Rethinking Post-occupancy Evaluation for Sustainable Learning Environments

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Abstract

Green or sustainable schools are an important building type from which to explore questions of changing social behaviors and the often overlooked social dimensions of sustainable development such as equity and inclusion. Building performance studies, including post-occupancy evaluations (POE) are increasingly taking into account behavioral and social dimensions of the build environment, as well as the more common objectives of reductions in energy efficiency, and adopting ethnographic and art-based research methodologies to examine building users' interaction with their environments. In this paper we examine contemporary evaluation methods in the context of school buildings to explore how some popular POE approaches imply only superficial objectives for green building. The need to create new habits of living and the role of the built environment in this task goes without question; but confronting scientific methods and engineering perspectives typical within the industry, meets professional barriers. In order to improve commonly adopted POE methods in the context of sustainable building, it is important that we are able to contest the meaning of sustainable design and include evaluation tools that have radical educational and transformative objectives, in particular those that allow communities to explore futures that demand both social and technical change. This paper suggests that through user feedback, architects and other building professionals have not only important tools to improve the performance of sustainable buildings, but also to confront the limited expectations of architects

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and engage users in a sustainable future. POE tools are educational and in listening to users, co-researching ways to transform environments, architects can transform their approaches to sustainable design.

Keywords
Sustainable design · Post-occupancy evaluation · Methodology

1 Introduction

Post-occupancy evaluation (POE) is not a new process, and the desire for feedback over history and methods adopted by architects has been discussed. While post-occupancy is generally considered to have developed as a field in the 1970s, historical research throws new light into this discipline. Interest in research in this area is growing, especially in terms of the actuality of the performance of sustainable architectural design. Moreover, ethnographic approaches to understanding performance and behaviour are also gaining greater interest from within the profession, as a way to challenge linear, systematic, and scientific ways of knowing. This direction is inspired by socio-material discussions of architectural practices and work within Science and Technology Studies (STS) as well as the recognition that architecture is a collective practice shared with various human and non-human actors. New ethnographic approaches that are seen in developing post-occupancy research follow principles of no-hierarchy and pay attention to not only words, but also gestural, non-verbal and visual language. There is also a current suggestion of an ethnographic turn in architecture, reflecting further on architecture as a social practice. The question of new methods of evaluating the built environment thus has some relevance to improving contemporary POE practices.

2 Post-occupancy Research and New Social Science Methods

This paper refers to two research projects. One project examined post-occupancy evaluation in school buildings (carried out between 2010 and 2011) in the UK and the second, theoretical study explored the potential to commercialize new approaches to post-occupancy evaluation (POE) funded by a special grant from the Iowa Energy Center. The objectives of this latter project were to develop a tool or method for post-occupancy evaluation of school buildings that could provide a marketable and commercially viable approach that would allow architects and other stakeholders to reduce energy use of buildings, specifically in Iowa schools. The first project thus provided the foundation to research questions in the second.

Very early on in the project, the questions that arose about commercialization and practicalities of marketing were considered to be more theoretical than practical. The questions, which were focused on a series of approaches to engage young people in the evaluation of their own school buildings developed by Wheeler and Malekzadeh (2015), inquired about the ways in which contemporary scholarship can inform current approaches to POE rather than the ways in which commercialization could be identified and overcome. Current and growing field of literature, especially in Europe, has reassessed the value of post-occupancy tools for architecture, especially in relation to the actual energy performance of buildings. However, the pertinent contemporary questions raised by consulting academics and professionals in the field in the early stages of the project asked how research focused on how the feedback and processes of post-occupancy can, or could, in themselves, be socially transformed and how communities could adopt sustainable energy technologies. The key problem, as it was identified, was how such building assessment and post-occupancy evaluation methods could be utilized to embrace the sustainable energy design approaches of new buildings to engage communities with the pressing questions of sustainable living, and at the same time acknowledging the developing nature of the conversation of sustainable development. That is to say, the question was how to engage a community in an evaluation of their building based on sustainability design features while acknowledging that the field itself, with its priorities and values, is subject to change. In designing sustainably, just as in the rapid growth of unsustainable development, we make decisions about technology without being able to fully test that technology on communities over time. These issues presented the greatest difficulty in the process of commercializing a tool and required the research team and its research assistants to examine some of the philosophical biases of the approaches that have been developed in the name of viability and marketability.

