Global challenges need attention now: educating humanity for wellness and sustainability

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Abstract

This Editorial sets the stage for 18 papers on the theme, *Contemplative inquiry, wellbeing and science education*. The special issue consists of a diverse set of papers that complement one another while each contributes in unique ways that will stimulate reflexive practices among the science education community as they ponder how they can contribute to the resolution of global challenges that define our lifetimes. In this Editorial we address priorities for improved science literacy for a worldwide community so that moment-to-moment practices can reduce the world's carbon footprint and reverse global warming and related challenges such as species extinction. We posit that to meet particulars of global challenges facing humanity, science educators need to expand their roles and definitions of science education. Accordingly, in an era of COVID-19, there is an imperative to expand and deepen functional literacy in science and in particular wellness for everyone as part of a necessary education on the birth through death continuum. Our advocacy for the use of authentic inquiry affords learning from research and ensuring that all research participants have opportunities to learn from ongoing research and one another. We expect that all participants will benefit equitably from being involved in research. Participants are educated about what is learned from research in which they are involved, and how that improves their practices. We anticipate that much of what is learned from such research will be enacted in everyday life, thereby affording those with whom they interact to learn by being-with them. Because of the complex, chaotic and dynamic nature of today's world and its associated lifestyles, we address contemplative activities we regard as highly appropriate for doing science in a manner that is restorative and nurturing for ourselves and for the world. Specifically, we examine breathing meditation, meditating to increase blood oxygenation, walking meditation, loving kindness meditation, soft touch energy work and mindfulness. Each of these contemplative activities relates to knowing thyself better and promoting and sustaining wellness and wellbeing. We address self-help in relation to wellness because so many people follow one or two pathways when they become sick, i.e., they rest until their health improves and/or they go to the doctor who may diagnose/prescribe pharmaceuticals or changes in aspects of lifestyle (e.g., diet, more sleep). We provide examples of self-help practices that allow individuals to be autonomous and proactive in avoiding sickness, and directly addressing symptoms if and when necessary. Finally, we examine the potential of using a dialectical approach to teaching, learning and future rethinking of science

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education and science educators. Grand challenges of the moment demand no less than ongoing research with transformations that catalyze improvements now. We do not have a luxury of waiting for the right time, and the right time to enact sustainable lifestyles is now.

Keywords Sustainability · Difference as a resource · Crisis of representation · Authentic inquiry · COVID-19 · Contemplative activities · Self-help · Know thyself

Λέξεις-κλειδιά αειφορία · διαφορά ως πόρος · η κρίση της εκπροσώπησης · αυθεντική έρευνα · COVID-19 · διαλογισμός · αυτοβοήθεια · αυτογνωσία

Παγκόσμιες Προκλήσεις Χρειάζονται Προσοχή Τώρα

Εκπαιδεύοντας την ανθρωπότητα στην ευεξία και την αειφορία.

Kenneth Tobin και Konstantinos Alexakos

Το άρθρο αυτό προετοιμάζει το έδαφος για 18 επιστημονικές εργασίες πάνω στη θεματική: Στοχαστική έρευνα, ευζωία και διδακτική των θετικών επιστημών. Αυτό το ξεχωριστό τεύχος αποτελείται από μια ποικίλα σειρά εργασιών οι οποίες όχι μόνο συμπληρώνουν η μία την άλλη αλλά παράλληλα η κάθε μία συνεισφέρει με το δικό της μοναδικό τρόπο ο οποίος εν τέλει θα διεγείρει τις αντανακλαστικές πρακτικές ανάμεσα στην κοινότητα των διδασκόντων των θετικών επιστημών, καθώς επεξεργάζονται το πώς μπορούν να συνεισφέρουν στην επίλυση των παγκόσμιων προκλήσεων που καθορίζουν την εποχή μας.

Στο συγκεκριμένο άρθρο γνώμης θέτουμε επί τάπητος τις προτεραιότητες για μια βελτιωμένη γνώση των φυσικών επιστημών για μια παγκόσμια κοινότητα ώστε οι ανά πάσα στιγμή πρακτικές να μπορούν να μειώσουν το παγκόσμιο αποτύπωμα διοξειδίου του άνθρακα και να αναστρέψουν την παγκόσμια αύξηση της θερμοκρασίας καθώς και σχετιζόμενες προκλήσεις όπως η παύση της εξαφάνισης των ειδών. Διατυπώνουμε λοιπόν την αρχή ότι καθηγητές των φυσικών επιστημών, για να ανταποκριθούν στις σύγχρονες παγκόσμιες προκλήσεις που αντιμετωπίζει η ανθρωπότητα, πρέπει να επεκτείνουν το ρόλο τους καθώς και τους ορισμούς τους σχετικά με τη διδακτική των θετικών επιστημών. Συνεπώς, στην εποχή του COVID-19 υπάρχει μια υποχρέωση να επεκτείνουμε και να εντείνουμε τη στοχαστική έρευνα στην επιστήμη και πιο συγκεκριμένα την ευημερία για όλους ως μέρος της υποχρεωτικής εκπαίδευσης στο συνεχές από τη γέννηση έως και το θάνατο.

Η υπεράσπισή μας για τη χρήση της αυθεντικής στοχαστικής υποστηρίζει τη μάθηση μέσω της έρευνας και διασφαλίζει ότι όλοι οι συμμετέχοντες ερευνητές θα έχουν την ευκαιρία να μάθουν από την τρέχουσα έρευνα καθώς και ο ένας από τον άλλον. Οι συμμετέχοντες εκπαιδεύονται για το τι μπορεί να αποκομίσει κανείς από την έρευνα στην οποία συμμετέχει ενώ παράλληλα η υεοαποκτηθείσα γνώση βελτιώνει τις πρακτικές τους. Περιμένουμε πως όλοι οι συμμετέχοντες θα ωφεληθούν ισότιμα από τη συμμετοχή τους στην έρευνα. Αναμένουμε πως το μεγαλύτερο κομμάτι αυτών που θα αποκομισθούν από την έρευνα θα εφαρμοσθούν στην καθημερινή ζωή και κατ' αυτόν τον τρόπο θα υπάρχει η πολυτέλεια για εκείνους οι οποίοι αλληλεπιδρούν μαζί τους, να έχουν τη δυνατότητα να μαθαίνουν συνάμα με αυτούς.

Λόγω της πολύπλοκης, χαοτικής και δυναμικής φύσης του σημερινού κόσμου και των σχετιζόμενων με αυτών τρόπων ζωής, προτείνουμε στοχαστικές δραστηριότητες

τις οποίες θεωρούμε ως τις πλέον κατάλληλες όσον αφορά τον τρόπο με τον οποίον ασκείται η επιστήμη και μάλιστα μέσω μιας οδού η οποία είναι ενδυναμωτική και ενισχυτική για τον εαυτό μας και για τον κόσμο. Πιο συγκεκριμένα, εξετάζουμε τον διαλογισμό μέσω της αναπνοής, το διαλογισμό ως μέσο για την αύξηση της οξυγόνωσης του αίματος, τον περιπατητικό διαλογισμό καθώς και τον διαλογισμό μέσω της αγάπης.

