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In what ways are teacher candidates being prepared to teach about the environment? A case study from Wisconsin

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There is an urgent need for primary and secondary students to develop awareness, knowledge, attitudes, and an environmental ethic necessary to undertake environmental issues and problems. The need to adequately prepare teachers to teach about the environment, and the challenges the field of environmental education (EE) faces lead us to the research question: In what ways are teacher candidates being prepared to teach primary and secondary students about the environment? Using a case study approach of the 33 teacher education programs in Wisconsin (USA), we explored the ways in which EE is integrated into teacher preparation. Surveys, interviews, and the analysis of course documents (e.g. syllabi, assignment sheets) were used to identify two primary ways in which EE is being integrated – courses and activities. After examining the commonalities among programs that are doing more than typical (such as using multiple ways to include EE or having high quality EE), we explored the role organizational resources – material, human, and social – play in teacher education programs.

Keywords: environmental education; preservice teacher education; methods courses; teaching methods

Introduction

Environmental issues and problems have become more prominent in our society. More time and attention is being devoted to their identification, discussions of relevance to everyday life, and discovery of true solutions that do not produce even more unintended consequences. Most of these problems and issues are very complex and are not easily solved. It is safe to say that some of these existing problems (and, undoubtedly, others that are looming) will still be here for our children to tackle. Thus, there is an urgent need to develop in primary and secondary students the awareness, knowledge, attitudes, and an environmental ethic necessary to undertake these issues and problems. Along with the home, schools are a likely venue for the development of the necessary skills, attitudes, and knowledge. Environmental education (EE) promotes such skills, attitudes, and knowledge. For the purpose of this study, we use the Wisconsin Environmental Education Board's (WEEB) definition of EE:

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Environmental education is a lifelong learning process that leads to an informed and involved citizenry having the creative problem-solving skills, scientific and social literacy, ethical awareness and sensitivity for the relationship between humans and the environment, and commitment to engage in responsible individual and cooperative actions. By these actions, environmentally literate citizens will help ensure an ecologically and economically sustainable environment. (paragraph 2, WEEB, 2015)

The importance of EE (or sustainability education) in the curriculum is well established. As far back as 1990, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) described the preparation of environmentally-literate teachers as a top priority (UNESCO-UNEP 1990). If teachers are not adequately prepared to teach our youth about the environment, then our hopes of the next generation being able to solve these problems has incurred a serious setback. Teachers who are well prepared to teach about the environment can have a lasting impression upon their students. According to Darling-Hammond, Wei, and Johnson (2009),

Teacher effects appear to be sustained and cumulative; that is, the effects of a very good or poor teacher spill over into later years, influencing student learning for a substantial period of time, and the effects of multiple teachers in a row who are similarly effective or ineffective produce large changes in students' achievement trajectories. (614).

There are many challenges to be addressed by higher education institutions and both primary and secondary schools if EE is to meet the complex problems presented by the human impact on Earth (Ryan et al. 2010; Velazquez, Munguia, and Sanchez 2005). These include time pressures on teachers and teacher educators (Paige, Lloyd, and Chartres 2008; Scott and Gough 2007), multiple priorities competing for time and attention (Moore 2005), lack of communication and sharing among subject areas (Dale and Newman 2005; Littledyke, Taylor, and Eames 2009), over-crowding of the curriculum (Pearson, Honeywood, and O'Toole 2005), and the lack of resources, marginalization of EE, and conceptual misunderstandings of key decision-makers in education (Summers, Childs, and Corney 2005). Given the context of the importance of including EE in primary and secondary schools, the need to adequately prepare teachers to teach about the environment, and the challenges the field of EE faces, we were lead to the research question: in what ways are teacher candidates being prepared to teach primary and secondary students about the environment? By seeking to answer this question, EE in pre-service teacher education programs can be strengthened and promoted.