The latter project was carried out between June 2015 and December 2016 with the aims to: (1) Consult with professionals in Iowa about the feasibility of the existing building assessment tool and modify the methods, practices, and test (see Wheeler et al. 2011; and more recently Wheeler and Malekzadeh 2015); (2) Network with academics and professionals who are known to the researchers, such as the creators of the Soft Landings tool in the UK (a widely utilized method) and those who are new to the field and offered new perspectives, such as the academic, Henrik Schoenefeldt; and (3) Develop a program towards commercialization.

Academics in the field that the project team consulted were enthusiastic to share their insights on the importance of this research direction in our current context of Iowa. However, others purposefully warned against the overly ambitious aims of commercialization, advising us to re-examine and re-evaluate the potential of post-occupancy tools or feedback mechanisms for the communities of new sustainable buildings, like schools. Moreover, the issues surrounding the commercialization and protection of intellectual properties within a small program of research that aimed to facilitate communication between scholars and practitioners were indeed not only onerous early in the project, but in fact overly time consuming and almost insurmountable for the team of academics and professionals who

originally gathered to collaborate on the research. After these early difficulties, it was decided that the project would address the methodological questions regarding post-occupancy in sustainable design, as was suggested by the consultants, rather than the direct testing of a method, which, it was argued, required theoretical review in terms of its qualitative approaches and its suppositions, anyway, before testing.

The qualitative and quantitative dimensions of the POE tool in general, and the necessity to include innovative ways of collecting qualitative data (see Wheeler and Malekzadeh 2015) in post-occupancy evaluation, posed the greatest concern in terms of examining method. These two seemingly distinct methodological approaches are nevertheless both foundational to the development of post-occupancy evaluation and highly relevant to the current trajectory of research on post-occupancy evaluation in art-based and ethnographic approaches.

3 Methodology

The difficulties encountered with the research team demonstrated the need for the research but also the importance of the new ways of collecting the qualitative data. The dissolution of the partnership with the industry collaborator and tensions with other co-investigators over intellectual property and collaboration agreements (questions about who would own the tool once it was developed and could all data be brought to the table) all added to a conscious decision to maintain the theoretic dimension of the research. Furthermore, the PI had successfully applied for, and been awarded, additional 'seed' funds to support this project. Thus, due to an overly ambitious research aim to commercialization and the needs identified by the academic community, important theoretical dimensions of the project were acknowledged. The development of scholarly work and the cutting edge of post-occupancy research in the UK proved successful also in terms of the networking objectives of the grant. Research Assistants maintained a series of discussion workshops and email and Skype contacts with international academics in the field, and they presented research work at International conferences in the US. The need for research in the area of post-occupancy evaluation of sustainable buildings, in terms of education and agency for communities, and in the area of science, technology and society is significant and was emphasized by international academics in the work carried out in the project. While the objectives towards a plan for commercialization were not been reached by the project, at least not yet, and the commercialization direction was put on hold, the theoretical work was significant. This research project work thus provides the preliminary research vital to any program of testing that may be carried out in the future. The members of the research team as well as research assistants (who left the University for other ventures) changed significantly over the course of the project. Nevertheless, the parallel 'seed' funds allowed a much greater wealth of student time to be devoted to the project. When the dissolution of the agreement with the industry partner came over the difficulty of intellectual property and effective academic and commercial partnership, and the

testing program of the refined method would not be implemented, the modified objectives and deliverables of the project were achieved. This was possible, in part, with intense research assistant effect and outputs from the project in the form of conference presentations.

3.1 Research Program

The project aimed to address critically the problem of qualitative assessment in sustainable architecture, and the student and faculty research team were able to consult with, and interview through Skype, international academics working in this field. These included Bill Boardass from the Soft Landings team in the UK, Thomas Berker from the Norwegian Institute of Science and Technology in Trondheim (with whom the PI had presented research findings at the *Nordic Environmental Social Sciences Conference* 2015 ahead of the IEC grant application questioning methods in sustainable design and its evaluation from an STS perspective), and Henrik Schoenefeldt from the University of Kent, School of Architecture. Schoenefeldt's pioneering work has addressed the history of building assessment through historical archive and case study at the Houses of Parliament, UK, offering a particularly valuable perspective to the project (Schoenefeldt 2016).

