage site construction – the Old City of Dubrovnik are prescribed by the UNESCO World Heritage Management Plan "Old City of Dubrovnik" and they include traditional building materials, i.e. stone instead of wood. According to the Law on Protection and Preservation of Cultural Heritage, the interventions that can be performed in the area are only those which are in accordance with the conclusions of conservation documentation relating to the repair of the structure, roof reconstruction, replacement of old joinery and using only traditional materials and construction details designed in the traditional way.

TOURIST CITY FLOWS

Detection real transit of number of people/area/time analyses displacements in historic centres of the cities in order to determine if high concentrations are taking place in certain transit routes, which hinder a normal flow of people.

The source of data for the indicator component are cameras placed at the critical points in the City of Dubrovnik. The data presented are for the time period from May 1 until October 31 in 2019 and 2020, and from May 1 until September 4, 2021. The total number counted in 2019 was 1147 233; in 2020 it was 502 175, and in 2021 it was 582 099. The number of daily visitors is shown in Figure 2. The figure shows that the largest number of people at critical points in Dubrovnik was in August 2019. In 2020, the number of people was much lower than the average due to the COVID-19 pandemic, but the numbers in 2021 show that tourism in Dubrovnik was not as affected by the pandemic as in 2021 – in some periods in August and September the number of visitors was the same as in the best tourist year, 2019.

The threshold for the indicator Detection real transit of number of people/area/time is still not defined, but considering that UNESCO recommended the maximum number of 8000 tourists daily, that threshold was achieved in both 2020 and 2021, when maximum number of daily visitors was 6055 in 2020 and 7986 in 2021. On the other hand, the maximum number of 10 240 tourists in 2019, surpassed the recommended number. The total number of days when the number of tourists surpassed the recommended number was 47.

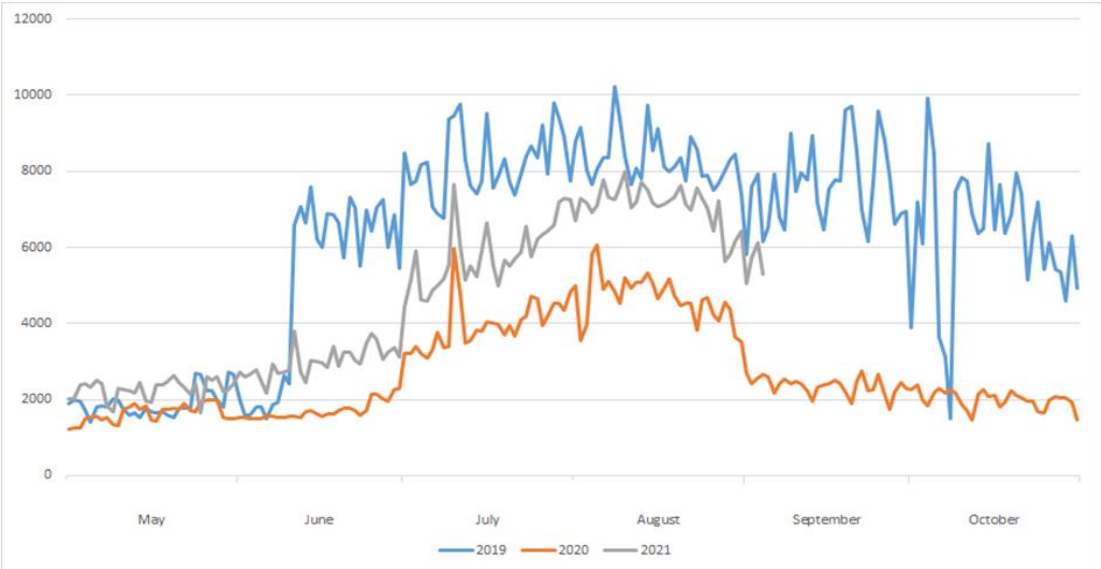

Figure 2. Number of visitors at the critical points in Dubrovnik (DURA City of Dubrovnik Development Agency).

Indicator Detection real transit of number of people/area/times also analyses the predicted number of tourists in areas where excessive crowding of people on transit routes can occur based on the information on tourist tour reservations and their route as well as to propose alternative routes. The indicator is measured through Application for predicting the number of visitors, which uses machine learning (the branch of artificial intelligence) to predict the number of people in the Old City of Dubrovnik on a given day. This data can be useful to both citizens and tourists to support optimal planning of their visits to the Old City of Dubrovnik. To predict the number, the machine learning algorithm uses various parameters such as the number of people coming from cruise ships, number of tourist arrivals and overnight stays as well as weather data such as temperature and precipitation.

The Application shows the predictions until the end of 2022 and predicts that in the following period, the Old City of Dubrovnik will be crowded for 4 days and slightly crowded for 15 days while the rest of the period there will be no crowd in the historic centre.

Saturation of accommodation facilities analyses the number of beds in official and un-official accommodation facilities, as well as the number of overnight stays in official and un-official accommodation facilities. Also, the component analyses the ratio between the number of tourists overnight stays and the number of residents. Total number of overnight stays in the City of Dubrovnik was constantly increasing until 2020, when the COVID-19 pandemic affected the world tourism. However, the data show that in 2021 the tourism sector has started to recover – the number of overnight stays was almost twice larger than in the whole 2020.

The most of the overnight stays were in official accommodation including hotels, villas, camps, etc. However, the share of overnight stays in official accommodation slightly declined when compared to the pre-pandemic period. In the period 2016-2019, the share of overnight stays in official accommodation within the total accommodation was around 65 %-70 %, while in 2020 and 2021 it was between 50 % and 55 %.

Saturation ratio of official and un-official accommodation are analysed on the yearly basis since there are no available data on the number of overnight stays by accommodation facilities, which is a reason why values of the saturation ratio are way smaller than expected. However, average annual data show that official accommodation facilities in Dubrovnik are more occupied than the un-official.

According to the Agency for sustainable Mediterranean cities and territories, threshold value for the Saturation of accommodation facilities is 93 % and it was achieved during the whole period of the analysis. The largest value of saturation of accommodation facilities was achieved in August 2016 and it was 88,07 %, which is presented in Figure 3.

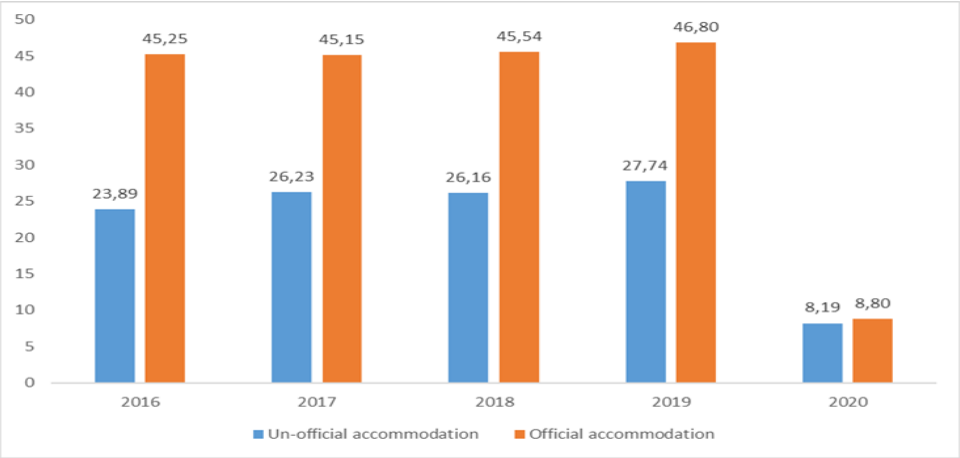

Figure 3. Saturation ratio of official and un-official accommodation facilities (City of Dubrovnik Tourist Board).

PEOPLE PERCEPTION OF OVERCROWDED PLACES

People perception of overcrowded places, brings together main elements of the tourist experience perception (both those generated by the tourist and of the population resident in the area), as a key qualitative component when diagnosing the behaviour of the system in relation to its greater or lesser saturation. It consists of five indicators: Tourist perception about adequacy of Overcrowded site experience, Residents perception of adequacy of Overcrowded site experience, Personal perception about adequacy of Security site experience, Personal perception about hygiene, sanitation and cleaning conditions site experience, and Personal perception about cultural heritage preservation site experience. All of the indicators are measured in real time as a social net perception and post-experience.

The social net analysis of the perception about Overcrowded site experience has been done using the Social searcher platform [13], using the key words Dubrovnik, crowd and overcrowded. The application searched through 11 sources including Web, Tumblr, Vimeo, Twitter, Facebook, Vkontakte, YouTube, Flickr, Instagram, Reddit and Dailymotion. The results of the analysis are shown for the period from April 5, 2013, to September 4, 2022. The total number of posts in that period was 465, out of which 141 were positive, 273 were neutral and 51 were negative.

The source of data for the Overcrowded site post-experience is the TOMAS research conducted in Dubrovnik in 2018 by the Institute for Tourism [12]. The research showed that overcrowding was the main element negatively affecting tourists staying in Dubrovnik. Most of the visitors are unsatisfied with crowds in public areas and presence of cruise passengers, followed by traffic jams, crowds on the beaches and presence of cruise ships.

The social net analysis of the residents' perception about Overcrowded site experience was carried out via the Social searcher platform, using the key words Dubrovnik, crowd and overcrowded while setting of the language was Croatian. The results of the analysis are shown for the period from January 19, 2008, to September 4, 2022. The total number of posts in that period was 304, out of which 19 were positive, 257 were neutral and 28 were negative.

The social net analysis of the perception about security was carried out via the Social searcher platform, using the key words Dubrovnik and security. The results of the analysis are shown for the period from November 30, 2005, to September 4, 2022. The total number of posts in that period was 283, out of which 93 were positive, 167 were neutral and 23 were negative.

Index perception post-experience Security analyses tourists and residents' perception of the environment security. According to the Institute for Tourism's TOMAS research, personal security is the second-best tourism supply element and it was rated as very satisfying with 92 % of visitors saying they were satisfied with personal security during their stay in Dubrovnik.

The social net analysis of the residents' perception about overcrowded site experience was carried out via the Social searcher platform, using the key words Dubrovnik, hygiene, sanitation, cleaning and garbage. The results of the analysis are shown for the period from April 5, 2013, to September 4, 2022. The total number of posts in that period was 100, out of which 33 were positive, 50 were neutral and 17 were negative.

Index perception post-experience about hygiene, sanitation and cleaning conditions also analyses the satisfaction of tourists and residents with cleanliness and hygiene of heritage spaces in order to see whether any adjustments should be made in the resources dedicated to maintaining the cleanliness and hygiene. According to the TOMAS research, perception about hygiene, sanitation and cleaning conditions is both, positive and negative. The research showed that tourists were very satisfied with tidiness of the place, ecological preservation and clean beaches. On the other hand, improperly disposed garbage, unpleasant odours and impossibility of waste separation negatively affected tourist stay.

Index perception post-experience cultural heritage preservation answers the question whether the conservation of the heritage space meets tourists' expectations. The data source for the indicator component is again TOMAS research, which showed that degree of satisfaction with cultural heritage preservation was high, with 77 % of visitors saying that they were satisfied with the richness of the cultural heritage.

CAPACITY AND QUALITY TO SERVICES ACCESS (HERITAGE AREA)

Capacity and quality to services access (heritage area), encompasses a measure of the degree of adequacy of access to strategic public services in the area: cleanliness, security, pollution, public transport and parking.

According to the data of Čistoća Dubrovnik (utility company in charge for cleanliness maintenance and waste management), the number of garbage bins in the Old City of Dubrovnik is 56, while the number of smart containers for small waste is 14 pieces, which gives the total of 70. When compared to the average number of people counted in the Old City of Dubrovnik in 2021, which is 4583 persons, it gives the value of 15,27 garbage bins per 1000 people. In the Old City, mixed waste containers are set up daily at night between 8 pm and 10 pm. They are emptied and removed from the streets in the morning between 5 and 7 o'clock. The total number of containers is 30 pieces of 240 litres. Together with the containers, the total number of bins in the Dubrovnik Old City is 100, which is 21,2 bins per 1000 people.

The total number of garbage bins in the City of Dubrovnik is 161, which together with 81 pieces of smart containers gives the total of 242. According to the assessment of the Croatian Bureau of Statistics, there is 44 743 inhabitants in the City of Dubrovnik, which means that the number of garbage bins per 1000 inhabitants is 5,41. In the City of Dubrovnik, the total number of containers is 931, out of which there are 572 containers for mixed municipal waste, 141 paper containers, 145 containers for packaging plastics, 65 packaging glass containers and 8 metal containers. When compared to the number of inhabitants, there are 20,81 containers per 1000 inhabitants. The total number of bins in the City of Dubrovnik is 1173, which means that the number of bins is 26,22 per 1000 inhabitants.

The threshold value set by the Agency for sustainable Mediterranean cities and territories for ratio people/baskets/containers is 31,2 litter bins per 1000 inhabitants, which means that the threshold is not achieved.

According to the data provided by Čistoća Dubrovnik, the average amount of waste varies from month to month. The biggest amount of waste is collected during July and August amounting to 8 tons per day. In April, May, June, September and October, the average daily amount of collected mixed waste is 6 tons, while in November, December, January, February and March, the average collected mixed municipal waste amounts to 3 tons per day.

The threshold value for volume of solid waste collection is annual average, with the toleration of 10 % exceeding. The annual average of solid waste collection is about 5 t/day, which means that most of the year, in the period from April until October, the threshold value is not achieved.

Mixed municipal waste containers are emptied daily in the morning. Small waste bins are emptied constantly during the day from 5 am to 12 pm. Streets and open gardens in the Old City of Dubrovnik are cleaned constantly during the day from 5 am to 12 pm. Intervention ratio hygiene service by area has a threshold once a day, which is achieved.

Crime rate in target area answers the question whether there is capacity to maintain optimal conditions of citizen security in heritage zones. The main aim of the component is to find out to what extent the perception of security during tourist visits is a factor that should be considered when managing mass tourism in cultural heritage areas.