Απευθυνόμαστε στην αυτοβοήθεια σε σχέση με την ευεξία καθώς πολύ άνθρωποι ακολουθούν ένα ή δύο μονοπάτια όταν αρρωσταίνουν κλπ., ξεκουράζονται έως ότου η υγεία τους βελτιωθεί ή/και απευθύνονται στον γιατρό ο οποίος ενδέχεται να διαγνώσει τη νόσο/συνταγογραφήσει φαρμακευτικά σκευάσματα ή να προτείνει αλλαγές στον τρόπο ζωής (π.χ. διαίτα, περισσότερος ύπνος). Παρέχουμε παραδείγματα πρακτικών αυτοβοήθειας οι οποίες επιτρέπουν σε όλα τα άτομα να είναι αυτόνομα και προορατικά στο να αποφεύγουν τη νόσηση και να καταπολεμούν συμπτώματα εάν και όποτε αυτό κρίνεται αναγκαίο.

Τέλος, εξετάζουμε την προοπτικής της χρήσης της διαλεκτικής προσέγγισης στη διδασκαλία, μάθηση και μελλοντικής επανεξέταση της διδακτικής των θετικών επιστημών και των διδασκόντων αυτής. Οι μεγάλες προκλήσεις του παρόντος δεν απαιτούν τίποτα λιγότερο από συνεχή εμπεριστατωμένη έρευνα με μετασχηματισμούς οι οποίοι θα επιφέρουν βελτιώσεις στο παρόν. Δεν έχουμε πολυτέλεια χρόνου. Η σωστή στιγμή είναι τώρα.

(Our thanks to Myrto Koutra-Iliopoulou for her translation of our abstract to Greek)

Then and now: a new vision for science education, but 16 years later, how can we meet the challenge?

In January, 2006 the founding editors of *Cultural Studies of Science Education*, Wolff-Michael Roth and Kenneth Tobin, announced the journal in a five-page Editorial. The first paragraph got right to the point (Roth and Tobin 2006 p. 1):

We are pleased to introduce with this volume the inaugural issue of a new journal, *Cultural Studies of Science Education* (CSSE), which was designed to provide new perspectives and new approaches to science education. In many ways, this new journal departs from the trodden paths in our discipline. CSSE is unique in focusing on the publication of scholarly articles that employ social and cultural perspectives as foundations for research and other scholarly activities in science education and studies of science. The journal encourages empirical and non-empirical research that explores science and science education as forms of culture enacted in a variety of fields that are formally and informally constituted. The editors seek to publish cutting edge scholarship to provide unique perspectives to ongoing problems associated with studies of science and science education and appropriate methodological advances that are salient to scholarly activities in these fields.

Roth and Tobin (p. 5) concluded the Editorial with the following affirmation:

We are introducing this new journal with the hope to contribute to the creation of a community of practice in which exchanges with peers become a major driving force of conceptual, theoretical, and methodological development. Debate, difference, and contradiction are essential elements in and of a community that considers itself as moving, continuously producing and reproducing itself in new forms, rather than steadfastly holding onto its past instantiations and the status quo. But our inten-

tions alone will not bring about change, though it can support and foster it. Both our authors and our readers will be essential to the production of new forms of scholarship as well as new forms of scholarly community, and therefore, new forms of identity for ourselves.

The Editorial makes clear that CSSE did not seek to continue a status quo that already was served by numerous journals, each of which sought to do much the same thing—provide a forum for science educators to publish their work. The editors felt that it was time for a journal that was markedly different, and encouraging of difference and transformation of the field. They did not feel the task would be easy and they expected resistance, and especially concerted efforts to appropriate CSSE as yet another forum for mainstream publications. Importantly, the vision announced in the inaugural Editorial was to be dynamic, changing, initiated and nourished by a community, not by editors' initiatives alone.

The current list of aims and scope of CSSE (Springer, 2021) begins with two key characteristics of the journal that:

- focuses on science education as a cultural, cross-age, cross-class, and cross-disciplinary phenomenon;
- publishes articles that have an explicit and appropriate connection with and immersion in cultural studies.

Contemplative inquiry, wellbeing and science education: a special issue

If you want to worry about things, you're living at a great time.

Bill Nye, 7/23/2021 (MSNBC interview).

The leadoff quote for this section of our Editorial was selected from a TV appearance in which Bill Nye was interviewed about US and world responses to problems associated with the Anthropocene, including climate change, global warming, population size and distribution, fires, flooding, species extinction and possibilities for extinction of human life. Most of these topics are also addressed in this special issue of CSSE. In this Editorial we refer to these topics and others like them as grand challenges (Powietrzynska, Tobin and Alexakos, 2015).

Through the pervasive impact of his popular, award winning TV program, *Bill Nye the Science Guy*, many English-speaking viewers benefited from 100 half-hour programs that Nye hosted. Nye's zany demeanor and use of catchy production resources were entertaining and engaging. Also, the program addressed basic science literacy that connected to contemporary aspects of everyday life. Since the series wrapped up in 1998, Nye has been routinely involved as a spokesperson for science and science education. As is the case with many TV celebrities, he continues to project a larger-than-life image through his clothing, and exaggerated prosody and body movements, such as gestures. Furthermore, Nye is one of just a few science educators who are invited by national media networks in the USA to address the grand challenges and other science-related topics such as UFOs, and establishing human colonies on Mars.

We consider it as an imperative for science educators to step forward in teaching, research and service to address citizens' literacy concerning the grand challenges, lifestyles, and contemporary advances of science. We regard it as self-evident that science educators will not seek to compete with or even mimic Bill Nye in their efforts

to educate a segment of a globally dispersed humanity. There is not just one path to be taken. Just as birds in flight create pathways to their destinations, there is no trace of the pathway that can guide those who may wish to get to the same destination. So, it likely will be for science educators with a vision for what they want to accomplish. Each science educator must forge a pathway that is deeply contextual and reflective of the resources that emerge to support their visions, which are necessarily collective, local, and dynamic.

This special issue of CSSE consists of 18 papers written by 48 authors, situated in five countries. The authors are quite diverse in terms of a variety of characteristics with approximately equal numbers of females and males, a relatively large number of ethnic groups, religious affiliations, and career levels (i.e., early, mid, and senior).

Each paper addresses one or more of the themes chosen for the special issue—*Contemplative Inquiry, Wellbeing and Science Education*. The authors push the boundaries envisioned when CSSE was created, and there is ample evidence that the authors expand conversations about grand challenges in myriad ways. We represent the expanding dialogue as seven interrelated clusters, each based on similarities among keywords provided for each paper that includes:

- Vision for science education: nature experience, environmental education, ecology, ecopsychology, contemplative pedagogy, lived experience, Goethean science, and teacher education
- Theoretical frameworks: Western worldview, atomistic worldview, humanizing science education, interdisciplinary, environmental ethics, ecological virtue, social justice, agential literacy, processual ontology, animism, Dao field, inner work, social justice, and equity
- Human influences: Anthropocene, anthropocentrism, post Anthropocene, and post human(ism)
- Research methodologies | methods: authentic inquiry, event-oriented inquiry, place-based, autobiographical narratives, reflective journalism, contemplative inquiry, poetic representation, and arts-based practices
- Dynamic collectivism: growing together, lines of becoming, development, transaction, holism, embodiment, relationality, and shared decision making
- Contemplative inquiry and practice: meditation, identity, mindfulness, reverence, radical listening, interbeing, and mindful consumption
- Wellbeing: sustainability, care, self-care, experienced time, and professional vision

The structure and purposes of this Editorial

In this Editorial we set the stage for what is to follow in this special issue of CSSE. Our approach is grounded in collaborative research, undertaken in the past two decades. Through our own research and teaching, we connect our learning and growth with the seven themes addressed in the papers that comprise the special issue. By so doing, the Editorial is akin to an Op-Ed, providing resources for readers to engage reflexively. Our goal is to invite readers to join ongoing dialogues associated with the clusters that emerged from our reading of the papers.