Through consultations, questions arose first about the beginnings of the post-occupancy method and about the role of the qualitative, which had been central to this history of building assessment. Building assessment methods have been used as "troubleshooting" methods in the past, uncovering the causes of both technical and operating problems associated with user discomfort. But an early reason for post-occupancy evaluation concerned the development of the agency of the building users' community to empower them to solve comfort or other building problems and to engage them willingly in the questions of sustainable development. This latter dimension of the research was particularly important to the question of sustainable learning environments.

Hence, in consultation with professional and academics a series of objectives were identified, and a literature review carried out in the field. The modified objectives of the project, examined through literature, were thus to:

- Investigate the importance and the potential of innovative approaches to post-occupancy evaluation of sustainable learning environments.
- Examine how post-occupancy methods could be modified to meet the real and actual needs of designing sustainable learning environments.
- Identify design approaches that have improved information feedback in POE to guide designers in developing new methods to designing sustainable learning environments.

A literature review was conducted to engage with these questions and to critical investigate some of the most current approaches to post occupancy.

4 Results and Analysis

While the team looked at specific strategies and solutions to overcome the limitations of current methods in post-occupancy evaluation, the concern identified early in the project was how to design a holistic post-occupancy method that addressed some of the undervalued dimensions of sustainable design. These place increased value on user experience and user agency, including within the school community. Narrative methods were of the immediate interest in this respect to the research team, but the research also explored the educational potential of post-occupancy tools in particular (the question was whether a POE method could be developed specific to schools) by critically investigating various programs of sustainable schools' design. The broader intention was to find ways to highlight the social aspect of sustainability, the physical and psychological health aspects of sustainable design, and the ways in which architects present the social, emotional, and intellectual development of children in the spaces they design. From the start, the creation of a post-occupancy tool indicated the need to integrate holistic paradigms of sustainability in educational built environments to better address understandings of sustainable design.

4.1 Understanding an Integrative and Holistic Paradigm in Post-occupancy Evaluation: The Relation of Child and Outdoor Learning Environment

Research presented by a group of psycho-analysts of the built environments from the Universitat Munchen, Germany, examined the psychological aspects of an outdoor science teaching program (Dettweiler et al. 2015). The group investigated the motivational behavior of pupils during outdoor science teaching using self-determination theory and revealed a number of advantages of open outdoor spaces that motivate students to learn. The study showed that student's motivation to study science decreased from adolescence onwards but after a week at an outdoor science center, the courses taught under the general heading of eco-climatology in an outdoor camp atmosphere fostered the sense of community, personal discovery, and personal responsibility. The quantitative research findings and students' responses indicated a positive psychological effect of outdoor environments. Albeit that some students found it difficult to adapt to extreme weather conditions. The study concluded that outdoor teaching could offer practical knowledge to children along with the scientific general application to be learned in a better way. However, children were more engaged with nature, and they displayed high motivational behavior. Irrespective of gender, the overall benefit from outdoor settings was greater than just improved learning. Along with higher activity levels compared to those conducted inside the classrooms, outdoor environment promoted a sense of wellbeing. While this study and many like it suggests the value of outdoors education for children, there are nevertheless limitations to teaching outdoors.

It connects students with the natural environment, allows space and time for 'free-play,' and allows students to discover vital dimensions of curriculum outdoor space is not the only type of space that has to be provided for children. A question about the sustainability agenda amongst architects has to be raised here in relation to the educational benefit of outdoor learning, and its increased value but nevertheless, specific questions about how sustainability is perceived and envisioned and how it is manifested (the focus of current post-occupancy evaluation interest) remain. The social dimension of sustainable development tends to be under investigated amongst architects. Our research question was how not only how to reevaluate the natural environment but to include in the post-occupancy tool developed during the course of the project, methods to increase the agency of school communities to change school environments and liberate the community at an educational level to consider the critical perspective of the sustainability agenda.