The total number of criminal offences in the City of Dubrovnik was 1172 in 2016, 1316 in 2017 and 1285 in 2018. In the analysed period, the largest crime rate per 1000 inhabitants was in 2017 – 29,81. The number of robberies with violence or intimidation in 2016 was 105. The number of criminal offences and misdemeanours of all types of theft was also largest in 2016 – 107, Table 2.

Table 2. Crime rate in the City of Dubrovnik (Dubrovnik Police Department. Overview of basic safety indicators 2018/2017 and 2017/2016.

	2016	2017	2018
Criminal offences	1172	1316	1285
Inhabitants	43 950	44 149	44 376
Crime rate per 1 000 inhabitants: (total known criminal offences/total population) x 1 000	26,67	29,81	28,96
Number of robberies with violence or intimidation	105	79	84
Number of criminal offences and misdemeanours of all types of theft	107	82	88

Threshold value set by the Agency for sustainable Mediterranean cities and territories is less than 45,2, which means that in Dubrovnik the threshold value is achieved.

Air pollution ranges in heritage environmental stations answers the question whether there is capacity to maintain adequate air quality conditions in heritage areas. The objective of the component is to assess the situation and dimensions of the pollution problems in the monitoring areas.

There are two air pollution measuring stations in the City of Dubrovnik – Žarkovica and the Dubrovnik Airport, both of which are situated out of the cultural heritage area. According to the Ministry of Economy and Sustainable Development of the Republic of Croatia database "Air quality in the Republic of Croatia", the data for Žarkovica station are not available.

As regards the Dubrovnik Airport measuring station, the data for five pollutants – NO2, O3, SO2, PM10 and PM2.5 are shown in Table 3. The table shows the maximum value of each pollutant in September 2021. Hourly concentration values were used in case of NO2, O3 and SO2, while in case of PM10 and PM2.5 pollutants daily concentration values were used.

Table 3. Air quality in the Republic of Croatia (The Ministry of Economy and Sustainable Development of the Republic of Croatia database).

Pollutant	Emissions, µg/m3	Air quality
PM2,5	19,46	Good
PM10	25,296	Good
O3	166,68	Regular
NO2	15,037	Very good
SO2	40,976	Very good

Comparing the values of emissions with the ranges established for each pollutant, it can be concluded that air quality in Dubrovnik is good, since maximum emissions of PM2.5 and PM10 in the analysed period were good, emissions of NO2 and SO2 very good and emission of O3 was regular.

Waiting times in main transport public analyses whether there is a capacity to maintain fluid access to public transport in heritage zones. According to the Libertas Dubrovnik Ltd. data, there is one bus stop situated near the Old City of Dubrovnik. It is covered by 8 bus lines. Buses run every 15-30 minutes on average on weekdays and Saturdays and every 15-35 minutes on Sundays. The average delay times on 5 out of 8 lines are negligible and there are no problems

with departures from the terminal as they are within a minute delay. Average delay time for two lines is slightly longer and is about 3 minutes, while for one line it is approximately 1 and a 1/2 minute.

Threshold value for the indicator component waiting times in main public transport is less than 10-15 minutes. Data for the average waiting times in public transport around the Old City is not available, but 8 lines go near the Old City whose average departure is every 15-30 minutes on weekdays and Saturdays and every 15-35 minutes on Sundays, which means that in the worst case, waiting time for bus will be 30 minutes on weekdays and Saturday and 35 minutes on Sundays. In this worst case, threshold value is not achieved.

Percentage of free parking spaces in parking areas around the UNESCO Centre analyses whether there is a capacity to maintain a fluid access to free parking spaces around the UNESCO Centre. Around the Old City of Dubrovnik (area from Ilijina Glavica to Boninovo) there are 744 parking spaces managed by the company Sanitat Dubrovnik. The average number of free parking spots around the Old City on weekdays until 4 pm is 0, and after 4 pm it is around 40 (5,37 %). On weekends, the average number of free parking spots is about 50 (6,72 %). These data refer to the period outside the tourist season. In the tourist season, it is almost impossible to find a free parking spot between 8 am and 10 pm. There are 711 additional parking spots in the Public Garage, but the number of free parking spots during the day is not available. The threshold value for the percentage of free parking spots in parking areas around the UNESCO Centre is over 5 %. That means that threshold values are achieved out of the season only during weekends and after work hours.

RESIDENTIAL QUALITY SITE

Residential/tourist housing ratio analyses the degree of touristification of the area, i.e. whether residents have access to housing in adequate conditions. Analysis of the way of living in the historic centre of Dubrovnik, the degree of touristification of the area is huge [14; p.135]. The data of the study showed that in the Old City of Dubrovnik, there are only 568 residential dwellings. On the other hand, the City of Dubrovnik Tourist Board unofficial data estimate that in 2019, there were 794 accommodation units in the Old City of Dubrovnik. That means that 58,3 % of dwellings in the Old City of Dubrovnik are dedicated to tourist rentals (tourist apartments).

Housing value (m2): rent/buy aims at collecting the data such as the price of housing and its annual variation, usually related to “gentrification”, alluding to the process by which the original population of a sector or neighbourhood is progressively displaced by another with a higher purchasing power.

According to the data of the Ministry of Finance of the Republic of Croatia Tax Administration Office, the average price of apartments for sale in the City of Dubrovnik in 2021 was EUR 2775,49 per square meter, while the average price of houses for sale was EUR 686,15 per square meter. Prices of houses and apartments for sale in the City of Dubrovnik for the period 2016-2021 is shown in Figure 4. It shows a rapid increase in the prices of apartments per square meter and a slight decrease in the prices of houses per square meter in the analysed period.

The indicator Optimal levels of access to housing in tourist areas by local population also analyses whether tourism in the heritage area has a consequence of displacing part of the resident population towards other zones.

Based on the already mentioned Internal Census conducted in 2016, a demographic picture of the remaining inhabitants was outlined, an analysis of the main demographic indicators was made and the demographic collapse of the city population was presented according to specially processed census data from 1981, 1991, 2001 and 2011, conducted by the Croatian Bureau of Statistics. The results of the demographic study confirmed the total depopulation in the historic core of Dubrovnik

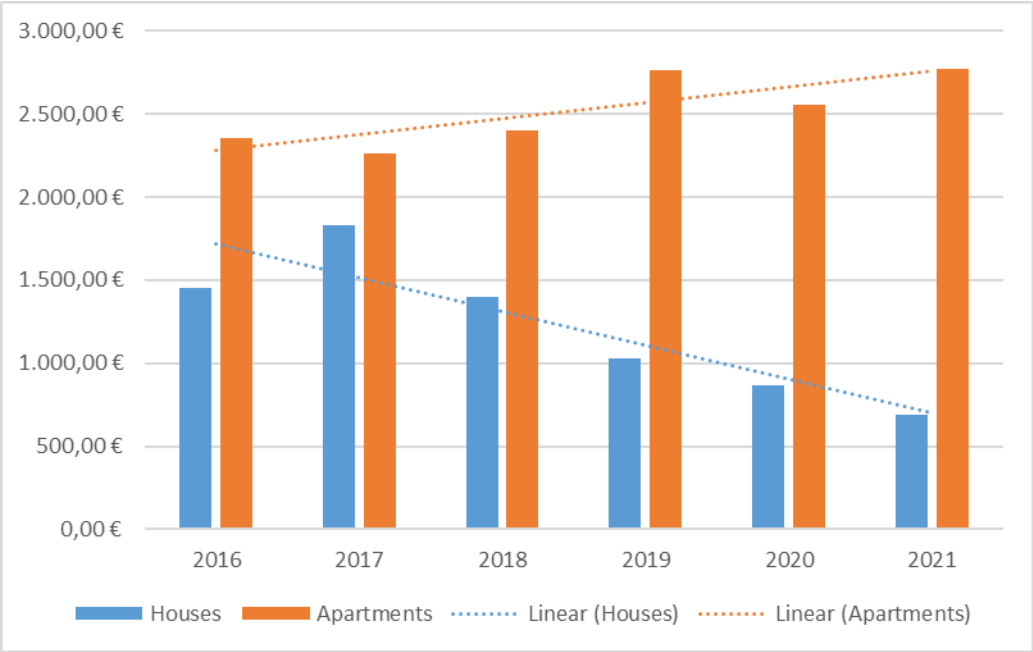

Figure 4. The prices of houses and apartments for sale per square meter (Tax Administration Office, Ministry of Finance of the Republic of Croatia).

today. In 2016, there were only 1557 inhabitants in 568 households, meaning that a quarter of that population was lost within a lapse of just five years (2011-2016). The urban image of the old city centre, which has never had fewer inhabitants before, has changed completely. The seriousness of the situation is indicated by the following data: from 1948 to 2016, the historic core of Dubrovnik lost about 65 % of its population, while in the last two inter-census periods (1991-2001, 2001-2011) it lost about 20 % of its population in every ten years period [14].

Rate and quality employment in target areas analyses whether the quality of employment in the tourism sector in the heritage areas is similar to other areas. In the City of Dubrovnik, tourism is the most important sector, which is also proved by the analysis of employment in Dubrovnik. Direct employment in tourism was calculated as the number of people employed in National Classification of Economic Activities sectors I – Accommodation and food service activities and N79 – Travel agency, tour operator reservation service and related activities. The total number of employed in those sectors was between 4631 in 2016 and 6290 in 2019. Compared to the total employment, direct employment in tourism in Dubrovnik is between 43 % and 48 % in the 2016-2021 period.

Compared to the direct employment in tourism within the total employment of the Dubrovnik-Neretva County, most of the direct employment in tourism of the County is in the City of Dubrovnik. However, it is important to keep in mind that this analysis only refers to companies. Crafts are being excluded since there are no available and comparable data at the city level.

Indicator Rate and quality employment in target areas should be compared to the region and cannot exceed it. The direct tourism employment in the total employment in Dubrovnik is between 43 % and 48 % in the five year-period, while the same ratio in the Dubrovnik-Neretva County is between 35 % and 39 %, which means that the threshold has not been achieved.

Analysis of the commercial offer in the target area answers the question whether residents have access to basic products in local shops. Since official data on the number of stores is not available, the analysis was carried out by Google Maps research. The analysis showed that in the Old City of Dubrovnik there are 38 shops – 5 retail shops, 2 bakeries, 3 pharmacies, seafood market, 1 convenience shop, 18 jewellery stores, 5 souvenir shops, 1 book store, 1 wine shop and 1 clothing shop.

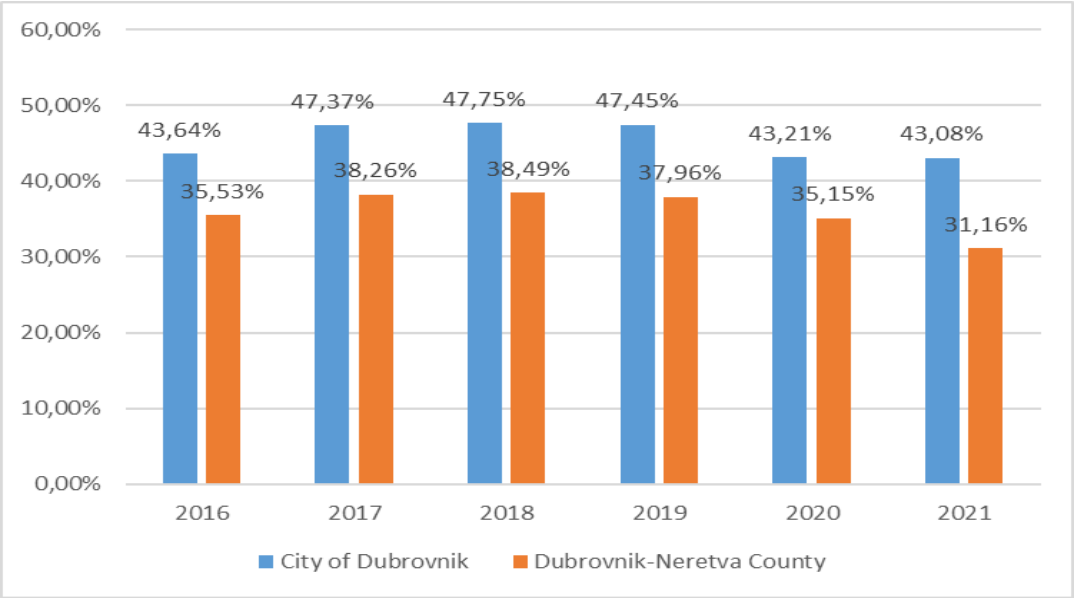

Figure 5. Direct employment in tourism within the total employment in the City of Dubrovnik and Dubrovnik-Neretva County (Croatian Chamber of Commerce, Digital Chamber).

Local price index analyses the degree to which life in the monitoring zones has become more or less costly.

Local price index for the City of Dubrovnik is not available. However, according to the data on NUMBEO the estimated monthly costs for a single person in Dubrovnik are EUR 727,34 without rent [15]. Compared to the other cities, Dubrovnik is 6,62 % more expensive than Zagreb (without rent). However, the rent in Dubrovnik is, on average, 14,14 % lower than in Zagreb.

Also, when monthly costs in Dubrovnik are compared with monthly costs in 8 Croatian cities (Zagreb, Slavonski Brod, Osijek, Sisak, Rijeka, Pula, Split and Varaždin) used for calculation of Consumer Price Index at the national level, Dubrovnik is also the most expensive city so it can be concluded that life in Dubrovnik is more expensive than in any other city in Croatia or in any other project pilot site.

Ratio between the number of tourists overnight stays and number of residents analyses the relevance of the number of tourist overnight stays compared to the local population in order to understand potential changes in social and economic aspects. Like indicators that analyse accommodation saturation, the indicator component ratio between number of tourist overnight stays and number of residents shows the largest values in August and July and the smallest in January. The largest value of the ratio was in August 2019, with 18,37 overnight stays per resident, while the smallest value of the ratio was in January 2016 with 0,58 overnight stays per resident.