Here, we do not review the papers that comprise the special issue. Instead in the sections that follow we present our work and standpoints. As clearly as possible, we make our

views and understandings clear so that other research groups can consider what we write as points of departure.

In the sections that address contemplative inquiry and wellness respectively, we employ an approach that is fine-grained in its detail. Our purpose in so doing is that, for the most part, these areas are not addressed in other papers to the same extent as the other clusters. Accordingly, in a section on contemplative inquiry we provide details on several approaches to meditation and mindfulness. Similarly, in a section on wellness, we describe how soft touch energy work can be used to sustain good health and treat every day wellness issues like allergies, headaches, sore back, and excesses of emotion.

It is important to mention self-responsibility and having not only agency to believe what we want to believe but also to be educated enough, whether through formal schooling or through our own efforts to have the capacity to sift through the news and information available to us in a systematic, informed and open-minded manner. Teaching inquiry in science should go hand in hand with independent thought and exploration of thorny issues in science that extends beyond what is right or wrong with a focus on the process of learning for self-responsibility for our own health and wellness and in making informed political and scientific decisions globally. Hence, an emphasis in this editorial is on Knowing Thyself.

Teaching and learning inside and outside of the pipeline

The science curricula associated with teaching and learning in the pipeline are hotly contested with politicians, policymakers, and scientists being central stakeholders. It seems difficult for science educators to have a major impact on adapting the curriculum, even though they are often represented on committees at local, state, and national level to transform science curricula. Our experience suggests that little changes, even though there is widespread agreement among science educators on key issues such as de-emphasizing high-stakes testing, and creating science curricula that intersect with everyday life and the grand challenges.

We are struck by our experience that many science education researchers undertake research within a context of a pipeline that begins with pre-k education, and extends through to the teaching and learning of doctoral level students. It seems that relatively less time is dedicated to educating citizens along the birth to death continuum.

Education, sometime and someplace, should prepare humans to live responsible lives and enjoy good health. Accordingly, we advocate an expansion of science educators' roles to plan programs that cater for the life continuum—from babies to aged people who are nearing death and perhaps a transition to an afterlife. Although programs such as those we envision can take place in schools, the expansion we have in mind involves programs offered outside of the academic pipeline, extending from pre-K-12 to graduate level studies. Given the importance of curricula that prepare citizens for appropriate practices in their lifeworlds, the stakes are too high to be distracted from by squabbling about what is in and out of a within-pipeline curriculum.

The range of legitimate roles of science educators should expand, rather than spiral inwards to follow pathways forged by reductive pressures. For the past few years, we have committed to expanding our research and teaching to include out-of-pipeline activities and a broader vision for what science entails. Since the vast majority of our work has focused on teaching and learning in schools and colleges, we have a commitment to continue to offer interventions that are consistent with what we have learned in our ongoing research.

Konstantinos: Ever since reading Heesoon Bai's paper *Peace with the Earth* (2015) and then Jeremy Narby's book *the Cosmic Serpent* (1998), I have been in an on-going philosophical conversation with myself, my science education students and those around me about how we | I may come to understand what is living ... what we label as being alive. We label it as such because it reacts to the world with some level of humanly perceived activity (eating, replicating, etc.). Thus, I think it becomes easy for us in the West to create a definition for what constitutes being alive that very much excludes whole categories that should also be seen as alive, like mountains, seas, planets, etc. ...

We ask our students to think outside of the box but our thinking, our teaching in formal classrooms is literally inside a box. We live in a box, we teach and learn in a box, and often we are buried in a box. Topics we regard as priorities are not highly suited to learning in boxes, e.g., what makes us human, our lives, and our interactions with the world around us.

What more is there?

In our multilogical approach to research we like to consider two broad questions such as—what is happening? And why is that happening? We seek answers that reflect different perspectives within a community, and identify patterns of thin coherence together with contradictions (Sewell, 2005). Our standpoint is that there is merit in answering broad questions in ways that retain polysemia, i.e., many meaning systems, and polyphonia, i.e., many voices. Our experience is that the approach is non-reductive, or to use a spiral metaphor—expansive in that what we learn about the two questions spirals outward, and is reflective of how participants make sense of social life and the ways they choose to represent what they know.

Based on our understandings of the crisis of representation (Greene, 1994), we regard what we learn as an underrepresentation of what can be known. No matter who we approach to answer our questions, and how creative and expansive they are in providing answers, there always will be more. Accordingly, we seek to find additional information by asking ourselves a third broad question (Garfinkel, 1967; Roth, 2009)—what more is there? We realize this is not a direct response to the crisis of representation, however, we provide interventions to "disharmonize the system," akin to casting a stone into a placid lake. As the stone breaches the surface of the lake, it creates waves, and in so doing, hidden forms of culture reveal themselves. Stated differently, we design interventions to create moments of reflexivity, when participants become aware of practices of which previously they had little or no awareness. For example, we may ask participants to respond to the following assertion: when a person comes closer to me than 3 feet, I feel that my personal space is violated.

This assertion may not address an issue that a participant has particularly been concerned about, and the initial response to our invitation to speak might be quite exploratory. Then, in subsequent social interaction, someone might come closer to them, and they notice the intrusion and associated emotions of irritation and discomfort. In our research project, we have designed numerous heuristics to serve as interventions that heighten awareness to specific social phenomena (Tobin and Alexakos, 2021a). The heightened awareness is potentially transformative, and serves as a vehicle for disseminating what we have learned from our research. That is, use of a heuristic is a mechanism for meeting the

goal of catalytic and tactical authenticity (see further discussion of these criteria later in the Editorial).

In regard to what has been accomplished in the papers and associated research featured in this special issue, we ask, what more is there? And how can we contribute more to what we have learned from these papers and myriad others authored by this set of authors and their associated research squads?

To readers of this Editorial, we cast some stones into an impressive reservoir of knowledge:

- To what extent can we contest Western imperialist ideology in our research?
- How can non-Western knowledge systems provide complementary perspectives on our research that can expand and enhance what we have learned and the potential of our research to be socially transformative?
- How do we engage in cogenerative dialogues that include non-Western people and non-Western wellness philosophies and practices focused on making sense of our research?

Below we present several scenarios and questions for conversation, especially given the focus of this special issue and the individual foci of the articles published in this issue. What is your response to each?