4.2 Understanding an Integrative and Holistic Paradigm in Post-occupancy Evaluation: The Relation of Child and Natural Environment

A joint study conducted by researchers from the University of Copenhagen (Bentsen et al. 2010) on the extent and dissemination of Outdoor teaching strategy 'Udeskole' in Danish schools also revealed improved concentration, high levels of physical activity, and improved motivation to study among students who studied in outdoor teaching environment. According to this study, 87% of 98 municipalities practiced 'Udeskole' by joining with the local government to increase the utilization of green space and subsequently found better results. Many other Danish schools are in the process of implementation of the 'Udeskole' strategy. 'Udeskole' can be conducted in both natural and cultural settings, including forests, parks, local communities; and yet, there are some disadvantages, like concerns with safety, the cost for extra teachers or transportation, presence and distance to green space, and resistance from unfavorable climatic conditions. An interview with a teacher at Indian Prairie School-Naperville (Middle school) who adopted such an approach conveyed similar concerns. The teacher complained about the safety and huge responsibility of taking care of every child since the school did not have fences, and it surrounded by busy roads. Extreme weather conditions, which limit outdoor teaching for almost quarter of the year, was a huge concern. Additionally, smart classrooms that transform the conventional teaching methods are becoming a norm in American schools today. The priority is being placed ever more on communications technology education, and bringing technology out to the open air can be very difficult. *Teaching lifetime pursuits* (2010) discusses outdoor school environments and acknowledges benefits of outdoor schooling. But outdoor schooling in itself while it is argued does induce self-confidence and helps students develop new skills, learn values of mutual support, fitness, communal enjoyment, and appreciation and respect for nature.

Some children can feel inhibited from experiencing or benefiting from outdoor spaces, and adults also express fear of outdoors and child's safety.

Outdoor educational experiences can occur in outdoor learning environments and can instill activities that connect young people and place but also in the school environment. Activities that expose children to weather, seasons, clouds, soil, gardening, plants, and water can all happen within the school environment and grounds. Outdoor school spaces can enhance child's fantasies, curiosity, and creativity, building in their minds a sensitive appreciation of earth but this can also start in the classroom environment. Outdoor spaces provide for authentic natural experiences because direct contact with the environment can foster an appreciation for nature that leads to care and stewardship, but so too a well-designed sustainable school.

4.3 Understanding an Integrative and Holistic Paradigm in Post-occupancy Evaluation: Designing a Post-occupancy Tool that Engages a School Community in the Questions of Sustainable Design—The Question of Agency

So can outdoor teaching be possible, irrespective of climate conditions, and can the need for sustainable school environments be solved simply—both educationally and environmentally—by integrating the outdoors more within school campus? The book "A practical guide to planning, construction and using school courtyards" extensively discusses courtyards as a sustainable way to create outdoor teaching climates (Bansbach et al. 2012). School gardens are used as vegetable gardens and to grow food. Promoting the importance of agriculture also improves student learning. Additionally, exposure to nature and outdoor habitats can improve children's physiological health, improve attention span, and promote psychological health; thus, a constant connection with nature can protect children against stress (Browning et al. 2014). Access to natural daylight and better ventilated breathable spaces have positive effect on the learning of children (Canton et al. 2014). These arguments support the motive of sustainability in the real sense. However, school environments are typically enclosed spaces, they depend largely on mechanical systems of heating, ventilation, and often artificial lighting. Furthermore, pupils and teachers alike can have little control over these environments in terms of temperature, air quality, noise, or lighting levels, and the like. Questions of agency in school, at the level of individual control, are significant at this level, but so is the engagement of the whole school community in affecting change in that community, especially in the context of sustainability or sustainable development.

Furthermore, various organizational efforts to integrate sustainable schools in the local community have already expanded with impressive outcomes. The USGBC created guiding principles to integrate sustainability in school organizations by establishing the 'Whole school Sustainability framework.' The framework focusses on organization culture through shared values and social norms, physical place

through energy efficiency, and active engagement with environment and Educational Program by incorporating principles of social justice, respect for limits, and local and global citizenship (Barr et al. 2014). The Program on Educational Building (PEB) encourages the use of school grounds as a teaching resource to raise the awareness of the natural environment, its complexity, and its vulnerability.