Finally, the threshold value for the indicator component Ratio between the number of tourist overnights and number of residents must be smaller than one. In the case of Dubrovnik, the target is not achieved since average yearly ratio between the number of tourist overnight stays and number of residents ranged between 6,6 and 8,2 in the analysed period.

The threshold values for the indicators and whether they have been achieved in Dubrovnik are presented in Table 4.

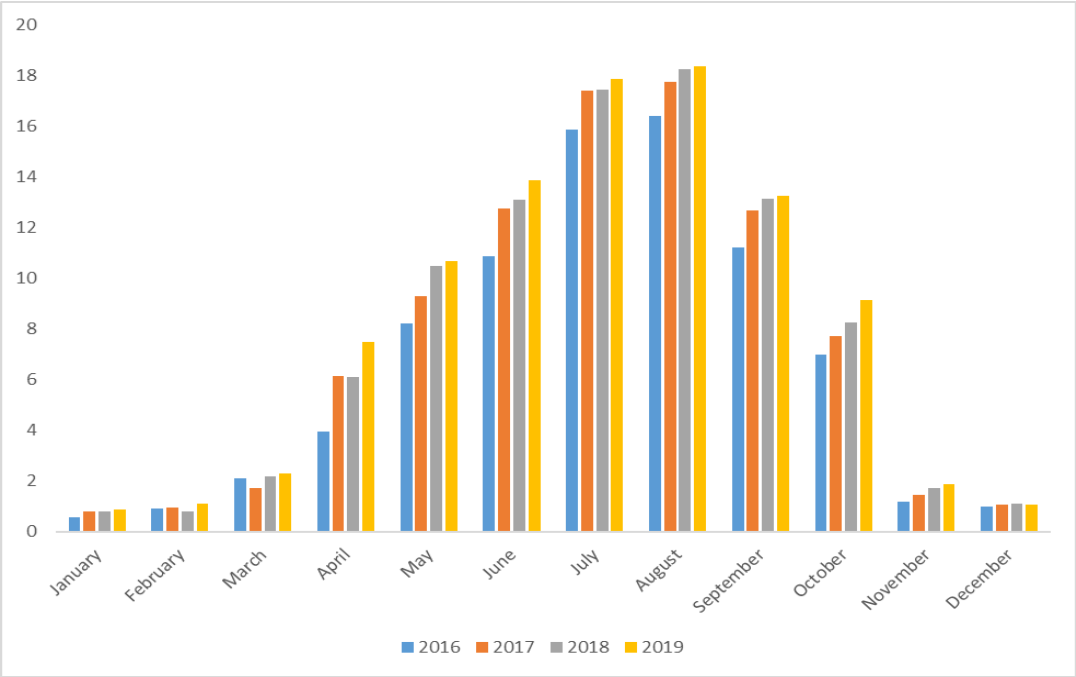

Figure 6. Ratio between the number of tourists overnight stays and number of residents (City of Dubrovnik Tourist Board, Croatian Bureau of Statistics).

Table 4. Achievement of threshold values in Dubrovnik (continued on pp.288-293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
Characterisation areas/sites of tourist value and tourism profiles	Delimitation and basic characteristics of sites subject to saturation: sites/spaces/heritage areas	535 immovable cultural assets under protection and under preventive protection 1968 registered cultural assets in the Region's area. The main tourist attractions in the City of Dubrovnik and its hinterland are the Dubrovnik City Walls, Fort Lovrijenac, The Franciscan Church and Monastery, Stradun, Cavtat Cemetery, Minčeta Fortress, Church of St. Ignatius of Loyola, Church of Saint Blaise, Dominican Monastery, St. John's	-	-

Table 4. Achievement of threshold values in Dubrovnik (continuation from p.287, continued on pp.289-293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
Characterisation areas/sites of tourist value and tourism profiles		Fortress, Fort Bokar, Synagogue, Cathedra Treasury, Brsalje Street, and the Ston Old Town.	-	-
	Characterisation of tourist profile visiting heritage areas/sites	The average age of Dubrovnik guests is 42 years. Half of the guests in 2018 (51 %) were between 30 and 49 years old. Slightly older guests (45 years on average) come from the UK and Italy, while the younger guests come from Spain (39 years), Ireland (40 years) and Scandinavian countries (40 years).	-	-
	Economic data tourism	Tourists: EUR 170 per day. Visitors from ships on international cruises: EUR 51 (EUR 59 spent by passengers and EUR 26 spent by the crew).	-	-
Access capacity charge	Number of cruise ships	2017: 443 2018: 414 2019: 486 2020: 47 2021: 139 2022 (until July): 125	Not defined	-
	Number of passengers	2017: 709 517 2018: 732 431 2019: 768 924 2020: 4 323 2021: 110 130	Not defined	-

Table 4. Achievement of threshold values in Dubrovnik (continuation from pp.287-288, continued on pp.290-293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
		2022 (until July): 121 370		-
Capacity charge of the heritage area	Capacity of saturation sites	The maximum number of tourists allowed in the Old City of Dubrovnik is 8 000 per day. The recommended duration of the visit to the Old City of Dubrovnik is 6 hours.	-	-
	Accommodation by type	2 hotels 1 Bed and Breakfast (B&B) 2 hostels 29 private accommodation facilities Total: 34	-	-
	Tourist services by type in heritage areas	206 in the Accommodation sector 266 in Food and beverage service activities 164 in Travel agency, tour operator and other reservation services and related activities Total: 636	-	-
	Restoration by type in heritage areas	63 restaurants in the Old City of Dubrovnik – 6 fast food restaurants and 3 ice cream shops. The number of bars in the Old City of Dubrovnik is 22.	-	-

Table 4. Achievement of threshold values in Dubrovnik (continuation from pp.287-289, continued on pp.291-293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
Preservation level in optimal conditions (environmental and architectural) of sites of cultural value	Environmental level sites	Temperature 18,5°C Relative humidity 58 % Air pressure 1015,1 hPa Wind ESE 3,4 m/s	-	-
Optimal levels of overcrowding of people transit	Detection real transit of nº people/area/time	Max 2019: 10 240 Max 2020: 6 055 Max 2021: 7 986	Not defined	-
	Analytics anticipated reserves management: prediction of critical values agglomerations	N/A	Not defined	-
Optimal levels of tourist overnights	Saturation of accommodation facilities	Max 2016: 88,07 % Max 2017: 86,25 % Max 2018: 84,74 % Max 2019: 84,69 % Max 2020: 40,49 %	93 %	Achieved
Tourists perception about the adequacy of overcrowded site experience	Real time perception overcrowded: Social net	30,32 % positive 58,71 % neutral 10,97 % negative	Not defined	-
	Index perception post-experience overcrowded (sample)	Bad	Not defined	-
Residents perception about adequacy of overcrowded site experience	Real time perception overcrowded: Social net	6,25 % positive 84,54 % neutral 9,21 % negative	Not defined	-
Personal perception about adequacy of security site experience	Real time perception security: Social net	32,86 % positive 59,01 % neutral 8,13 % negative	Not defined	-
	Index perception post-experience security (sample)	Excellent	Not defined	-

Table 4. Achievement of threshold values in Dubrovnik (continuation from pp.287-290, continued on pp.292-293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
Personal perception about hygiene, sanitation and cleaning conditions site experience	Real time perception about hygiene, sanitation and cleaning conditions: Social net	33 % positive 50 % neutral 17 % negative	Not defined	-
	Index perception post--experience about hygiene, sanitation and cleaning conditions (sample)	Average	Not defined	-
Personal perception about cultural heritage preservation site experience	Index perception post-experience cultural heritage preservation (sample)	Good	Not defined	-
Optimal capacity of the urban cleaning service and décor	Ratio people/baskets/containers	Old City of Dubrovnik: 21,82 / 1000 inhabitants Dubrovnik: 26,22 / 1000 inhabitants	31,2 litter bins/ inhabitant	Not achieved
	Volume of solid waste collection	January: 3 t/day February: 3 t/day March: 3 t/day April: 6 t/day May: 6 t/day June: 6 t/day July: 8 t/day August: 8 t/day September: 6 t/day October: 6 t/day November: 3 t/day December: 3 t/day	Annual average + 10 %	Not achieved
	Intervention ratio hygiene service by area	Constantly during the day	1 time/day	Achieved
Capacity to maintain optimal citizen security	Crime rate (tourism and general) in target area	2016: 26,67 2017: 29,81 2018: 28,96	Crime rate: <45,2	Achieved
Capacity to ensure permitted ranges of contamination – basic environmental	Air pollution ranges in heritage environment stations	PM2,5: 19,46 – Good PM10: 25,296 – Good	Not defined	-

Table 4. Achievement of threshold values in Dubrovnik (continuation from pp.287-291, continued on p.293).

Indicator	Indicator component	Value	Threshold	Achieved / Not achieved
conditions in heritage areas		O3: 166,68 – Regular NO2: 15,037 – Very good SO2: 40,976 – Very good		
Fluid access to public transport in heritage areas	Waiting times in main public transport	Max 15-30 minutes on weekdays and Saturdays Max 15-35 minutes on Sundays	<10-15 min	Not achieved
Fluid access to parking spaces around heritage areas	percentage of free parking spaces in parking areas around the UNESCO Centre	During the tourist season (8 am - 10 pm): 0 % Out of the season (8 am - 4 pm): 0 % Out of the season (after 4 pm): around 5,37 % Weekends: around 6,72 %	>5 %	Not achieved
Optimal levels of access to housing in tourist areas by local population	Residential/tourist housing ratio	Residential: 41,7 % Tourist: 58,3 %	Not defined	-
	Housing value (m2): rent/buy	Houses (sale): 2016: 1453,48 EUR 2017: 1832,53 EUR 2018: 1396,38 EUR 2019: 1026,89 EUR 2020: 868,22 EUR Apartments (sale): 2016: 2352,78 EUR 2017: 2261,20 EUR 2018: 2404,91 EUR 2019: 2766,30 EUR 2020: 2553,41 EUR	Not defined	-
	Population movement flow analysis: historic centre – other areas	2011-2016: -25 %	Negative change of resident number related to the middle term time series	Not achieved

Table 4. Achievement of threshold values in Dubrovnik (continuation from pp.287-292).

Optimal levels of access to employment quality in tourist areas by local population	Rate and quality employment in target areas	2016: 43,64 % 2017: 47,37 % 2018: 47,75 % 2019: 47,45 % 2020: 43,21 % 2021: 43,08 %	Compared to region, cannot exceed the region	Not achieved
Optimal levels of access by residential population to local stores and products in tourist areas	Analysis of the commercial offer in the target area	38 shops – 5 retail shops, 2 bakeries, 3 pharmacies, seafood market, 1 convenience shop, 18 jewellery stores, 5 souvenir shops, 1 book store, 1 wine shop and 1 clothing shop	Not defined	-
Higher prices in target areas	Local price index	N/A	Variation cannot exceed the variation in the region	-
Optimal ratio tourists-residents around heritage areas	Ratio between the number of tourist overnights and the number of residents	Average 2016: 6,6 Average 2017: 7,5 Average 2018: 7,8 Average 2019: 8,2	<1	Not achieved

CONCLUSIONS

The City of Dubrovnik is one of the most visited Croatian tourist destinations and often a bad example of overtourism. However, the literature overview showed that it is important to determine its degree and effective measurement and monitoring of overtourism. In this article, the monitoring of tourist flows management has been done following the system of indicators developed by the Agency for sustainable Mediterranean cities and territories. The system of indicators consists of 21 indicators divided into 6 indicator groups. This system of indicators does not monitor only tourism and tourist flows, but also the protection level of heritage site, tourist city flows using innovations and smart technology, both tourists' and residents' perception using the social net analysis, capacity and quality of services and the quality of life of residents.

The first group of indicators provides the characterization of the areas of heritage value. Old City of Dubrovnik is an area of high heritage value, including the Old City, The Franciscan Church and Monastery, Upper Corner Tower Foundry Museum, Dubrovnik City Walls, Pile Gate, Synagogue, Church of Saint Blaise, Lokrum Island, Fort Lovrijenac and City Harbour. Dubrovnik is very popular among more solvent guests and cruise passengers who, in

pre-pandemic time, used to arrive in large numbers. The average consumption of tourists is EUR 170 per day while average consumption of cruise passengers is EUR 51. The second group of indicators, Building Site/Capacity Overcrowded measures direct effects on the spaces and infrastructures. In the City of Dubrovnik, environmental levels are favourable for achieving optimal conditions of sites of cultural heritage.

The second group of indicators analyses whether the concentration of the people in transit limits a normal flow of people. In the Old City of Dubrovnik, the number of visitors is limited to 8000 per day and during the period from 2019 to September 4, 2021, the number of days when the recommended number of visitors was exceeded is 47. Saturation of spaces and accommodation facilities in Dubrovnik has also achieved the target value, so it can be concluded that tourist saturation does not negatively affect spaces and infrastructure.

The next group of indicators analyses the perception of the tourist experience. The real time analysis of the social net posts showed that most of the experience related to overcrowding, security, hygiene, sanitation and cleaning conditions are neutral. On the other hand, the post-experience analysis showed that biggest problems of Dubrovnik are crowding, improperly disposed garbage, unpleasant odours and impossibility of waste separation. Dubrovnik is a very secure city with a high level of ecological and cultural heritage preservation and clean beaches.

Further group of indicators measures adequacy of access to strategic public services in the area and it shows scattered results in Dubrovnik. Positive results have been achieved in the hygiene service, since public spaces in the Old City are cleaned and garbage bins are emptied constantly throughout the day. Additionally, the level of crime rate in Dubrovnik is also very low, while the quality of air is good. Another positive aspect of the public services in Dubrovnik is public transport since the Old City is well connected with the rest of the city with 8 bus lines that run frequently. On the other hand, the number of litter bins is not sufficient for the number of people and the volume of solid waste collection throughout the year is much above the average. Another big problem of public services in Dubrovnik is a lack of parking spots around the Old City, i.e. in both the tourist season as well as out of season, it is almost impossible to find a parking spot during the working hours in the area.