- The systemic destruction of our world is overwhelmingly caused by international finance capital, multinational agribusiness, the petrochemical industries, imperialistic wars, big pharma, etc. Frequently, contemporary research sets the blame for the plight of the world on individuals and their lack of education. It is as if some poor farmers or coal miners, struggling to keep their families from starving, are just as responsible and to blame for damage to our planet as global corporations.
- Whereas COVID-19 is caused by a virus, the pandemic and harrowing death toll and suffering that followed have been exacerbated and magnified by a system where profits matter more than human lives.
- How are both good and evil inextricably entwined with the COVID-19 pandemic, and in many other current and historical sites of conflict?
- What is the role of self-responsibility in relation to global, grand challenges and personal wellness projects?

A time of crisis

Arguably we write at a time of crisis, especially as it applies to public understanding of and appreciation/respect for science. In the wake of an era of former President Trump in the USA, in which science, and most everything else is hyper-politicized, we face a major contradiction that is contextualized in the rapid spread of the Delta variant of COVID-19. The present international spike in positive cases of COVID-19 is characterized by the emergence of the Delta variant as the predominant cause of infection, with greatest risks for serious health issues being associated with those who are unvaccinated. A paradox in the USA is that there is ample supply of multiple vaccines, which are free of cost to potential recipients. For a variety of reasons, as of this writing, about 50% of the US population is not fully vaccinated. An underlying problem that has emerged is widespread fear and disbelief of science and willingness by many to choose to believe intentional and harmful lies,

conspiracy theories, and misleading claims pushed by media personalities and politicians at local, state, and federal levels.

Setting aside the intentions of those responsible for distributing massive streams of misinformation, it is important to note that vaccines and vaccination are not the only targets. Medical science in particular, and science more generally are targets that have shaken public confidence in practices, and necessary to prevent massive surges in hospitalization and death rates, e.g., when and where to wear masks, when and where to quarantine, and whether shutdowns of public gatherings are necessary and can be mandated.

There is a clear need for science educators to have a prominent role at this time. Consider the following exchange between Dr. Anthony Fauci and Republican Senator Rand Paul during a congressional committee hearing in the USA (New York Times July 20, 2021). Fauci is director of the US National Institute of Allergy and Infectious Diseases and chief medical advisor to the president of the USA. Paul, an ophthalmologist, accused Fauci of lying to Congress about the National Institutes of Health funding the "gain of function" research in Wuhan, China. Fauci responded angrily, "[i]f anybody is lying here Senator, it is you." Prior to this episode in an ongoing public dispute between two well-known figures, Paul has repeatedly opposed all efforts of the current President and White House staff and any legislative efforts to fund vaccines and/or mandates such as wearing masks, requiring social distancing, and shutting down institutions in which social gathering can facilitate transmission of the virus. How can the public be educated now, to address this challenge that is pervasive within the USA and elsewhere in the world?

Our position is that science educators have a responsibility to address emerging aspects of the COVID-19 pandemic in ways that can transform social life. On the one hand, there are crises related specifically to the pandemic and then there is a larger picture of population, sustainability of the planet, climate change, and arresting the rate of species extinction, including possibilities of humans becoming extinct. As we have maintained for more than 25 years, science educators should undertake research that produces greater understanding of personal, and others' perspectives on salient issues and substantive changes in social life; changes that transform practices in ways that address grand challenges such as those we discuss here, together with those explored in the articles that comprise the special issue.

Accordingly, we exhort science educators to look beyond what has been commonly seen as standard science curricula. It is the failure of these curricula, the way students are taught science and a pipeline that excludes such a high proportion of our youth, our adults, and our elderly, that is on full display during this COVID-19 epidemic with the multitude of people becoming ill while the means to fight this pandemic are available. It is these failures and the failure of the system as a whole that has left millions desperate and destitute, deprived of proper healthcare and livable income while the few grow ever so wealthy and head for the stars. It speaks volumes that globally many people have had very little real access to the COVID-19 vaccines further exacerbating the health and economic hardships they face.

We take this opportunity to emphasize a high priority for citizen literacy in science education. In a context of science being politicized to an increasing extent, it is becoming customary for claims and assertions that are science-based to be considered as political assertions. Also, there are widespread misunderstandings of the peer review process, and ways in which scientists handle difference. What is needed as far as citizen education is concerned extends beyond what is possible in a 30-s exchange on national TV, or even a 12-min video presentation on YouTube.

There is a need for courses and programs designed to promote literacy in science for everyone, across the age continuum. These curricular development activities, in conjunction with associated research programs to ascertain whether the curricula make a difference, should, address the grand challenges and environmental and personal sustainability, personal hygiene, nutrition and sexuality, health and wellness practices, poverty, and access to quality food and health care. Any such research should itself aim to be transformative in the sense that participants change their ways of being in their day-to-day lives and aim to contribute to the communities researched and beyond.

In the next section we take this exhortation further in a discussion of authentic inquiry and multilogicality.

Using authentic inquiry to address grand challenges now

The changing nature of our research not only reflects the priorities we assign to what we should study, but also the purposes we value for doing research that we consider authentic. As part of our applications of authentic inquiry (Alexakos, 2015), we also incorporate contemplative inquiry and wellness and sustainability practices that include compassion, empathy, care, honesty, trust, respect, and inclusivity.

Starting from a base of Egon Guba and Yvonna Lincoln's Fourth Generation Evaluation (1989), we developed a research approach we call Authentic Inquiry (Tobin and Alexakos, 2021b). For a study to be considered authentic, we plan for participants to change their ontologies (descriptions of what was happening and why it was happening) and to understand and value others' perspectives, whether or not these align with their own. In addition, what we learn from a study, about ourselves and others, should be used to catalyze improvements for all participants and to ensure that those who are not well-placed to benefit from what we learn receive support to also benefit. Furthermore, in our ongoing efforts for research to improve education (i.e., teaching, learning, and curriculum) for those participants in the study we also would disseminate what we had learned and any tools we created to catalyze improvements and distribute beneficence equitably via ripple effects. We consider authentic inquiry to be a transformative methodology | method, central to a multilogical bricolage that is generative of practices and activities that expand what we value as researchers, and what we count as research.

We advocate for authentic inquiry being an integral part of a multilogical approach to research engaged by science educators and their collaborators (Tobin and Alexakos, 2021b). As we explained in a recent book (Tobin and Alexakos, 2021c), we use authentic inquiry along with other frameworks that include hermeneutic phenomenology, emergence and contingency, and event-oriented inquiry. We do not consider participants as subjects, but instead as colleagues and co-researchers.

In summary, the authenticity criteria require that each person heightens awareness about their ontology and others' ontologies. We expect participants to get to know themselves better, and also to understand where others are coming from and why they do what they do. Accordingly, participants become aware of what they understand to be happening in particular contexts and juxtapose their own perspectives with others' perspectives. There is an expectation that all participants will change their ways of witnessing and making sense of their lifeworlds, and also understanding difference as it manifests in how others view what is happening and why it is happening that way. Often, these intentions are covered by the first two authenticity criteria, usually referred to as ontological and educative.

We expect participants to change as a result of being in the research. However, we want them to have freedom to learn what they value and not to be coerced or indoctrinated to our preferred perspectives. Their ways of seeing and making sense of what is happening and why it is happening are expected to change because they learn from being involved in the research, i.e., learn about themselves and others. Also, we anticipate that all participants learn to push on the viability of what they know—putting it to the test and adapting as necessary. Resources for testing viability extend beyond the primary research field to include any and all fields of the lifeworld. What is learned from ongoing research should be put to the test elsewhere, and as necessary, adaptations should be made.