Review of relevant literature

For teachers to effectively teach about the environment, they should be knowledgeable (Schmidt 1996), skillful, and have a disposition that teaching about the environment is important. Teacher education programs can play a role in achieving this. For example, Lane et al. (1994) found that teachers are more active in providing EE if they had pre-service training opportunities on this topic. Science education organizations can assist teacher educators since many have espoused the importance of EE. For example, the Association for Science Teacher Education (ASTE) strongly supports the inclusion of EE in pre-service science teacher education as a way to instill environmental literacy in students. ASTE's official position statement declares,

The environment offers a relevant context for the teaching and learning of core science content. In addition, environmental education promotes inquiry-based teaching and learning in educational settings. Environmental education in pre-service science teacher education is critical because informed decisions regarding the future of our planet depend upon an environmentally literate citizenry. (ASTE Newsletter 2009, 10)

However, there is room for improvement as evidenced by students' questionable achievement of environmental literacy assessments and these students' desire to have more EE in the curriculum (Lane et al. 1996).

The challenges related to the goal of effectively preparing teacher candidates to teach about the environment are well known (Heimlich et al. 2004; McKeown-Ice 2000; Powers 2004) beginning with the concept of EE being interdisciplinary, where the conceptual frameworks, perspectives, and ideas from the arts and humanities join those from the sciences and technology in addressing solutions and interventions to environmental problems and concerns. However, as Vincent and Focht (2011) note, interdisciplinary programs and initiatives can lead to a lack of a clear identity and definitions of core competencies and confusion among instructors as to 'who is supposed to teach what?' In practice, this many times means 'since everyone is supposed to teach EE, no one does.' In subjects outside science and social studies, this can lead to incidental, sporadic, and/or tangential EE experiences as described by Buchanan (2012), diluted experiences as described by Miles, Harrison, and Cutter-MacKenzie (2006), or a lack of whole-school approaches to sustainability as described by Ferreira, Ryan, and Tilbury (2006).

Questions of how to effectively prepare teacher candidates to teach EE are multi-faceted and wide-ranging. These questions from specific countries are nearly universal in their application to many other nations as well:

- Should separate EE curriculum units be used in teacher education courses in Australia or should EE be infused across a number of discipline areas (Ballantyne 1995)?
- How can EE be used to connect with students in England who are disinterested in science (Bore 2006)?
- How can teachers in Latin America and the Caribbean develop high quality curriculum materials that focus on local or regional issues (Cronin-Jones et al. 2003)?
- How can we best prepare children to live in a society in Fiji that is becoming increasingly wasteful and demanding more resources, such as consumer goods and energy, when teacher candidates also aspire to a more wasteful lifestyle (Taylor et al. 2007)?
- How do we best prepare teacher candidates in Israel and Turkey who themselves have a low level of environmental literacy (Goldman, Yavetz, and Pe'er 2006; Oztas and Kalipci 2009)?

In some teacher education programs, a separate EE course is required for certification, or EE is included in a science methods course (Barber and Tomera 1985; Disinger and Howe 1990; Plevyak et al. 2001; Wood 1992) while other programs integrate elements of EE across courses. In either approach, the resources of time and space within the teacher preparation curriculum becomes a challenge (Mastrilli 2005; McDonald and Dominguez 2010), just as it does for EE within the primary and secondary curriculum.

EE in Wisconsin

Wisconsin has long been a leader in EE and on the cutting edge in corresponding requirements for teacher preparation. In the 1930s, Wisconsin citizens first identified the need for conservation education for youth in the state (Wisconsin Department of Public Instruction 1998). Since 1983, every school district has had to ‘develop and implement a written, sequential curriculum plan incorporating instruction in environmental education into all subject area curriculum plans’ (Wisconsin Administrative Code PI 8.01(2)(k) as cited in Wisconsin Department of Public Instruction 1998). An EE consultant was hired at the Department of Public Instruction (DPI) to audit programs and support implementation. The position was removed in 1994 and then re-instated in 2010.