Finally, the last group of indicators analyses the effect of touristification on residential population. In the City of Dubrovnik, local residents are greatly affected by mass tourism. In the 2011-2016 period the Old City of Dubrovnik lost a quarter of its residents and during the year. On average, the number of tourists exceeds the number of residents for about 7 times. Also, the ratio between residential and tourist dwellings in the heritage area is in favour of tourists and the prices of apartments in Dubrovnik are constantly rising so most of the local residents cannot afford to buy an apartment in the city. The problem with prices does not only concern apartments, but also the cost of living, i.e. Dubrovnik is the most expensive city to live in compared to other Croatian cities. Last, but not least, Dubrovnik's dedication to tourism is visible in the analysis of employment because most of the employers work in tourism sector. It is also obvious from the analysis of shops in the Old City where most of the stores are dedicated to tourists and their needs. These results are in line with Milano, Novelli and Cheer [2, 4], and Verrisimo, Breda, Guizi and Costa [5] conclusions that overtourism leads to decreased power parity of local residents and their dissatisfaction.

The developed monitoring system showed that the tourism flows are still not affecting the cultural heritage of the City of Dubrovnik, but it is greatly affecting local residents. Tourism is the most important sector in Dubrovnik and everything is dedicated to it. Huge number of tourists and cruise passengers represent the threat to the preservation of the Old City of Dubrovnik, and it is also negatively affecting the quality of local residents' life. Therefore, it is

of the greatest importance to manage tourism in a more sustainable way, to develop a holistic approach to the management of city flows and to find the balance between tourism and its economic contributions and sustainability.

Finally, it is important to emphasise that since cameras that count the number of visitors in the Old City of Dubrovnik have been installed, there were only several days when the number of visitors exceeded the maximum recommended number. Additionally, smart solutions for dealing with overtourism already exist, the application that predicts the number of visitors, which uses machine learning (the branch of artificial intelligence) to predict the number of people in the Old City of Dubrovnik on a given day. To predict the number, the machine learning algorithm uses various parameters such as the number of people coming from cruise ships, number of tourist arrivals and overnight stays as well as weather data such as temperature and precipitation. However, at the moment, the data are used by citizens and tourists to optimize planning of their visits to the Old City of Dubrovnik, but it should be also used in the management of tourist flows in the Old City of Dubrovnik.

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HYBRID STEM INTERVENTION AS NEW POST-PANDEMIC APPROACH TO MOTIVATE STUDENTS TO STEM

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ABSTRACT

There has long been a struggle over how to increase student interest in careers in STEM and meet the labour market's need for specialised knowledge and skills. The long-standing debate at the EU level about the role of formal, informal, and non-formal education in meeting these challenges has not yet reached a clear conclusion. In the last decade, there has been a significant increase in the number of STEM programmes offered by various non-governmental organisations in Croatia. These interventions are often localised and have limited social impact, but there is a strong willingness to create an environment for their greater inclusion in the formal education system, triggered by comprehensive curriculum reform in Croatia. Motivation, especially intrinsic motivation, is a crucial driving force in our lives. In our pilot study, conducted with 6th grade elementary students, we aimed to explore the extent to which STEM interventions encourage students to learn more about the topic and whether it is possible to incorporate lessons learned from the pandemic into the design of future interventions. Our results show that there is no significant difference in student motivation after a 45-minute whole-class interactive intervention between face-to-face and virtual delivery. Although the intervention was entertaining, students perceived the science as interesting and useful rather than entertaining. Considering that students have positive attitudes toward Nature as a school subject, an early intervention with students at this age could be useful in maintaining their interest and preventing a decline in interest later in life. This finding is particularly important in the context of the transformation of the Croatian elementary school system into a "whole-day school", which provides room for incorporating this type of intervention into a regular school system.

KEY WORDS

STEM education, motivation, school, virtual, wow effect

CLASSIFICATION

APA: 2227, 2260, 2360, 3560

JEL: I21

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INTRODUCTION

EU POLICY CONTEXT

The times we live in have changed the way we work, communicate and thrive. The ongoing double (digital and green) transition has been catalysed by the COVID-19 pandemic and the energy crisis. Learning and working in a digital (virtual) environment have become part of our routine in the last two years. The EU's transition to a resource-efficient, circular, digitised, and carbon-neutral economy and the widespread use of artificial intelligence and robotics are expected to create new jobs, while other jobs will change or even disappear [1]. In 2021, over 68 million people aged 25-64 were employed in science and technology in the EU, a 2,3 % increase from 2020. The EU Skills Agenda 2030 proposes 12 actions, including "Increasing STEM graduates, fostering entrepreneurial and transversal skills". People with high skills in STEM (science, technology, engineering, and math) are critical to driving the dual transition. However, only one in five young people in Europe complete higher education in STEM, which is less than two million STEM graduates each year [1]. On the other hand, the tests from PISA show that the percentage of low performance in basic mathematical skills is stagnating (22,9 % in 2020 compared to 22,7 % in 2010), while low performance in basic scientific skills is increasing at the EU-27 level (22,3 % in 2020 compared to 17,8 % in 2010). In Croatia, the trend is similar but the figures are higher (31,2 % in 2020 compared to 33,2 % in 2010 for mathematics and 25,4 % in 2020 compared to 18,5 % in 2010 for science) [2]. One of the EU recommendations to address this problem is: "Collaboration between formal, non-formal and informal educational providers, enterprise and civil society should be enhanced to ensure relevant and meaningful engagement of all societal actors with science and increase uptake of science studies and science-based careers to improve employability and competitiveness" [3].

CROATIAN CONTEXT

With more than 75 years of tradition, the Croatian Association for Technical Culture is the highest national institution in the field of technical culture in the Republic of Croatia. It is regulated by a special law and is financed directly from the state budget. Its mission is to stimulate and promote all activities in the field of technical culture and to harmonize the activities of national associations in the field of technical culture.

Since the early 2000s, there has been a growing number of activities in the field of science communication in other STEM disciplines in Croatia organized by public institutions. It all started with universities and research institutions organizing an "open day" and a Science Festival, followed by European Researchers Night projects, as well as numerous smaller initiatives (school visits, public lectures etc.).

In parallel, there is a growing nongovernmental organization (NGO) scene active in science communication and STEM educational activities, including workshops in their own premises, public events, visits to school activities, etc. These actions are often local and have limited social impact. Evaluation of these interventions is mostly internal, without longitudinal monitoring of participants or social impact.

Prior to 2020, there were limited opportunities for national funding of science communication and STEM education projects. From the background analysis of the European Social Fund (ESF) call for improving the capacity of civil society organizations in the field of STEM, it appears that in Croatia (at the end of 2019) only 1,15 % of all civil society organizations are registered for activities related to STEM and only 0,01 % of public funds allocated to civil society at the national level are used for them. In order to increase the impact of science

communication and STEM education programs, it is important to map and evaluate the ongoing activities and establish some guidelines for future activities.

Comprehensive curricula reform of elementary and high school system in Croatia have started in 2018 with the implementation of an experimental program “School for Life”, followed by total implementation by 2021. One of the key goals of the reform is implementation of an approach based on educational outcomes, which are directed towards solving problems and critical thinking [4], which open the institutional system for novel approaches and interventions, especially in STEM. COVID-19 pandemics accelerate the implementation of novel teaching approaches, especially in a field of using digital learning tools and technology in general. The next step in the reform of the Croatian school system is the introduction of "whole-day school" [5] with a pilot phase (50 schools) planned for the 2023/24 school year, and with full implementation in 2027. This opens a new opportunity for cooperation between formal and informal education, especially in a variable part of the school day.

MOTIVATION MEASUREMENT

The impact of the intervention on students can be observed at different levels - overall satisfaction with the intervention, knowledge or skills acquired, attitude towards science or the subject STEM etc. Motivation is one of the most commonly used terms in evaluating interventions, and there are several theoretical concepts. Rosenzweigh and Wigfield evaluate the effectiveness of various motivational interventions in improving motivation in STEM through a review of the literature targeting middle and high school students. Overall, the results show that the interventions studied improve student motivation and various academic outcomes in STEM courses under certain circumstances. Intervention effect sizes varied widely, with researchers who implemented interventions reporting small to moderate effects on average. However, some researchers found large effects, while many others found mixed or no effects [6].

However, there are a number of aspects that should be considered to increase the motivational impact of the intervention. The study conducted in the USA and the Netherlands on students’ motivation and attitude towards STEM aimed to analyse motivation on two scales (controlled and autonomous motivation). It was found that the following characteristics of outreach activities were statistically significantly related to autonomous motivation and positive general attitude toward STEM: Workshop format, understanding of science, an out-of-school component [7]. Students prefer workshops to projects and lectures. Hands-on approaches at an early age when students are "doing the science" may be more affective compared to the "being a scientist" approach [8], with parents playing an important role in the process [9]. The wow effect is well known in marketing and is created by the perception of a memorable experience related to a product or service. Science communication and educational strategies from STEM try to achieve the same, especially with children. Although the wow effect is not a formal concept in educational theory, Kamstrupp has attempted to show its positive impact in teacher education in Denmark [10]. Some researchers are sceptical about the long-term impact on motivation for STEM, but the wow effect is the driving force of many social network challenges and could be useful in developing novel approaches to science communication and STEM education.

In the last decade, few studies have been conducted on STEM interventions in Croatia. Science competitions in STEM were for a long time only official activities for motivated students. Vinković and Potočnik analysed link between regional development index and student’s participation in the science fair competitions in biology, chemistry, physics, mathematics and astronomy. Students from the most developed regions of Croatia (Zagreb, Varaždin and Međimurje) participated more in science fair competitions (in all five monitored STEM

subjects) on the national level compared to students from less developed regions. The authors stressed the importance of research of interest and motivation of the students and their mentors [11]. A qualitative analysis of data gathered during a four-year longitudinal study of relations between achievement, self-competence beliefs, and career interests among students of 16 Croatian elementary schools (JOBSTEM) suggest that the impact of intervention is related to previous STEM experience, as well as family and teachers support. For the maintaining of the interest, longer interventions focused to teamwork, autonomy in activities, learning through play and giving a sense of real-life usage is important. Moving towards younger age groups, especially with lower socioeconomic status and providing materials and resources for STEM activities at home are also suggested [12].

In our pilot study, we wanted to observe how "hidden motivators" affect student motivation and whether the wow effect motivates them to talk about it, explore more, and ultimately do it themselves. In addition, the COVID-19 pandemic has shifted many activities related to STEM to the virtual world. A deeper understanding of the triggers that move students to action could help science communicators and STEM educators design post-pandemic activities that combine virtual and face-to-face elements. Preliminary results already suggest that mixed STEM interventions may be more inclusive (especially for rural areas and/or students from lower socioeconomic backgrounds) and may encourage participants to be more open and participatory [13].

METHOD

INTERVENTION DESIGN

The intervention was designed in the form of a 45-minute workshop entitled "Water" The workshop was developed by chemistry student Maja Dugandžić, the first author of the manuscript, under the supervision of Marko Košiček, who holds a PhD in chemistry. All workshops were led by Maja Dugandžić.

The workshop consisted of theoretical and practical parts aimed at introducing scientific methods and scientific research and motivating students to conduct experiments themselves. During the workshop, "hidden motivators" were delivered. Simple experiments were presented, but some of them were explained without presentation and students were encouraged to try them at home.

Through the theme of water, many multidisciplinary topics were addressed, from chemical and physical concepts (density, solvent, heat capacity, surface tension, etc.) to ecology and biology. Water is simple, well known, safe to use and all experiments (presented or explained) can be easily repeated in any kitchen without special vessels or chemicals.

This activity was designed for 6th grade Croatian elementary school students. 6th graders were selected because they are already learning about nature and scientific methods, but do not yet have separate nature subjects (chemistry, physics and biology).

STUDY PARTICIPANTS AND DATA COLECTION

Elementary schools applied to an open call published for the Ruđer Bošković Institute Open day in spring 2021. The intervention was one of the offered activities during the virtual Open day without mentioning that this workshop is part of the research study. Teachers who chose to participate in the “water” workshop were contacted and informed about the study (without scientific details), and parents of students signed a written consent for data collection for this study.

Five schools participated in this study: elementary school Vladimir Nazor, Čepin; elementary school Miroslav Krleža, Čepin; elementary school Tordinci, Tordinci; elementary school Cvjetno, Briješće and elementary school Ivana pl. Matačića, Zagreb. Four of the five schools participated in the study with the next generation of sixth graders in the fall of 2021 (the school in Zagreb did not participate due to COVID -19). The intervention took place online in spring 2021 and face-to-face in fall 2021. The total number of 6th graders who participated in this study was 187 (in the 2020/21 school year) and 141 (in the 2021/22 school year), giving a total sample size of 328.

Students were given two questionnaires, the first one a week before the intervention and the second one two weeks after the intervention. 154 students (47 %) responded to the first questionnaire and 124 students (38 %) responded to the second questionnaire. Responses were anonymous and passworded.

54 % of the paired responses were from students who had participated in the online intervention and 46 % were from students who had participated in the face-to-face intervention. There was no significant difference between the post-workshop questionnaire response rates between generations (online 36 %, face-to-face 40 %).

A total of 76 responses to the first and second questionnaires were paired beyond a reasonable doubt (61 % of the collected post-workshop responses and 23 % of all study participants). 68 % of the paired responses were from female students and 32 % from male students.

The first questionnaire was more comprehensive and included questions about attitudes toward school in general, academic achievement, socioeconomic patterns, hobbies, and interests. The second questionnaire was shorter and included control questions and questions about motivation and attitudes toward science.

ADDITIONAL DATA FOR COMPARISON AND DISCUSSION

To validate our results with other similar interventions, selected questions were included in other intervention series from our project partners at SCOPE (Virtual Arts and Culture Project). The interventions were 45-minute workshops conducted online. The topics were sound, water-earth-air, and cryptography.