Over the years we have found cogenative dialogues (hereafter cogens) to be ideal activities for learning about self and others (Tobin and Alexakos 2021a). Learning from and developing respect for the viability of others' perspectives and practices and adjusting their own different perspectives only when it makes sense to do so.

Learning with and from others is always emergent and contingent, and is also consistent with the idea of "for the greater good." If perspectives lead to stances and practices that are not for the greater good then cogen is a field in which participants can interrogate both advantages and disadvantages of assertions and other warrants used to support practices being considered. In their essence, cogens are educative. The field of cogen is a place where consensus is often the goal—but it also is important to recognize and accept contradictions, understand and respect differences and acknowledge their potential to be transformative for the greater good. Our work with cogen is consistent with William Sewell Jr's idea of culture being experienced as patterns having thin coherence together with ever present contradictions (Sewell, 2005).

As we assert, cogens have the potential to foster improvements by discussing what is being learned in our ongoing research and making adaptations when and as necessary (i.e., authentic inquiry is catalytic). In addition, in cogen, awareness about what is learned is heightened, and plans can begin to emerge about how to enact what has been learned in other fields, with other participants. Enacting what has been learned from a study in other fields of the lifeworld raises the potential for others to learn by experiencing these new practices being enacted. That is, if persons enact new practices in a number of fields, there is an increased possibility of others learning from them—simply by being-in-with them as they try out what they have learned. We describe this possibility metaphorically as ripple effects. The enactment of new schema and practices become resources for others' learning.

Tactical authenticity usually necessitates a plan by one or more participants in a study to use what they have learned from the study to educate others who might otherwise not be well-placed to benefit and learn from the research. We regard this criterion as being associated with designing interventions to heighten awareness of schemas and practices that have arisen during the conduct of research. Often, we say that the central idea of tactical authenticity is to design interventions to help those who are not placed ideally in social and cultural space to benefit from what others had learned. Hence, the key purpose of tactical authenticity is to create beneficence—equality that extends beyond opportunities to learn from research. All participants in research are encouraged to go an extra mile and ensure that everyone is provided the resources they need to benefit from being participants in the research.

A clear example of the salience of tactical authenticity involves educating citizens about the desirability of being vaccinated to protect against the spread and further mutation of COVID-19 among African Americans in the USA. There are several related concerns, namely spread of the virus among African Americans and associated chances for mutations to occur and a priority to educate African American citizens to protect against

infection by getting vaccinated. There is a real history of science, and medical science not only during the American eugenics' movement but also in the current era of science and medicine being used to experiment and harm those with the least means (Gould, 2002) and just being plain racist (Pilkington, 2021). This heightens suspicion among many, not only those of color who may have fear of vaccines and malevolent intent on the part of those who carry authority and power in its many guises. It is surmised by many scholars who have studied vaccine hesitancy (MacDonald, 2015) that historically documented abuses, such as the Tuskegee Syphilis Study (Alsan and Wanamaker, 2018), are never-to-be forgotten atrocities committed as racist acts to promote science to benefit a domineering white capitalistic society. Historically constituted stories, such as the Tuskegee Syphilis Study and those associated with eugenics, are major deterrents to many citizens who are refusing to be vaccinated because they are suspicious of politicians and who may see science and the scientists who produce science as doing the bidding of the big pharmas (Hoffman and Bowditch, 2021).

We advocate for authentic inquiry as part of a fresh approach to science education that is potentially transformative, where "learners act upon the new perspectives which they experience through their critical awareness" (Pandey, 2021, p. 125), and suited to conduct of research that can address grand challenges such as those we describe in this Editorial. Having described the tenets of authentic inquiry, we exhort science education colleagues to include authentic inquiry in a multilogical bricolage of frameworks that they deem appropriate for their research while adopting tools such as cogen, mindfully speaking and learning, as well as respect for others, compassion, empathy, trust, and willingness to take a stance against efforts to marginalize and otherwise oppress and exploit others.

Contemplative activities

First, know thyself. We encountered this mantra when we were learning a Japanese healing art known as Jin Shin Jyutsu (Tobin, Alexakos and Powietrzynska, 2015).

In this section we examine breathing meditation, humming on the out breath as a way to enhance blood oxygenation, walking meditation, and loving kindness meditation.

Breathing meditation

On the basis of our ongoing research we developed a breathing meditation in which participants keep their mouth closed during the in breath and the out breath processes. While breathing, the focus can be wherever a participant wishes it to be. For example, a person might focus on the out breath only. Alternatively, the focus might be more generically on the breath. Because they have not done so previously some people might find it helpful to focus on the lips being closed. Others might focus on the air entering and leaving the nostrils. Personally, we like to focus on the sensation of the air we breathe in or the sensations we feel in different parts of the body at different times during the meditation.

Wherever we decide the focus to be, we recognize that the mind cannot be controlled. Just notice thoughts and emotions as they enter the mind. Notice if the focus skips to parts of the body, such as an itch on the elbow or a pain in the lower back. We like to use the phrase bear witness. If the mind is thinking about what you will eat for dinner this evening, notice the mind thinking about this. If the mind starts to think about the commute to work, notice the mind thinking about the commute to work. If you feel pain in the left lower back,

notice the pain as it rises, peaks, and falls. Notice impermanence of what happens during the meditation—nothing is permanent.

We suggest spending at least 10 min, twice a day, doing this meditation. The health benefits of breathing in and out, with the mouth closed, relate to increasing the amount of nitric oxide that flows in the airways. The presence of nitric oxide allows the hemoglobin to carry more oxygen to different parts of the body.

Konstantinos: For readers interested, one of my favorite books with many powerful breathing practices is the *Jewel in the Lotus* (Saraswati and Avinasha, 2010).

Humming on the out breath

An adjustment to breathing meditation is to hum on the out breath. If you adopt this practice you will increase the amount of nitric oxide in the airways substantially. The research suggests that 15 times the amount of nitric oxide can be transferred to the airways by humming on the out breath (Weitzberg and Lundberg, 2002). It is certainly worth trying so that you can see whether humming on the out breath makes a noticeable difference to your wellbeing over a period of a month, for example.

Another adaptation to breathing meditation that can make a significant difference to wellbeing is to focus on the out breath—of course while the mouth is closed. As you breathe out, breathe softly. Do not push hard to eliminate all of the air. Simply breathe out, and make sure as much of the air as possible leaves the body. During an out breath your eyes can be closed gently. During the in breath open your eyes, and allow the body to breathe in. Repeat this process for a minimum of five minutes. Breathe in with eyes open and mouth closed, breathe out with eyes shut and mouth closed. During out breaths, try to eliminate as much of the air as possible from the body. As your awareness shifts, bear witness. Notice your nimble mind moving from place to place and topic to topic. Don't try to control it, just notice. Bear witness.

Breathing meditation can be done while you are seated, with your feet flat on the floor, and as you are walking. Details for walking meditation are provided below. Of course, other postures and activities can be enacted while you are practicing breathing meditation. For example, we often do breathing meditation as we lie on our backs on a bed or massage table. In addition, breathing meditation can be augmented by soft touch holds as we explain later in this Editorial.