Architects in the US and Australia teach sustainable design in schools to increase teachers and students' awareness of nature through a program called Learning by Design and the Schools Environment Assessment Method (SEAM) significantly contributed to the environmental effects of the building. SEAM was intended to be used by designers of new schools, by users of existing school, and as a part of national secondary curriculum. The notion that designers can both engage the school community in sustainable architectural design as well as build the community and its agency is well discussed in the field. An interesting case study of Ofsted schools in the UK was helpful also for investigating real case scenarios for sustainable strategies implemented in schools. In these schools in the UK, sustainability was to be achieved through principles laid out by the authority (Moncaster and Simmons 2015). Most schools had limited knowledge of sustainability, and teachers tried to use imaginative skills to improve practical knowledge. Schools tried to integrate sustainable development plans and ensure the availability of resources and training. This was done by identifying one key person to manage and coordinate sustainable development. Sustainable development of schools in Ofsted terms was thereby defined as a place and school culture where each learner could be healthy, safe, joyful, and accomplished to make a positive contribution and achieve economic wellbeing all within the earthly environmental limits.

Nevertheless, the various initiatives taken by the schools in these instances were supporting mostly environmental and economic sustainability, ensuring recycling, energy savings, and water efficiency for example. Teaching on sustainability addressed eco-friendly tourist resorts, problems of droughts in less economically developed countries, and science covered issues of environmental sustainability, such as renewable energy, global warming, and biodiversity. Students were encouraged to discuss and find solutions, reminding them of their responsibility towards the environment but from the literature, it was clear that Ofsted schools did not address issues of political and social injustice.

The lack of a critical perspective on sustainability has led to a haphazard development of the principles of sustainability in education but this extends to tools and methods. The eight doorways of Ofsted, which were the principles used, focused mainly on the environmental and economic aspects of sustainability. Though a small aspect of inclusion and participation was included, this approach did not explore the depth of social sustainability in a wider context, the perspective is of environmental and economic sustainability.

These questions raised issues about both the design of school environments and the education of sustainability in school in relation to the school environment, and they illuminated the problems at hand when developing a post-occupancy framework. Attempts have been made to simplify and depoliticize the discourse on sustainability for schools and for designers and to turn it into a technical issue.

However, the school with its function to house the education of young people reveals, by its nature, demands the social dimension of the sustainable design to be taken into account. A post-occupancy tool needs to address this social dimension both in the assessment of the actuality of school buildings as places for communities to work together and to learn and as places of the discovery of and interconnectedness with the natural environment.

4.4 Understanding an Integrative and Holistic Paradigm in Post-occupancy Evaluation: Designing a Post-occupancy Tool that Engages a School Community in the Questions of Sustainable Design—The Status of Post-occupancy Methodology in Building Design

Post-occupancy evaluation (POE), defined as a process of evaluating buildings in a systematic and actuate way after they have been occupied for some time (Gonzalex et al. 1997), has been traditionally aiming for continuous improvement in design (BRI 2001; Zimmerman and Martin 2001); hence, it has been an important factor in the building process (Preiser 2002). The feedback characterizes the logic of the process, and the purpose of the POE is also described as to help practitioners avoid mistakes. Current questions nevertheless generated by critical conversation within the profession emphasize the questions about the methods of approaching this feedback process, about the quality of information to be obtained from the user about their experience.

In its own way POE is an innovative departure from dominant methodologies of construction rooted in the positivist tradition offering limited researchers abilities to grasp the meaning of social action from the perspective of actors involved. Nevertheless, a constructivist epistemology underpins most traditional post-occupancy evaluation and assumes that people of different backgrounds, while experiencing the same situation differently, will arrive at a common problem (Pink et al. 2010, 648). Ethnographic approaches propose more sophisticated ways of understanding building users' interactions with the building and the potential of their feedback to architects. Moreover, more recent and innovative approaches to ethnography have sought ways to understanding user's engagement with their environment, that are participatory and collaborative. These are designed to enable ethnographers to 'share' other people's experiences in order to better understand their experience in recognition of empathic and sensory dimensions of our relationships with environments and community (Pink 2007, 2009). Nevertheless, ethnographic research remains unconventional and little understood in the context of the building industry and further issues, for example, how can a community be educated about sustainable design and what pedagogic attitude or philosophy shapes such 'teaching' approaches, remains in part governed by ideas about what constitutes a sustainable building or a sustainable school from educational authorities and academic and professional discourse in general. How can post-occupancy methods, seeking to engage communities to participate in research in a critical and authentic manner,