The workshops took place in 22 elementary schools in 18 cities in Croatia, with more than 600 participants in 53 interventions. Responses from 3rd grade (N = 54), 6th grade (N = 53), and 7th grade (N = 54) elementary school students were collected after the event.

DATA ANALYSIS

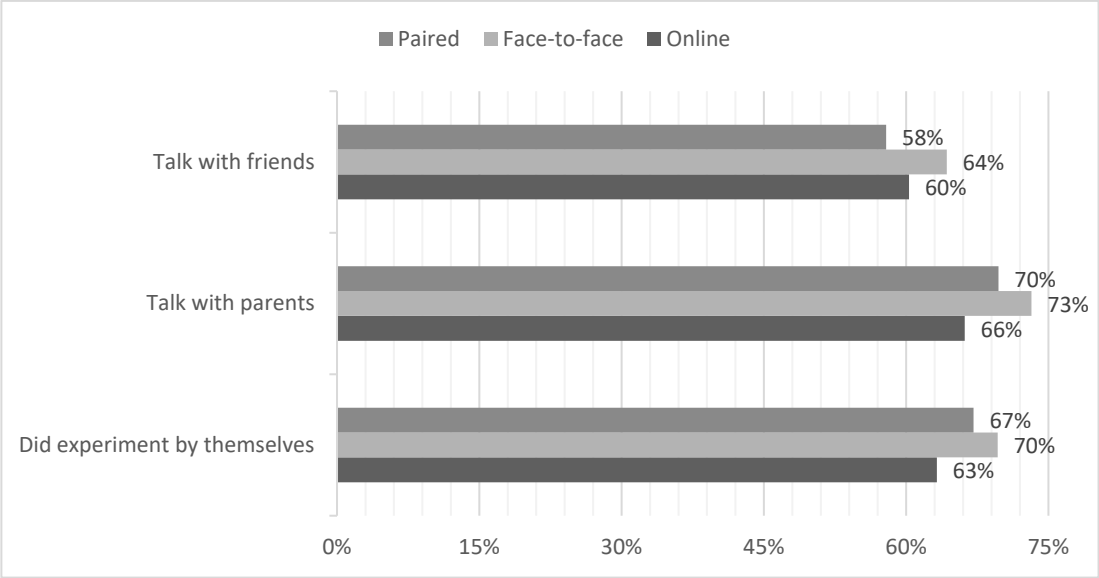
Statistical analysis was performed using difference test (difference between two proportions) and t-test for unpaired variables.

RESULTS

ONLINE AND FACE-TO-FACE INTERVENTION HAVE SIMILAR IMPACT ON STUDENT MOTIVATION

The COVID-19 pandemic has moved many activities into a virtual space. Science communication and educational activities that are interactive and personal addressed transformational issues. This study tested whether virtual interventions with a facilitator not physically present in the classroom differed from an face-to-face delivery of the same intervention in terms of student motivation. Student responses (68 online, 56 face-to-face, and 76 paired) to three questions about their post-intervention activities were compared (Fig. 1A).

A



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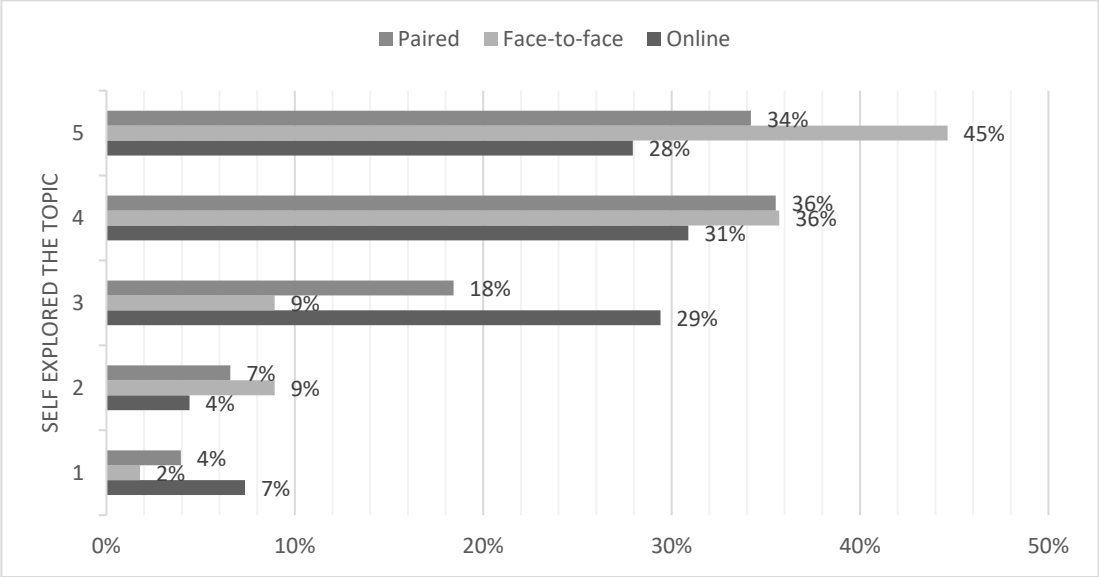

Figure 1. Activities after the intervention. **A**) there is no statistically significant difference between activities after online and face-to-face activities: did experiment by themselves (p = 0,414), talk with parents (p = 0,403), talk with friends (p = 0,649). **B**) Distribution of marks which show in which extent this intervention encourage students in research the topic by themselves moved to higher marks if intervention is done face-to-face (p = 0,024).

Because there were no significant differences in the three monitored motivational variables, a detailed analysis of the pairwise responses from the combined online and face-to-face interventions was conducted.

Students were also asked to rate their interest in the topic after the intervention by rating (1 strongly disagree – 5 strongly agree) the extent to which they agreed with the statement "This workshop encourages me to explore the topic". Nearly 70 % of students rated this statement at the two highest levels, which is consistent with the previous three motivational variables (Fig. 1B). There is a statistically significant difference in marks distribution between the online

(average 3,68) and face-to-face (average 4,13), p=0,024. This result suggests that personal contact during an intervention has a positive influence on the subjective opinion about the intervention, but not on the stimulation to concrete actions (e.g., to repeat the experiment themselves).

To validate our findings, we compared them to interventions delivered by our partners to sixth graders in the same school year by different facilitators on different topics. About 79 % of the students who responded to the questionnaire indicated that they tried to repeat the experiments at home. There is no statistically significant difference between frequency of this answer between our and this intervention Virtual Arts and Culture Projects (p = 0,138). Interestingly, motivation decreases sharply in 7th grade, where only 17 % of the students who answered the questionnaire indicated that they tried to repeat the experiments at home. This striking result should be investigated further (Fig. 2). Third graders are probably still too young to do the experiments themselves, so this activity depends on parents' time and willingness to participate.

The question about self-exploration of the topic was a yes/no question, so it is not possible to fully match it with our results, but about 1/5 of the participants indicated that they were exploring the topic themselves. Similar to the sixth graders' responses are the third graders' responses, but there is also a significant decrease in seventh grade, which is consistent with the previous question (Fig. 2).

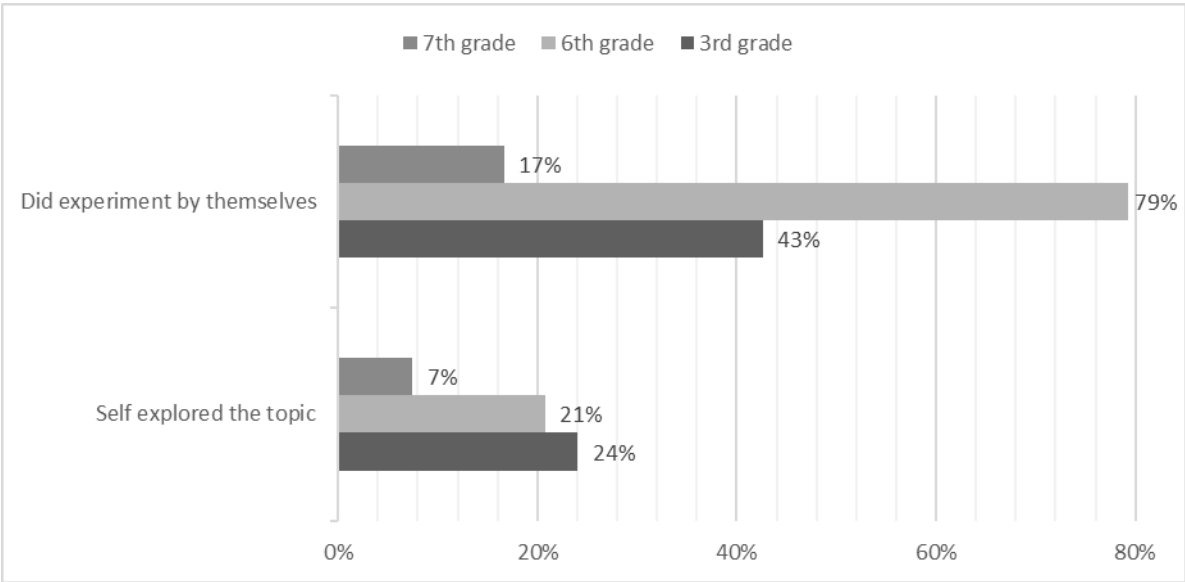

Figure 2. Data comparison with other intervention and age groups. 6th graders were the most active in experimenting at home (no statistically significant difference between frequency of this answer between our and this intervention (p = 0,138). Self-exploration of the topic was yes/no question, so it is not possible to fully adjust it with our result.

WOW EFFECT IS NOT JUST ENTERTAINMENT

In both questionnaires, students were given a set of five words from which to choose one that best described science. The distribution of responses is shown in Fig. 3. 32 students (42 %) chose different words in both questionnaires. There is a notable but not statistically significant decrease (p = 0,084) in the word "difficult" - 4 students change it to "useful" and 3 students to "interesting" after the intervention. Although there is an increase in "interesting" it is not statistically significant (p = 0,139). Only one student changed the selection from "useful" to "difficult" after the intervention. There was only one selection "boring" before the intervention, and it was replaced by "interesting" after the intervention.

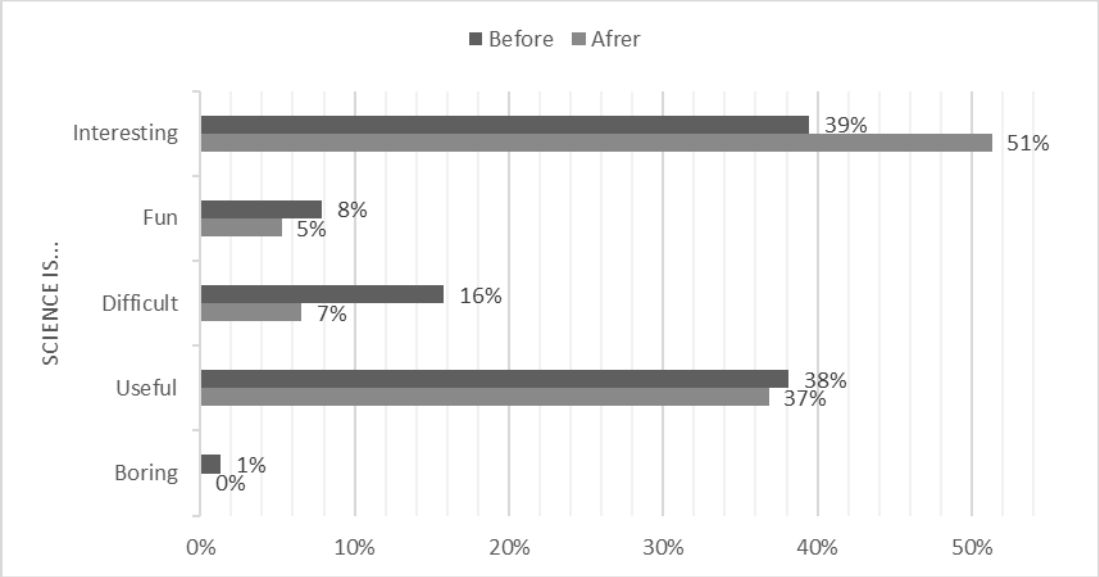

Figure 3. Distribution of selected words which best describe science before and after the intervention. There is no significant difference in the distribution of most selected words (interesting and useful), as well as for word difficult although the difference is notable (p=0,084).

Interestingly, the distribution of selected words did not change when we filtered out only the responses of students who indicated that they try to conduct experiments at home (N = 51) (Fig. 4). The students who described science as "difficult" also attempted to conduct experiments themselves. Next to the word "difficult", the word "fun" was the second lowest selection, decreasing slightly after the intervention.

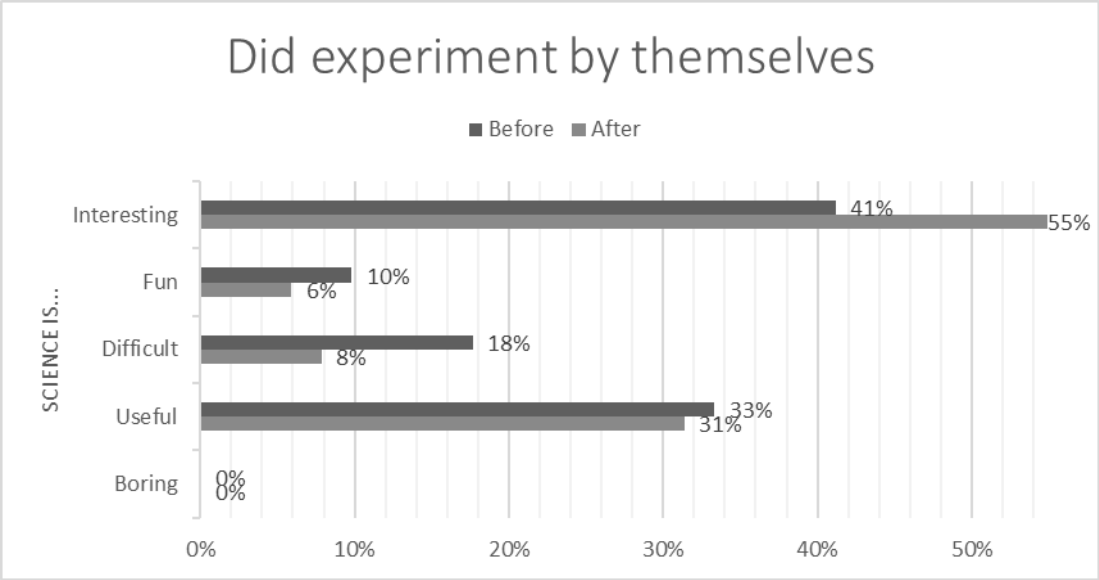

Figure 4. Selected word distribution among students which did experiment by themselves at home after the intervention. The distribution is similar to all answers presented in Figure 3.