Walking Meditation

Meditation is a practice that can be done as you go about everyday life. One of the most common forms of meditation is walking meditation during which a participant walks. There is nothing special about the way a person walks, where they walk, how they walk, how fast they walk, etc. To get started, a participant simply walks. As is the case with breathing meditation, keep your mouth closed, and bear witness to your nimble mind.

Luangpor Pramote Pamojjo, a Theravada monk, encourages Vipassana insight meditation to include walking just as everyday activities like eating, washing dishes, sweeping, and commuting to work. In regard to walking meditation, Pamojjo advocates keeping the eyes open and walking in busy streets where a lot is happening (V. Pamojjo, 2013). Of course, that does not preclude walking in secluded places such as a forest, a beach, or around a lake.

Ken: A common place to do walking meditation is in the bedroom. I walk for about 12 yards until I arrive at a wall, whereupon I turn around and walk back to the other wall. I continue to walk back and forth between the two walls for a little over an hour. As I walk I bear witness to my thoughts, emotions, and when and where I focus on the body. If something hurts, or if it tickles, or there is some other bodily sensation, I notice what has happened. Then, my intention is for the mind to return to focus on the out breath. If it does so, I notice. If it does not return to focus on the out breath, I notice what it does focus on. During walking meditation allow your awareness to shift—don't try to control it. Just bear witness.

A common question that frequently is asked is: What should I do to control my monkey mind? In response to the question note the following: Do not try to control the mind, just bear witness. Allow the mind to be nimble. Each time the mind focuses or starts to chatter, notice what it does. When the mind switches from one focus or activity to another, just notice. Notice how it rises and falls if any emotion occurs: Again, know that nothing is permanent. If a body part starts to hurt or itch, and the mind moves to the hurt or the itch, notice the switch and the rise and fall of what you feel. As you walk, be aware, but just walk. It is easier to have a home for the mind to return to. For example, the home you select might be the out breath. In that case, notice when the mind returns home to the out breath. Never force, just bear witness.

Loving kindness meditation

Many approaches to meditation are part of our journeys into the infusion of contemplative activities into our lives. Metta meditation is an example that was highly influential throughout our lifeworlds, including our professional lives as science educators. Metta is a Pali word that is often translated as positive energy and kindness. Other definitions of metta include benevolence, friendship, affection, and kindness toward others. These constructs are good places to start, and yet we think of metta mainly in terms of love, opening the heart to give and receive love, where love is considered much as a mother loves her children; rather than romantic love, it is more of platonic pleasure that ascribes value in worldly beings. Although our understandings might extend beyond the original Buddhist meaning of metta, we think of metta as loving kindness meditation, embracing the following qualities: friendliness, appreciation and joy, compassion and equanimity. Yau Yan Wong (2021a) explains that equanimity is a frame of mind that is carefully accepting of difference, and does not discriminate. She notes that when we have an equanimous mind we can live within a community in harmony. Here, Yau Yan extends community to include humans and other animals, plants, and minerals. In accord with Yau Yan, we use ecosystem as a metaphor to include all of the material and non-material resources needed within the community to sustain harmony. Finally, in a recent communication, Yau Yan noted that her views on equanimity are grounded in a dhamma talk by Luangpor Pramote in which he explained "the ideal state of equanimity is when there is no sphere of self, or when there is no boundary between mind and nature." (Wong 2021b, personal communication).

Usually we regard fields as having no boundaries. However, Yau Yan's elaboration of the meaning of equanimity suggests two possibilities, which we explore as a dialectical relationship, boundary | no boundary, self | other. In this way our framework is expanded to see what more we can learn. We use this expanded framework even though the idea of fields having boundaries is incommensurable with the frame of boundary | no boundary, and self | other. Through this window, we see equanimity emerging in conjunction with a

transition from an experience of separation between mind and nature to an experience in which there is no boundary between mind and nature, mind and nature being experienced as one. The idea that self does not have a boundary does not exclude self. Self in dialogue with nature where self is in flux, both is and isn't part of the broader universe, i.e., self | nature | universe.

Our approach to loving kindness meditation is expansive, accepting Yau Yan's assertion that "true happiness is possible when we practice ... loving kindness, compassion, joy, and equanimity" (Wong 2021a, p. 85). Accordingly, we opt to include all of these elements in our loving kindness meditation.

Following the tradition of first know thyself, we begin loving kindness meditation by first focusing on offering loving kindness, compassion, joy, and equanimity to our self. That is, we treat ourselves with the elements of the Buddhist concept of true happiness. To begin loving kindness meditation, we connect with the breath, mouth closed, paying attention to the out breath while bearing witness to the shifting mind. When we feel connected with the breathing, we:

- consider the intention of cultivating loving kindness to self, love that is unconditional, open, gentle and supportive.
- offer compassion to our self in ways that are tender and accepting of self as we are now.
- recall times when we were kind and generous.
- emphasize a preference for happiness over suffering.
- consider how we experience love.
- consider ways in which we receive and send love.
- experience the way we experience giving and receiving love in our body.
- contemplate on how we give and receive smiles.
- ask ourselves if we are open to receiving love from all others.
- make sure we offer love to all others.
- practice offering and receiving unconditional love.
- and, learn to express the joy of living.

When it is appropriate to do so, expand the community to include those for whom you offer loving kindness. Think of someone who is dear to you, a person who is always supportive and reflect on their basic goodness. Feel what you most like about this person as you send them the energy associated with loving kindness. Bask in this energy as you feel it in your body. Expand the circle of loved ones and send each one the energy of loving kindness.

The next step is to identify neutral persons, with whom you do not have a particularly close relationship. Send the energy of loving kindness to each person you identified. Remember the love is unconditional and they can stay as they are, they do not have to change to conform to your view of an ideal.

Next, identify a person with whom you have experienced difficulties. This could be a person who doesn't seem to like you, and may even have tried to harm you in some way. Or, think of a person you do not like, and prefer to avoid. Usually, this would be a person for whom you do not like to feel sympathy or compassion. Let go of resentment and dislike by offering each person unconditional forgiveness for any transgressions you associate with them. As is the case with loved ones, and those you regarded as neutral, expand the circle of difficult people to whom you will send loving kindness. They do not have to change their ways: No conditions are attached. Replace feelings and emotions of hatred you might have with love and compassion.

A final step in the meditation is to expand awareness to include the ecosystems of the planet—include all animals, plants, and material and non-material resources needed to create and sustain harmony. Send loving kindness and freedom to all.

A great advantage of loving kindness meditation is that it can occur in any place and at any time. It can be of relatively short duration, or one meditation can take several hours. Loving kindness meditation can be done in its entirety or in its parts. Furthermore, the meditation can be secular and taught as a life skill across an age spectrum that extends from infants to the elderly.

In a context of researching potential benefits of loving kindness meditation, the following could be foci for authentic inquiry. Consider whether the list of benefits is a warrant for the inclusion of loving kindness meditation in science education courses at graduate and undergraduate levels. What about in science courses for elementary and high school students as well?

- Loving kindness meditation can provide benefits that include: appropriate self-criticism (not destructive), more positive emotions, less self-destructive thinking, reduction in pain, higher resilience, and increases in empathy and kindness to strangers.
- Kindness, compassion, forgiveness, and love can create spaces for learning, understanding, and welcoming difference as a resource to support learning rather than a nuisance to stamp out.