develop responsible relations to build natural environments? This question exceeds most contemporary approaches to designing sustainable schools. Current methods typically include surveys to collect the quantitative data, and open ended questionnaires, but can also include building walk-throughs, facilitated discussions, energy use data, and the performance of systems. Research projects have recently adopted these methods to evaluate contemporary school buildings (Ahmadi et al. 2016; Choi et al. 2012; Sanni-Anibire et al. 2016). Furthermore, user participation or involvement methods have been reviewed recently to provide a clear framework for user involvement in architects' design activities, including at the level of post-occupancy (Kim et al. 2016). However, the POE method can indeed also include ethnographic methods, including video ethnographic, and visual data collection methods. These assessment methods can be used to collect information from the very often missed sensory dimensions (Pink 2015). It is this dimension that is mostly missing from our evaluation of sustainable architecture and yet it is the aspect of our engagement with environment that has such potential to motivate change in community. Nevertheless, as Pink et al. (2010) stated, 'Ethnography is a serendipitous craft: Ethnographers often expect to learn precisely when they are least expecting to… what is learned goes beyond what could be said in an interview and can only be known by being there, as events unfold' (Pink et al. 2010, p. 658). Moreover, she further wrote that '…ethnographic methods in building design research can make visible informal worlds of actions, interactions and ways of knowing that can easily slip under the industry (or official) horizon of notice' (Pink et al. 2010, p. 258). These methods have significant potential in the context of sustainable design, for building community knowledge, for engaging architects and communities, and for building community. Furthermore, ethnographic perspectives offer an educational potential to reconnect children and the school community with the natural environment through the senses, this is a powerful way to reevaluate and address our human connection to the built and natural environment but it is one also how the built environment is conceived by building professionals.

4.4.1 Barriers to Adopting Innovative Methods

The barriers to adopting innovative methods that question how user experience is captured, such as sensory ethnography and visual methods, are difficult from both institutional and professional perspectives. Evaluating the performance of a building and user satisfaction in ways that are open to elicit information beyond traditional confines risks professional reputation and possibly even financial loss. However, various issues concerning the appropriate method and the validity of user data in the architectural and architectural engineering context (as described by those professionals in early project meetings) must emerge if sustainability in the build environment is to progress. Social data is seen of at best as benefitting 'marketing' purposes from the point of view of the architecture or to appease clients who want their voice to be heard. Confronting the dominant methods of scientific and engineering norms of research in architecture, thus poses a significant challenge, despite a growing body of criticism in method. Nevertheless, the academic and research field has a responsibility to present the case to the profession. Innovative

approaches have the potential to address the "green wash," of many sustainable buildings by engaging with the actuality of designs but the question is whether architects or other building professionals could or would use a post-occupancy tool to elicit such information.

4.4.2 Communicating the Benefits

It is crucial that we are able to contest the meaning of sustainable design and sustainable lifestyles. Evaluation tools that include radical educational objectives that allow communities to explore futures that demand both social and technical change have potential, through their feedback, to significantly transform the ways in which architects design.

5 Conclusion

In this project, we examined how contemporary evaluation methods indicate different perspectives on improving the environmental performance of buildings. Research method always contains within it philosophical assumptions, worldviews, epistemologies, ontologies, paradigms, beliefs, as well as direction on procedures. The field of architectural science however, barely engages with such questions. The main lesson learnt is that it is important that we are able to contest the meaning of sustainable design and to develop evaluation tools that include radical educational objectives. Tools that promote community agency so that communities are engaged with the environmental problem, and allow communities themselves to explore how our futures demand both social and technical change especially for their own immediate contexts. The second lesson learnt is that POE approaches can be developed to address the superficial agenda persistent in the design of "green" buildings and to confront the architects' limited expectations. The objectives of the original project, as proposed, changed over the course of the research (based on the feedback from the academic and scholarly community in this field) and to improve potential future work in this field an integrative definition of environmental sustainability is crucial to tools within the field and needs to consider social, economic, and cultural realms. Through constantly striving to make our built environments more interactive, it is necessary to interrogate the broader implications of design strategies. Schools are one of the first built environments that individuals encounter. These environments can have a strong impact on children as well as families and communities in their awareness of environmental sustainability. Feedback mechanisms in the form of post-occupancy evaluation tools provide some of these opportunities, but their real potential to engage communities, including school communities, in their environments is undervalued. Future research in POE has the opportunity direct some attention to the potential POE has to transform attitudes and behaviors.

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