Comparing this result with the responses collected after the partners' interventions (Virtual Arts and Culture Project), the cumulative selection of the two most important words "interesting" and "useful" was similar, but with a different ratio (51 % "interesting" and 37 % "useful" vs. 32 % "interesting" and 47 % "useful"). This may be due to different topics that can be related to real life problems (useful) to different degrees. The seventh graders' responses were consistent with the sixth graders' responses. The distribution of the selected words among

third graders varied widely. “Fun” was chosen more often in third grade than in sixth and seventh grade. At the same time, "boring" was chosen 6 % of the time, and “useful” was chosen much less frequently. The frequency of “difficult” is also increasing (Fig. 5).

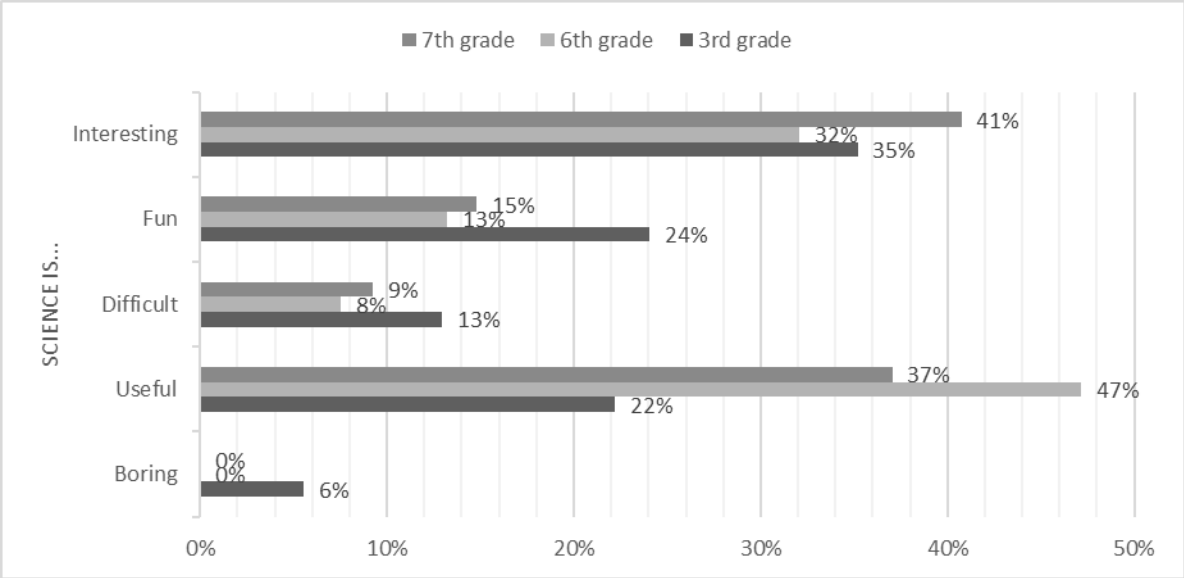

Figure 5. Distribution of selected word in partners’ interventions in three age groups. Distribution of the selected words in 3rd graders differ from 6th and 7th graders in the selection of the less frequent selections – “fun”, “difficult” and “boring”.

NATURE IS A ONE OF THE FAVOURITE SCHOOL SUBJECTS IN 6TH GRADE

Students in our cohort completed 5th grade with an average grade of “very good” (4,54, rank 3-5) and are equally distributed in general feeling about the school. In the statement “I like going to school” 38 % disagree, 33 % agree and 29 % have a neutral answer. On the other hand, 67 % of them say that it is easy for them to complete their schoolwork.

Overall, their favourite subjects are foreign languages, history, and nature, while technical culture, musical culture and mathematics are less popular (Fig. 6).

Mathematics is generally disliked. Mathematics is one of the least liked subjects in our study. 19 % of students like solving math problems, and 66 % of students say their classmates dislike math.

In contrast to math, nature is one of the top 3 subjects in school and students consider themselves good at the subject. 68 % of students say they like exploring new things, and 58 % of them say school makes them think and develop new ideas. Although these are indirect indicators of science education, students do not directly associate this with science. The statement “Science is taught in 7th grade” is disagreed with by 33 %, 36 % gave a neutral response, and 31 % agree with the statement. Slightly more of them agree with the statement “In school we learn about science and research” (15 % disagree, 34 % neutral, and 52 % agree). Students are also neutral about the statement “At school we often do experiments” (30 % disagree, 34 % neutral, 35 % agree).

The majority of students claim to be good at computer science (72 %) and nature (63 %), while only 42 % claim to be good at mathematics (Fig. 7).

Lower elementary students’ positive attitudes toward science (before they are formally taught chemistry, physics, and biology) provide room for more activities and interventions in students’ free time. In our study, only 2 of them report participating in STEM activities in their free time,

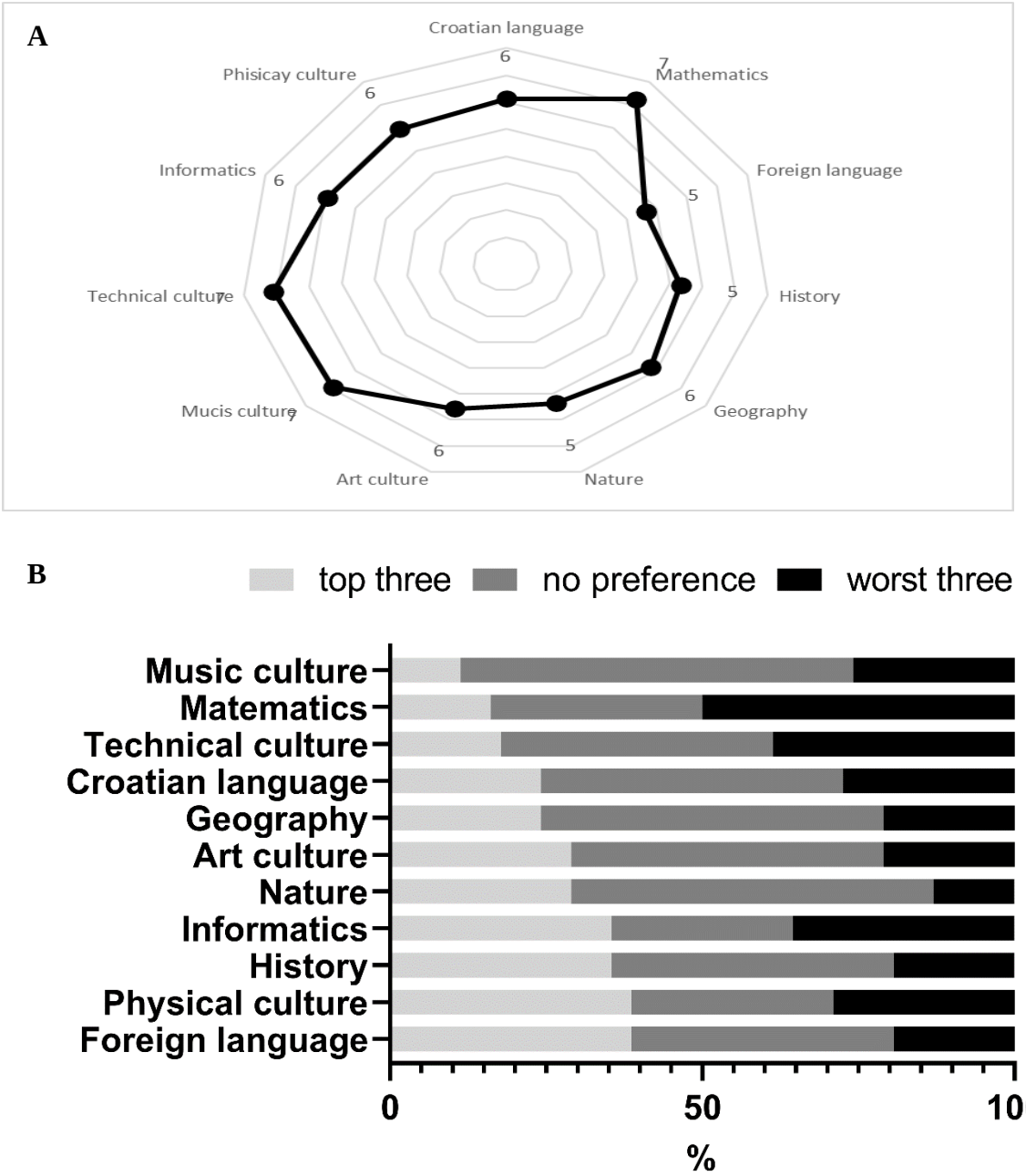

Figure 6. Distribution of ranking of the school subjects overall average (A) and top three and wors tree (B).

and 5 of them watch documentaries on TV. Most of the students (more than half of them) spend their free time in front of TV (series and movies) or on social networks. Between 40 and 50 % of the students said that they play sports, video games, or paint/sculpt.

LIMITATIONS AND FUTHER RESEARCH

The main goal of our pilot study was to develop a motivational monitoring tool that can be adapted for broader use in STEM interventions. Our goal is to create a functional instrument that can be integrated into standard project evaluation forms and provide valuable feedback to STEM educators and science communicators. The hybrid model provides the ability to quantify post-intervention activities. The next step is to link the "hidden motivators" to supplemental materials that can be used for do-it-yourself activities and/or deeper exploration of the topic after the intervention.

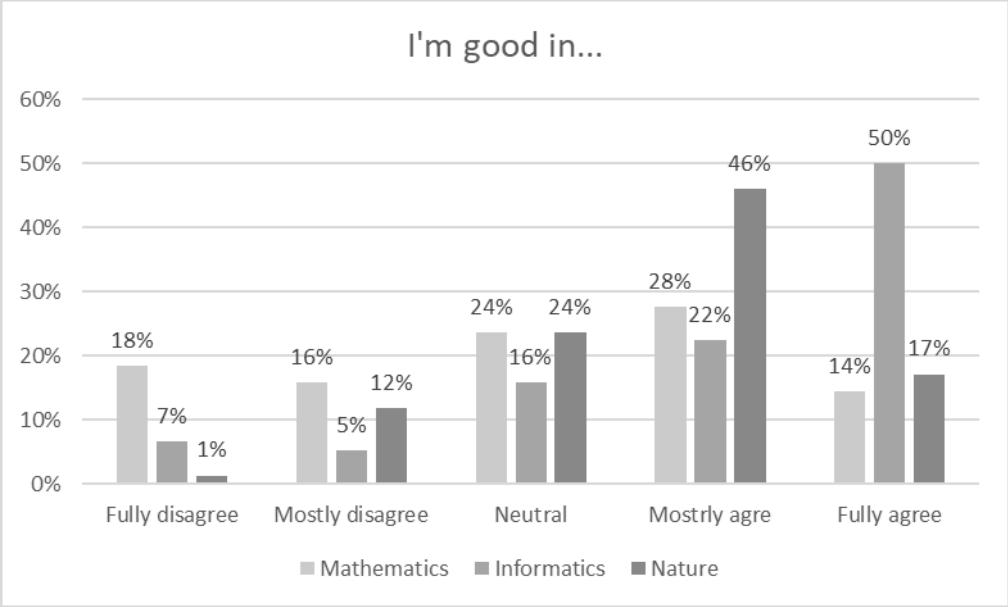

Figure 7. Distribution of self-estimated subject competence.

To provide recommendations for broader application of the tool, we tested our design on a controlled sample. The designed 45-minute workshop was delivered virtually and face-to-face by the same presenter in the same schools in collaboration with the same subject teachers in two consecutive generations of sixth graders. Because our sample is relatively small and not representative, our findings need to be validated in planned broader research.

CONCLUSIONS

Our study suggests that 45-minute interactive workshop-like interventions can motivate students to independently explore STEM topics, regardless of their grades or attitudes toward science. Nature is a widely accepted subject, and interactive activities can provide much more than just the wow effect. Unfortunately, access to optional STEM activities (offered by the academic community and/or NGOs) is not evenly distributed in Croatia. Incorporating these types of activities into "whole-day school" may partially overcome this problem. Our findings suggest that online versions of activities may be a good alternative while the system is being developed. Future collaboration among key stakeholders-schools, government, academic community, and NGOs-is a prerequisite for scaling up ongoing activities and experience.

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INITIAL CONSIDERATION OF THE ENTERPRISENESS OF THE UNDERGRADUATE STUDENTS IN CROATIA

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ABSTRACT

The article discusses the interplay between the enterpriseness and higher education. Current attitudes toward enterpriseness of the Croatian undergraduate students of mechanical engineering were collected partially with a questionnaire. The attitudes are analysed and their alignment with the general technology trends discussed.

KEY WORDS

enterpriseness, venturesomness, higher education institution, mechanical engineering, Kranzberg's laws

CLASSIFICATION

JEL: I25, J23, O14

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INTRODUCTION

Enterpriseness is a general human characteristic, observable in different fields. It is related extensively to the entrepreneurship, but also to the creativity and innovativeness. Ranging from shorter-in-time chapters of one's life to life-long endeavours, it presents the unavoidable, constantly present, often ubiquitous impetus for final result, which is a change spanning forms from local improvement in life to global, historical technological changes. That makes the enterpriseness rather important for our whole civilisation.