Wellness in harmony

In our schools the closest thing that comes to knowing thyself often relates to human biology and physiology. Unfortunately, the approach usually relates to the limit of knowing the names and locations of organs, systems, bones, muscles, tissue types, etc. Even though teachers might make serious endeavors to connect to everyday life and to the particulars of an individual, the evidence suggests that the knowledge is not all that useful in handling every day wellness issues. To illustrate this point, we offer examples from our use of contemplative activities in our authentic inquiry, coteaching, and more generally our transactions in the social world. In this section we describe knowing thyself, and how to use soft touch energy work as a complementary approach to self-help when individuals seek to enact self-help, and thereby facilitate their wellness concerns.

From an early age, children can be taught simple wellness techniques that can keep the energy in their bodies flowing in the channels in which energy is supposed to flow, and also to sustain good health. We consider a good place to start is by holding each finger, for example on the left-hand, for a minute or two until all fingers have had their turn of being held. Finally, the person can bring their palms together as if they were saying a prayer. Holding the palms in the prayer position can also be beneficial to a person's good health.

Know thyself: soft touch energy work

Be sure to note that the health information provided in this section, and throughout the Editorial, is not an alternative to seeking and obtaining diagnosis and treatment from a licensed medical practitioner. As the title of this section suggests, the purpose is educating for self-help, where the goal is to use touches and energy work proactively to harmonize

energy flows and sustain good health. What we describe below is based on our own understanding and learnings as we personally practice and become more knowledgeable with these other complementary wellness knowledge systems.

Good health is in the fingers and hands

If you hold a thumb on the left hand, lightly wrapping the fingers of the right hand around the left thumb, you may feel the steady beat of pulses in the thumb, and the fingers that are holding the thumb. If the left thumb is held this way for about a minute or two, a person who may have been a little worried about something will no longer be worried. That is, by holding the left thumb, the energy flowing through the thumb is harmonized—which means it is flowing in one of the correct ways into and out of the thumb, without experiencing diversions and blockages. As well as harmonizing the emotion of worry, holding the thumb can also produce good health by harmonizing energy flows that come through the thumb while flowing to other parts of the body as well. If you experience effects like the following, it may be beneficial to hold the thumb: if you feel you may vomit, or perhaps you have been vomiting, abdominal pain, indigestion, stress, skin projects, insomnia, and some headaches (for some headaches hold the base of the thumb, and that can lessen the severity of pain).

Holding the left index finger can harmonize fear, making a person less fearful of whatever is happening in the moment. Just as it makes sense not to spend too much time being worried, it makes sense not to be afraid. Knowing that fear can be harmonized by holding the index finger is a life skill that young children can learn and use throughout their entire lives. Lightly holding the index finger can address projects related to the shoulder, neck, back, and issues with your teeth or gums.

Ken: When I am at the dentist and the technician is working on cleaning the right side of my teeth and gums, I hold the left index finger. When the dental technician moves to the other side I swap to the index finger on the opposite hand to the side she is working on.

The health projects addressed by holding the index finger include nausea, bladder infections, muscle tension, migraines, headache, high blood pressure, sinus infections, muscle tension, self-criticism, and shyness. Holding the index finger can provide relief when a person has been standing a relatively long time.

The middle finger is associated with anger. If the middle finger is held for a minute or two anger can be harmonized. Health projects associated with the middle finger include emotions related to anger, such as frustration, resentment, and impatience. Other health projects include fatigue, flatulence, and eyestrain that may result from heavy reading.

The ring finger is associated with sadness, and can be harmonized by holding it lightly. Holding the ring finger addresses breathing difficulties, a buildup of mucus and phlegm, earaches, tinnitus, coughing, and skin projects.

If there is a problem with the heart organ it may be beneficial to hold the pinky. Similarly, if a person finds their heart is racing for some reason, harmony might be reached by holding the pinky. Just like the other fingers, the pinky is associated with an emotion—in this case pretense or trying to. These emotions need some explanation. “Trying to” applies to situations where a person is putting in effort to accomplish something or other. It might be as simple as trying to tidy the kitchen so that guests who will soon be arriving at your home will experience a very tidy home. Or, it might involve trying to control somebody

else, such as a sibling, parent, or schoolmate. If a person is trying to exercise control over someone else, then they might harmonize the energy flows in the finger by holding the pinky. Sometimes, this emotion is called efforting. If a person is putting too much effort into the activity of the moment, it may be advisable to hold the little finger for a minute or two so that harmony is maintained.

As you might imagine, the emotion of pretense can arise when a person is feeling insecure and/or nervous. Hence, holding the little finger can assist a tendency to try to be something we are not. That is, if a person is feeling insecure and/or nervous, that feeling might be harmonized by holding the little finger. In terms of wellness projects, holding the little finger can assist projects associated with bones and the heart. Also, if a person has diarrhea, or feels bloated they can attain some relief by holding the pinky finger. Interestingly, if a person has been doing a lot of walking (e.g., walking meditation, walking for exercise, or just walking in the garden), they can benefit from holding the little finger for several minutes.

When the hands are held in the prayer position for 1–2 min the emotion of despondency can be harmonized. Someone who is feeling down in the dumps might get some relief by holding hands in the prayer position while focusing on their breathing, or focusing on the pulses felt in each hand.

When you are holding any body part, keep in mind that the front, back, top, bottom, and sides usually connect to different universal energy flows in the body. For example, holding the tip of the middle finger can address major health projects that include coma, heatstroke, and cardiac pain. Lesser issues addressed while lightly touching the tip of the middle finger include irritability, stiffness, swelling, and pain in the tongue.

If you make a fist with your hand and note where the middle finger touches the palm, this locates a space that can be lightly touched or held to address wellness projects associated with mouth ulcers, halitosis, vomiting, and fungal infection of the hand. Just like the position on the tip of the middle finger, the position close to palm center also can address coma and cardiac pain.

Rather than going through each of the front, back, and sides of the main body parts (e.g., torso, legs, arms, feet, hands, head), we conclude this section with a know thyself challenge.

Lightly hold the left hand at the wrist crease on the inside of the hand/arm. The right hand can cover both sides of the wrist crease, extending to the base of the thumb to some distance down the wrist. Maintain this hold for a few minutes and bear witness to the physiological changes that arise during that time. Then, turn the left hand over, and use the right hand to hold the back/outside in much the same way you held the front side. Be sure to keep the touch light. Once again notice the physiological changes that occur during the second three minutes. Make a note of the similarities and differences.

Are you ready? Who are your teachers?

When the student is ready the teacher will appear. When the student is truly ready...
The teacher will disappear. Lao Tzu-Tao Te Ching (circa 6th century BCE)

For more than two decades, we have infused dialectical reasoning into our research and thinking. When we consider learners, we also consider teachers, and when we think about learning, we also think about teaching (Alexakos 2015). We represent the dialectical relationship with the vertical bar, i.e., teacher | learner. Similarly, our theorizing of culture also

includes numerous dialectical relationships, such as production=reproduction | transformation. Here, our understanding of cultural production has evolved over time to be transformative that links learning with life events/experiences. Accordingly, all learning is both reproductive and transformative. Much can be written about our understandings of this relationship, but in this Editorial, we make just a few points. Production is both aware and unaware, and it is ongoing. Often, we assert that if a person is breathing, they are learning. From this perspective, there is a realization that learning is continuous for a living, breathing person. That being the case, we find it useful to ask—if a person is learning at a given point in time, who are the teachers?