A spontaneously arising question is in what amount can the enterpriseness be cultivated, that is learned, either as an accompanying part or as the central point of an education process? In addition, do we already have developed and reliable methods for determining the portion of the enterpriseness that is intrinsic to an individual?

There is extensive literature covering inclusion of enterpriseness-related topics into education, ranging from initial education [1] to higher education [2], along with informal approaches [3]. The topic is far from resolved, partially because of the dynamics character of the enterpriseness' approaches in the more digitised world.

This article has twofold goal. On the one hand, it discusses how enterpriseness is intertwined with the technology basis, with the later formulated in the form of Six laws of technology by M. Kranzberg [4]. On the other hand, as an initial additional contribution, we collect and analyse the preliminary data about the attitudes toward enterpriseness that some undergraduate students of mechanical engineering have.

In section two, we present theoretical framework and critically approach the role that enterpriseness has in it. Section three is devoted to questionnaire formulation and presentation of the collected results. Section four summarises and concludes the article.

RELATING ENTERPRISENESS TO TECHNOLOGY

REPRESENTATION OF THE TECHNOLOGY

On a general level, in this section we represent the technology basis, and tackle its role in society using the Kranzberg's Six laws of technology [4]. In this subsection all these laws are listed, for completness. In the second subsection we relate the enterpriseness to first four of these laws.

Kranzberg's First Law of technology read as follows: Technology is neither good nor bad; nor is it neutral [4]. In order to understand it, one must take into account that technology is applied or introduced within some society. That application influences and changes lives of a group, usually of many people. Moreover, the change itself is a process, and eventually brings about a set of consequences. The corresponding dynamics needs time to develop and conduct. Dominant and additional consequences of introduction of a particular technology change during some time span. Because of that, a consequence that was in some time period considered as a good for a group of people tackled by it, can be considered by same group as bad in a different time period, still within a time span of the technology's consequences. There are other possibilities, in that within the same time period for a part of influenced people the consequences are good and for other part of influenced people bad. However, since technology induces a change, it is constantly evaluated as a good or bad, thus not neutral.

Kranzberg's Second Law of technology read as follows: Invention is the mother of necessity. In order to understand it, one must take into account in more details the typical S-curve pattern of innovation [5, 6], as a specific manifestation of the dynamics of innovations [7]. After the initial period of introduction of a technology, a majority of population starts to use it. Gradually,

from habit, through being something useful technology adoption becomes a necessity in order that someone is aligned with the majority of the population.

The Third Law of technology states that technology comes in packages, big and small. Kranzberg himself states that the notion of package other people denote as a system. The meaning of that law is that one cannot separately introduce a single change in the society. There is as a rule a myriad of connected changes, a sequence of related innovations and inventions, that in the end result in new technology. In that sense, introduction of a technology is like making of a chain – one needs a lot of links connected, each link must function properly and each link is necessary.

The Kranzerg's Fourth Law of the technology is "Although technology might be a prime element in many public issues, nontechnical factors take precedence in technology-policy decision". The role of humans in directing the technology is thereby implicitly considered as a crucial. It does not simply mean that humans conduct all the research, development and other types of work underlying the introduction of a technology. Instead, it emphasises the facts that technologies which are considered relevant and understandable by a given population, eventually develop in encouraging social environment, have more possibilities to assure funding, to utilise existing skills and tools, etc. Overall, they have the larger probability for development and introduction in comparison with the technologies that are not considered relevant, or that are not understandable to a majority of people.

The remaining two laws ask for a much broader context and discussion in order to be sufficiently covered and understood as the previous four. Kranzberg's Fifth Law: All history is relevant, but the history of technology is the most relevant. Finally, the Sixth Law of the technology states that technology is a very human activity – and so is the history of technology.

ENTERPRISENESS WITHIN THE LAWS OF THE TECHNOLOGY

Regarding the First Law of technology, it is in fact impossible to predict precisely possible consequences of introduction of a technology. But one may expect that thorough thinking about possible consequences, during research and development of a technology as well as during other phases of its introduction, contributes to lessening the outcome of bad consequences and to maximising the outcome of good consequences. That can be augmented by introducing relevant classes into regular, formal or informal education since that includes also the enterprisers. Examples of relevant classes include classes about ethics in technology related disciplines, as well as classes about systems theory. With that approach one may argue that short- and middle-term consequences of a technology can be in a larger portion good. Regarding long-term consequences one may argue that they will be partially influenced with middle-term societal dynamics that considerably lessen the possibility to predict them in a reliable amount nowadays. Yet, that considered time span also provides significant period for timely observation of possible bad consequences and for timely development and application of measures that will lessen these.

Second Law of technology point to one fact that is in the basis of human society, a constantly conducted pattern: change in the technological level causes changes in society, which brings about possibility for further changes in the technological level. In itself, that pattern is neither good nor bad, but also not neutral (before proceeding let us emphasise that the very formulation of the First Law of technology has been here applied in a meta-theoretic way onto the Second Law of technology). If that is generally constant, repeatable pattern, then one can discuss and (also on the general level) prescribe parts of that pattern which can have important consequence onto some person's enterpriseness and corresponding initiatives.

Aforementioned relating the enterpriseness with the First and Second Laws of technology relied on the emphasising the possible consequences, that implies somewhat more analytic approach. Yet, the synthesis of the consequences and its causes in the dynamics of technologically modified society, must be constantly taken into account. The way that incorporates partially analytic and partially synthetic point of view is the systems point of view, as developed within the systems theory and systems thinking. Its importance for the proper evaluation of the technology was identified in the aforementioned of the alignment of the enterpriseness and the First Law of technology. Here one encounters additional aspect – a package (or a system) gradually emerges out of the large number of inventions and innovations, which has diffused through society. Innovators, one type of the enterprise people, the people who creates them are naturally important for existence of the inventions and innovations. Yet, another type of enterprise people, the organisers, is also important. The organisers are people who combine existing innovations and inventions with other characteristics of the society and thereby form that very self-contained, robust and sustainable package (the system) that underlies the notion of the technology introduction.

In the context of this article, the Fourth Law of technology stresses previously stated need for proper inclusion of ethical concepts into regular education, so that it maximally influences the enterprisers.

DATA COLLECTING AND ANALYSIS

DATA COLLECTING

Data collecting was taking place using the questionnaire, during summer and autumn od 2022, among the students of the technical profile of the University of Zagreb, in particular of the undergraduate and graduate studies Faculty of Mechanical Engineering and Naval Architecture. The purpose of the data collecting was to gain some insight about the students' experiences of non-technical aspects and problems related to their technical work. The questionnaire formulated was of preliminary character and the results presented here are on the one hand also the basis for further, more detailed and thorough collecting of data.

The questionnaire was given during the seven university classes belonging to different study areas. Classes were chosen following the several criteria. First criterion is that the students know their study in some extent, both in the organisation of the study and in the content of the classes. That was fulfilled by giving the questionnaire to graduate students. The second criterion is that classes are connected to professional areas that are considered rather novel and innovative, to be contrasted with the classes belonging to well established professional areas, that are considered as requiring presumably application of previously gathered knowledge. Overall, such a criterion should be fulfilled at the individual level, by students that (answering the part of questions) profile themselves as enterpriseners. One may argue that it is partially included along by choice of the classes. Naturally, there are many other classes that fulfils both stated criteria.

The students were asked to fill the questionnaire during the regular classes, in agreement with the faculty and corresponding professors. Time span of the questionnaire was initially determined by pandemic measures, that restricted the access to the classes and communication among the students and the faculty personnel and eventually disabled filling the questionnaires until the second half of the 2022. The questionnaires were printed on paper and filled during July and October of 2022, during regular face-to-face classes. One of the authors was always present during the questionnaire filling, but altogether there was no additional question asked by the students. We considered the questionnaire to be filled if all closed-type questions were answered. There were 56 completely filled questionnaires, all used in subsequent analysis. Among these, there were altogether three questionnaires containing writen answers to the open

type question and its sub-question. Collected answers were transcribed into Google-form for questionnaire analysis.

The questionnaire consists of nine questions; eight of the closed type with given answers and the last one of the combined type. Seven of the closed-type questions asks for precisely one answer, while the eight closed-type question allows the multiple answers. Some of the questions of the closed type are listed in the figures. The question of combined type has one closed and one open sub-question. Its closed sub-question asked the students to address the main reason for not doing sufficient number of simulations and/or models (including not doing them at all). The accompanied open sub-question asked the students to describe why they chose a particular reason. In addition, since among the list of given answers included the money, in case that the students marked it as a reason they were additionally asked to describe what would they use any additional money for. In order for the questionnaire to be concise, we did not include into it many other questions, rather relevant for the topic.

The questionnaire is stated as follows:

1) How old are you?
2) What is your study year?
3) Where did you finish your middle school?
4) Do you make privately objects from out of different materials (metal, paper, cardboard, wood, stone, plastic, textile, …)?
5) Do other people (parents, cousins, neighbours, friends, …) help you in making the objects?
6) Do you make computer simulations of the objects that do not exist yet?
7) Do you plan or wish to make objects and computer simulations that do not exist yet?
8) If you do not make such objects or computer simulations, or make them in too small a number, what do you consider to be main reason for such a case (multiple answers possible)?

DATA ANALYSIS

Basic statistic was conducted on the received answers, having in mind that their total number is rather small for reliable extraction of eventually possible, additional characteristics.

Most of the students, and their average age is 23 years. Since classes during which the questionnaires were filled belong prevalently to graduate study, this is to be expected. There are few rather young students, which is probably a consequence of their starting the elementary schooling in earlier age than average children, along with few older students. Some of the previous statements are along with the answers to the second question, since 46 (82 %) of the students are the graduate students.

Prior to entering the university, students were in 28 different middle schools, mainly in Croatia, but some also in neighbouring countries. There were no additional questions to find out whether these schools are vocational schools or gimnasia.

Regarding three further questions (numbers 4-6) students prevalently do not make any of asked products. In particular, 68 % do not make any objects, while 82 % do not make computer simulations. Thus, out of the 32 % of students who make some objects, the 56 % of them conduct computer modelling. For the present moment we cannot relate that percentage to other data, thus to contextualise it. Before proceeding let us note that in general there are students who make objects without conducting computer simulations as well as students who conduct computer simulations without making the objects, along with the students who do both these actions. Moreover, out of the 32 % of student who make some objects, the 78 % of them use some sort of help from other people (family members, relatives, friends, ...). We do not have

additional data to check what percentage of the help provided belongs to advices and additional knowledge, and what to mere physical help in case that making of some object requires simultaneous work of two or more people.

Regarding the seventh question, 60 % of students wish to make objects or their computer models.

Regarding the eighth question, majority of students (60 %) list lack of time as the main reason preventing them from making objects or conducting computer modelling. Having in mind that generally the corresponding undergraduate and graduate studies are considered as demanding ones, that seems consistent. Other listed obstacles for individual student making of objects or conducting computer simulations are: lack of knowledge (49 %); lack of will (36 %); lack of appropriate tools (30 %); lack of raw materials (19 %) or something else. In additional subquestion it was clarified in three questionnaires that something else was money (2 answers) and tiredness (1 answer). If provided with additional money, both students would buy additional tools, and one of them also the licensed software. The answer about tiredness belong to the student who privately work, so if eventually too tired to make some objects in the small available free-time.

Overall, most of the students are concentrated on the regular studies, and that leaves them too small time for additional professional endeavours like is making objects and/or conducting computer simulations. If a change of that is wanted than the most prospective way seems to be modification of regular classes. Individual work of students is rather rare, yet additionally demanding and in fact more than fulfils their desire for making objects and conducting computer simulations. It is to be noted that the questionnaire was conducted among the students that regularly enrolled the classes, so one may expect that among other groups of students there is a larger number of the students who spend more time on making objects or conducting computer simulations, for their individual purpose or as employees or contractors.

SUMMARY

Enterpriseness is a general, rather fundamental human characteristic, manifested in diverse fields. It is insufficiently researched, not sufficiently resolved, thus many times it is interpreted as the enterpreneurship, but also as the creativity, ingenuity and related human characteristics.

In this article we related two fundamental notions: enterpriseness as an individual characteristic with technology as a collective characteristic. The emphasis is put onto the education for enterpriseness in order for it to contribute optimally to further technology progress. Data initially collected for grounding our approach are analysed.

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REVIEW OF DACE-KRIGING METAMODEL

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ABSTRACT

This paper presents a conceptual review of the kriging metamodel that is introduced for the design and analysis of computer experiments (DACE). Kriging is a statistical interpolation method to build an approximation model from a set of evaluations of the function at a finite set of points. The method originally developed for geostatistics, and it is now widely used in the domains of spatial data analysis and computer experiments analysis. The main difference between these domains the dimensionality of the problems. Geostatistics and spatial data are mainly deal with the coordinates. Computer experiments, simulation outputs and other engineering problems have multidimensional input variables. With this study, it is aimed to examine the limitations of the prediction performance of the DACE-kriging metamodel. The result of the study shows that the regression part of the DACE-kriging metamodel is the most important part to develop an approximation, and if there is a spatial relationship of the residuals, kriging part will also contribute to the improvement of the prediction performance. Otherwise, kriging will have no contribution to the DACE-kriging metamodel, and even worsen the prediction performance. If the regression part perfectly fit to the observations, the residual will have poor spatial relationship and the kriging part will be meaningless anymore.

KEY WORDS

DACE-kriging, regression, basic kriging, correlogram

CLASSIFICATION

JEL: C15

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INTRODUCTION

Kriging term covers several spatial interpolation models. Kriging theory was originally developed as a geostatistical interpolation method [1]. The kriging model makes predictions at unobserved locations using a linearly weighted combination of observations. Each observation influences the kriging prediction is based on geographical proximity to the unobserved location, the spatial spreads and the pattern of spatial correlation of the observations. Kriging models are meaningful only if the observations are spatially correlated. The kriging weights are recalculated using the appropriate variogram or correlogram model for each prediction point. There are many kinds of kriging in the literature such as simple kriging, ordinary kriging, universal kriging, cokriging, median polish kriging etc. [2].

Sacks et al. [3] presented a modified kriging approach as a metamodel to deterministic computer experiments. The use of kriging metamodels has been remarkably effective for global metamodeling in the design and analysis of computer experiments (DACE) community when the simulation models are complex and/or very expensive to run [4]. Their approach is a hybrid method that combines a regression between the output variable and input variables with the simple kriging (SK) of the regression residuals. Firstly, a polynomial regression model is applied to the outputs and then basic kriging applied to the residuals. Their main contribution to the kriging literature is expanding of the problem dimensions from two-dimensional coordinate to the high dimensional computer experiments. Additionally, they have used high dimensional correlogram models instead of variogram mostly used in geostatistics to find the kriging weights. Prediction at each new point is performed by summing the predicted trend and residual. The parameter set used for the regression part are estimated once for the whole search space, and for the kriging part the weights are re-estimated at each new point. In the literature it is known that Regression models are local and kriging models are global. Kriging models are flexible because of the diversity of the correlogram model obtained from the experiments. Therefore, it reveals the importance of the kriging part to develop a global metamodel for the whole search space.

There are several names of this method in the DACE literature. Some of them are as follows. Kriging [3, 5-16], spatial correlation metamodels [8, 17, 18], Gaussian process models [4, 19, 20], Gaussian stochastic process models [21, 22], Gaussian kriging [21] are used as the name of the method in the related references. In the geostatistical literature this method is called regression kriging [23, 24]. Some authors variously call this method as regression with residual simple kriging [25], detrended kriging [26, 27] and residual kriging [28, 29]. I prefer to use “DACE-Kriging” in the metamodeling process as the same meaning with the “regression kriging” in Geostatistics as the name for this method to prevent some misunderstanding because the kriging term refer to a general class of geostatistical interpolation methods.

The aim of this study is to examine the limitations of the prediction performance of the DACE-kriging metamodel. The results of this study show that the regression part of the DACE-Kriging model is the most important part to develop an approximation, and if there is a spatial relationship of the residuals, kriging part will also contribute to the improvement of the prediction performance. Otherwise, kriging will have no contribution to the DACE-Kriging model, and even worsen the prediction performance. If the regression part perfectly fit to the observations, the residual will have poor spatial relationship and the kriging part will be meaningless anymore.

Remaining of this article as follows. Model formulation of DACE-Kriging metamodel is presented in Section 2, numerical examples are given in Section 3, and Section 4 presents conclusions.

MODEL FORMULATION OF DACE-KRIGING METAMODEL

DACE-Kriging metamodel is a mixed estimation method that is a combination of multiple regression methods and simple kriging. It can be defined as the estimation of residual values obtained from the difference between the estimation values made by methods such as regression and the observation values by kriging method [3]. Simply, prediction at each new point is performed by summing the predicted trend and residual. Predicted trend is obtained by linear or quadratic regression (or higher order) and predicted residual is obtained by simple kriging applied to regression residuals.

Model assumptions of $\mathrm{Y}(\mathbf{x})$ are given in the followgin equations:

$$\mathrm{Y}(\mathbf{x}) = \mathrm{M}(\mathbf{x}) + \mathrm{Z}(\mathbf{x}), \tag{1}$$

$$\mathrm{M}(\mathbf{x}) = \sum_{j=0}^{b} \beta_j f_j(\mathbf{x}), \tag{2}$$

$$\mathrm{Z}(\mathbf{x}) = \mathrm{Y}(\mathbf{x}) - \mathrm{M}(\mathbf{x}), \tag{3}$$

$$\mathrm{Z}(\mathbf{x}) = \mathrm{Y}(\mathbf{x}) - \sum_{j=0}^{b} \beta_j f_j(\mathbf{x}). \tag{4}$$

DACE-Kriging predictor is given in the following two equations:

$$\hat{y}(\mathbf{x_0}) = \sum_{j=0}^{b} \beta_j f_j(\mathbf{x_0}) + \sum_{i}^{n} \lambda_i \, z(\mathbf{x_i}), \tag{5}$$

$$\hat{y}(\mathbf{x_0}) = \sum_{j=0}^{b} \beta_j f_j(\mathbf{x_0}) + \sum_{i}^{n} \lambda_i \left(y(\mathbf{x_i}) - \sum_{j=0}^{b} \beta_j f_j(\mathbf{x_i}) \right). \tag{6}$$

The first part of the model in (5) and (6) shows the regression model and the second part shows the simple kriging model. Where, $\mathbf{x_0}$ is a new point vector for prediction, $\mathbf{x_i}$ is the observed point vector, β_j is the j. coefficients of the regression model, f_j indicates j. regression design unit and f_0 is equal to 1. DACE-Kriging predictor can be rewritten as a vector form in (7) and (8).

$$\hat{y}(\mathbf{x_0}) = \mathbf{f_o'}\widehat{\boldsymbol{\beta}} + \boldsymbol{\lambda}'\mathbf{Z}, \tag{7}$$

$$\hat{y}(\mathbf{x_0}) = \mathbf{f_o'}\widehat{\boldsymbol{\beta}} + \boldsymbol{\lambda}'(\mathbf{y} - \mathbf{f}'\widehat{\boldsymbol{\beta}}). \tag{8}$$

Where, $\mathbf{Z}$ is residual vector, $\mathbf{f_0}$ is design vector of input variables at $\mathbf{x_0}$, $\widehat{\boldsymbol{\beta}}$ is regression model parameters vector and $\boldsymbol{\lambda}$ is the kriging weights vector. Considering the spatial correlation of the residuals, the model coefficients are solved with the following generalized least squares estimator [2].

$$\widehat{\boldsymbol{\beta}} = (\mathbf{f}'\mathrm{R}^{-1}\mathbf{f})^{-\mathbf{1}}\mathbf{f}'\mathrm{R}^{-1}\mathbf{y}, \tag{9}$$

$$\boldsymbol{\lambda} = \mathrm{R}^{-1}\mathbf{r}. \tag{10}$$

Where, $\mathbf{f}$ is the input variables design matrix at the observation point, $\mathbf{Y}$ is the observation vector, $\mathbf{r}$ is the correlogram vector of new point, and R is the nxn-dimensional correlogram matrix of the residuals. R and $\mathbf{r}$ are obtained from correlogram model.

$$\mathrm{R} = \begin{vmatrix} r(x_1 - x_1) & \ldots.. & r(x_1 - x_n) \\ \ldots. & \ldots.. & \ldots. \\ r(x_n - x_1) & \ldots.. & r(x_n - x_n) \end{vmatrix}$$

The covariogram is estimated with the following equation:

$$\hat{\mathbf{c}}(\mathbf{h}) = \frac{\mathbf{1}}{\mathbf{n(h)}} \sum_{\mathbf{i=1}}^{\mathbf{n(h)}} (\mathbf{Z}(\mathbf{x_i}) - \boldsymbol{\mu})(\mathbf{Z}(\mathbf{x_i} + \mathbf{h}) - \boldsymbol{\mu}), \tag{11}$$

where $\hat{c}(h)$ is the covariogram estimator, μ is the mean of the stochastic process and $\hat{c}(0) = \sigma^2$ is the variance of the stochastic process, $n(h)$ is the number of experiment pairs. The correlogram is estimated as in (12).

$$\hat{r}(h) = {}^{\hat{c}(h)}/_{\sigma^2}, \tag{12}$$

where $\hat{r}(h)$ is the correlogram estimator. A theoretical correlogram is used to calculate the kriging weights for each point. Theoretical correlogram model must fit to the experimental correlogram. General theoretical correlogram model is given in (13). Where, θ_i is the correlogram model parameter, h_i is the univariate distance and p_i is the power of the model valued one or two [3, 30-32]. Estimation of parameters in (13) is realized by maximum likelihood estimation method (MLE) or least squares estimator. Some mostly used theoretical correlogram models regarded Euclidean norm are given in Table 1.

$$r(h) = \prod_{i=1}^{k} \exp\left(-(\theta_i h_i)^{p_i}\right). \tag{13}$$

Table 1. Theoretical correlogram models.

Model name	Model
Gaussian	$r(h) = \exp\left(-\left({}^{h}/_{\theta}\right)^2\right)$
Exponential	$r(h) = \exp\left(-{}^{h}/_{\theta}\right)$
Linear	$r(h) = \max\ (1 - \theta h, 0)$
Mathern 1	$r(h) = \exp\,(1 - \theta h)\left(1 + \theta h + {}^{\theta^2 h^2}/_{3}\right)$
Mathern 2	$r(h) = \exp\,(-\theta h)\,(1 + \theta h)$

NUMERICAL EXAMPLES

Numerical examples are performed on the four test problems which are Six-hump camel back function, Perm function, Stablinski–Tang function and Quintic function given in the Table 2. LHD is the one of the popular experimental design methods for computer experiments since developed by Mc Kay et al. [33]. It is convenient both for kriging and regression because of the space filling property. The levels of each factor are included in the design once. All factors have the same number of levels. Experiments are designed as many as the number of levels. In this design, the permutation of the levels is determined randomly. Training and validation datasets are generated with LHD. Training datasets consisting of 20, 27, 45 and 72 experiment were generated for the test problems (Six-hump camel back function, Perm function, Stablinski–Tang function, Quintic function). Since the kriging models are the best unbiased linear estimators, the validation data set consisting of 500 experiments was generated for each test problem. The validation is assessed by standard accuracy measures. The measures used in this study are Root Mean Squared Error (RMSE) and R^2 given as follows:

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n}\left(y(\mathbf{x_i}) - \hat{y}(\mathbf{x_i})\right)^2}, \tag{14}$$

$$R^2 = 1 - \sum_{i=1}^{n}\left(y(\mathbf{x_i}) - \hat{y}(\mathbf{x_i})\right)^2 / \sum_{i=1}^{n}\left(y(\mathbf{x_i}) - \bar{y}\right)^2. \tag{15}$$

Table 2. Test functions.

No.	Function Name	Test Functions
1	**Six-hump camel back**	$f(x) = \left(4 - 2.1x_1^2 + \frac{1}{3}x_1^4\right)x_1^2 + x_1x_2 + (-4 + 4x_2^2)^2x_2^2$ $-3 \le x_1 \le 3, -2 \le x_2 \le 2$
2	**Perm**	$f(x) = \sum_{i=1}^{3}(\sum_{j=1}^{3}(j + 10)(x_j^i - \frac{1}{j^i}))^2$ $-3 \le x_i \le 3$
3	**Styblinski–Tang**	$f(x) = 0.5\sum_{i=1}^{5}(x_i^4 - 16x_i^2 + 5x_i)$ $-5 \le x_i \le 5$
4	**Quintic**	$f(x) = \sum_{i=1}^{8}\lvert x_i^5 - 3x_i^4 + 4x_i^3 + 2x_i^2 - 10x_i - 4\rvert$ $-10 \le x_i \le 10$

Linear regression and quadratic regression parameters were estimated with (9) for four numerical examples. Residual values were calculated with (4). By applying simple kriging to the residuals as given by (5), estimation errors for validation points were obtained.

Table 3. RMSE of the metamodels.

No.	Function Name	LR	QR	LR+SK	QR+SK
1	**Six-hump camel back**	31,5011	16,1573	19,94	13,8584
2	**Perm**	87761,27	44295,82	66390,76	44085,06
3	**Styblinski–Tang**	75,056	69,770	72,124	70,726
4	**Quintic**	79565,51	58847,17	59626,04	59437,34

LR in the Table 3 denotes linear regression and QR denotes quadratic regression. LR+SK shows simple kriging applied to linear regression residuals and QR+SK shows simple kriging applied to quadratic regression residuals. Considering the RMSE, it is seen that the residuals after LR have a spatial relationship for all test problems and the DACE-Kriging model produces more successful predictions when SK is applied to the residuals. According to RMSE, the DACE-Kriging model, as a result of the SK applied to the residuals after QR, produced more successful predictions at the validation points for the first and second test problems, and the prediction success at the validation points for the third and fourth test problems was worse due to the weak spatial relationship of the residuals.

Table 4. R^2 of the metamodels.

No.	Function Name	LR	QR	LR+SK	QR+SK
1	**Six-hump camel back**	–0,357	0,645	0,459	0,739
2	**Perm**	–0,068	0,728	0,389	0,731
3	**Styblinski–Tang**	–0,028	0,111	0,048	0,087
4	**Quintic**	0,014	0,458	0,460	0,447

According to the R^2 performance criterion given in Table 4, QR produces better predictions for all test problems than the LR and LR+SK models. QR+SK gives better prediction performance for the first and second test problems because of the spatial relationship of the residuals among all applied models, and worse for the third and fourth test problems due to the weak spatial relationship of the residuals at the validation points.

These four test problems show that the regression part of the DACE-Kriging model is the most important part of the model, and if there is a spatial relationship of the residuals, the SK model will also contribute to the improvement of the prediction performance. Otherwise, the SK will have no contribution to the DACE-Kriging model, and even worsen the prediction performance.

CONCLUSION

QR produces better predictions for all test problems than the LR and LR+SK models. QR+SK gives better prediction performance for the first and second test problems because of the spatial relationship of the residuals among all applied models, and worse for the third and fourth test problems due to the weak spatial relationship of the residuals at the validation points.

These four test problems show that the regression part of the DACE-Kriging model is the most important part of the model, and if there is a spatial relationship of the residuals, the SK model will also contribute to the improvement of the prediction performance. Otherwise, the SK will have no contribution to the DACE-Kriging model, and even worsen the prediction performance.

Future studies will focus on developing new kriging approaches to increase the prediction performance of the metamodel.

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