What counts as knowledge? Our acceptance of cultural production as equivalent to learning carries an important implication. Knowledge is more than what can be represented as words since it includes all forms of production. Furthermore, as Greene has noted, knowledge is transcendent in that no matter what forms of representation are used, alone and in combination, there always is more that is known (Greene 1994). Accordingly, when a person goes for a walk, production occurs continuously. Many methods can be used to identify what was learned, but they always will fall short of capturing all that was learned. What has been learned during a walking activity?

Before we provide an example that includes walking, we make an additional point about axiology. For the most part, higher value seems to be assigned at least in formal schooling to knowledge that can be expressed verbally (e.g., oral, written). When it comes to wellness it is arguably more important that knowledge represented in practices is of high importance—as are values and emotions.

During a recent successful doctoral defense at the Graduate Center of the City University of New York, Corie McCallum noted that when there were work-related issues to be resolved (during the COVID-19 pandemic, when work was done at home) Corie took a walk, during which many of the problems were resolved as her wellness was also enhanced (McCallum 2021).

What did Corie learn as she meditated?

As Corie walks, she meditates and notes a tendency to engage reflexive practices with heightened awareness about the affordances of working from home—especially for health-related projects such as weight control. Also, by working at home she is able to take walks outside and experience the ambience of sunlight and fresh air. Importantly, working from home provides Corie with freedom about to whom and when she is accessible.

Corie's research brings our attention to questions that can be raised concerning who are the teachers during walking meditation. In many instances the teachers, we decide, are inanimate, and depending on where the walk occurs, they may be non-human. Inevitably, questions arise about the nature of learning environments. It seems self-evident that there likely will be differences in walking on a sidewalk of an inner-city street, walking in a bedroom, walking in the city park, and walking on an unpaved pathway in the forest. Rather than creating answers to questions that concern the teacher | learner relationships in different places—we provide a set of assertions that may serve as starting points for an expansive dialogue about teaching and learning.

Corie's vignette about the uses of walking meditation harmonizes the mind and body so that she is better able to attend to her health while also performing her professional duties as a conduct counselor; it highlights the importance of autonomy to change her schedule when and as necessary. She does not avoid doing her job, but ensures that she addresses

health projects when issues arise and need attention, and plans proactively to minimize the occurrence of serious health projects.

What can we learn from this research that might have implications for teaching and learning in and out of the pipeline? Consider the following scenarios, arrange a cogen, and partake in an expansive set of possibilities.

- Students are provided with timeouts that can be used for contemplative activity when they feel their mind | body is not able to support learning to the maximum extent.
- Students can engage in breathing, walking and selected healing meditations when they regard it as beneficial to do so.
- Periodically, the classes are scheduled to take place in a contemplative garden that is built and maintained by the students and teachers themselves, and members of the local community who are also invited to use it. The garden may feature a running stream, waterfall, and a variety of trees, large, medium and small shrubs, flowering and herbaceous plants.

Out of the pipeline curricula and associated activities can be planned using the resources of a given location, such as existing parks, riverside and beachside resources, mountain and forest walking trails, and specially created spaces to educate the citizenry for specific purposes, such as dying and death (e.g., death parks). The creation of suitable spaces can be built along with curricula designed by science educators for specific purposes, with the proviso that once they are built; the purposes and uses would be dynamically flexible.

Konstantinos: Recently I visited a museum in Thessaloniki, Greece. I read an inscription of how Aristotle used to tutor Alexander the Great under the shaded trees. How many of our public schools give such an option to their students? As science educators how often do we take our traditional classes outside or allow our students (of any age) to take a nature walk break or to go hug a tree or stick their bare hands or feet into the ground during class when they feel the need?

The following texts can be used in cogens to expand the dialogue and the possibilities for educating the citizenry in regard to the grand challenges and other priority topics such as maintaining wellness.

- When I walk along the banks of a river, my thoughts are mediated by the water, the still, reflective surface, the clear sky and the fresh air. I find myself resolving problems, playing music in my head, and feeling the serenity of solitude that mother nature teaches me.
- My walk in the forest is without people. I feel the energy and wisdom of the trees. How best can I learn from the trees?—don't seek the teacher, when the time is right, the teacher will come to you. What and how can I learn from being in a forest with trees?
- What counts as nature? Can I experience nature inside my home? Am I experiencing nature when I walk in my garden? What about if I walk on the pavement? Must I go to a place where flora and fauna are pristine and influences of humans are difficult to discern. Are humans constituents of nature? What about selves?

Are we up to the challenges that confront us now?

On August 9, 2021 the Intergovernmental Panel on Climate Change released a brief report that began as follows:

Scientists are observing changes in the Earth's climate in every region and across the whole climate system, according to the latest Intergovernmental Panel on Climate Change (IPCC) Report, released today. Many of the changes observed in the climate are unprecedented in thousands, if not hundreds of thousands of years, and some of the changes already set in motion—such as continued sea level rise—are irreversible over hundreds to thousands of years.

We see this as a rallying cry for science educators to step forward and get to work. Whereas the grand challenges extend beyond climate change, it is clear that a strong, unprecedented collaborative effort is needed to jump start pathways toward success. We are confident that our Editorial, and the papers to follow, can inspire readers of CSSE and catalyze forms of action that are proactive and free of the shackles that have bound us to roles that simply reproduce and even exacerbate extremely low levels of science literacy—on display now, not just in the West, but throughout the world. It is time for science educators to rise up and take the lead in educating ourselves and our global citizenry to successfully grapple with these grand challenges for the betterment of ourselves and our planet.

Which pathways will we choose?

This special issue is dedicated to pushing the boundaries of mainstream science education. We honor the authors of these papers for their contributions and courage.

As we consider what to do and where to go, we may ponder whether we are ready to meet the challenges we will encounter, and if so, who are the teachers to afford our learning?

We are not the first to argue that science education should be of use to our citizenry, or that we access our agency to meet responsibilities to ourselves and a global community. At the same time, in the decades the two of us have been involved in teaching science and science education, rather than progress we have experienced regress. For example, the pressure on teachers to teach to the test attributed to the advent of assessments ad nauseum (both for teachers and the students). We are not optimistic of accomplishing the changes in science education that we argue for in this paper, given systemic foundations of current inequities and ideologies that continue to breed ignorance, miseducation and mistrust in what is science, and who and how it can serve the global citizenry. These issues are further confounded by the contested purposes and goals of education, and science—in particular medical science. At the same time though we believe it is important to have and to engage in difficult conversations such as those we broached and those that follow.

Because we have come to believe that current science education curricula and practices are at best inadequate for preparing our citizenry to have the experience and knowledge to engage current and future grand challenges we (and our planet) face, both of us have moved on with our studies and teaching. We feel liberated by studying and teaching wellness and sustainability from a perspective that combines Eastern, Western, and Indigenous wellness practices and ideas. Also, we feel reconnected with ourselves and the world around us, and

have been reminded of the criticality of awareness, caring, compassion, kindness, and love in our own personal and professional lives as well as our own impermanence.

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