The revised Wisconsin Administrative Code Chapter PI 34 Teacher Education Program Approval and Licenses (DPI 2000), requires institutions of higher education to prepare teachers to address all state standards, including the Model Academic Standards in EE. According to the Wisconsin DPI, teacher education programs should be designed to enable all students to demonstrate knowledge and understanding of the following: EE including the conservation of natural resources for licenses in agriculture, early childhood, middle childhood to early adolescent, science and social studies.

Additionally, the Wisconsin Center for Environmental Education (WCEE) and WEEB were created by Wisconsin Act 299 (Wisconsin Legislature 1989) to further support implementation of EE in Wisconsin schools and communities. The WCEE provides programming and staff support across the state for primary and secondary schools. The WEEB has a grants program that provides support to schools and other environmental educators. The Wisconsin Association for Environmental Education (WAE) was first created in 1974. With a membership that includes school teachers and other environmental educators, the WAE offers networking opportunities and is an advocate for EE. The Wisconsin Environmental Education Foundation was created in 2005, providing an avenue to garner financial support for EE. All of these organizations promote and support EE in the state.

Although Wisconsin has a long history of EE, a comprehensive description of how Wisconsin’s teacher education programs are currently preparing teacher candidates in this realm is lacking. Recent systematic data have not been collected concerning the philosophies, approaches, and practices used to prepare teacher candidates to teach primary and secondary students about the environment. Lane et al. (1994) and Wilke (1985) surveyed teachers about their teacher education experiences in learning to teach about the environment, and Sanera (1997) examined the content of EE materials used in courses required for teacher licensing at eight University of Wisconsin System campuses (no private colleges), but both of these studies are over fifteen years old and neither occurred after the implementation of current academic and teacher education standards.

Thus, using Wisconsin’s teacher education programs as a case study, this manuscript will attempt to do two things:

- (1) Provide a description of the ways in which teacher candidates are being prepared to teach about the environment at the 33 teacher education programs in Wisconsin. This description is based on data collected in 2009 and augmented with follow-up data collected in 2013. Trends in the data are noted

along with the identification of programs that are doing ‘more than typical’ with respect to integrating EE.

- (2) As one might expect, there is wide variability in the ways in which the 33 programs prepare teacher candidates to teach about the environment. Is there an analytical framework that might help guide us to explain this variability? After examining the commonalities among the five programs that are doing more than typical, we explore the role organizational resources – material, human, and social – play in teacher education programs.

Analytical framework

Time and space can be viewed as important resources that are needed for the effective preparation of teacher candidates in EE (Buchanan 2012). Are other resources also needed? In their investigation of how school districts can support effective teaching and meaningful learning, Gamoran et al. (2003) discuss three key elements – groups, practices, and organizational resources. We have found this framework to be useful in our thinking about why some teacher education programs more fully integrate EE while others do much less, in particular the discussion concerning resources. Gamoran et al. distinguish among three kinds of resources – material, human, and social:

Material resources include money and anything money can buy, electronic information, and physical objects and structures. Teaching tools and materials, computers, databases, and records of data are also included.

Human resources are qualities of individuals, including knowledge, skills, attitudes, and commitments. The understanding of students, how individuals learn best, and knowledge of the cultural and social aspects of classroom groups (including teacher candidates) are also included.

Social resources are attributes of roles, relationships, and methods of communication, including shared meanings in language, values, and social norms (as cited in Newmann and Associates 1996; Swales 1990). A shared sense of purpose, habits of collaboration, and traditions of reflective dialogue are key ingredients of a group rich in social resources. With time, group members share a history that supports a sense of community and trust. These aspects of social resources are similar to issues raised by Scott (1996) in the context of teacher preparation in EE:

- The lack of a shared vision of what EE should be within pre-service teacher education courses.
- The absence of an agreed-upon pedagogical approach to working with teacher candidates.
- Too much of a focus by teacher educators on knowledge transmission and not enough focus on active learning strategies.

Gamoran et al. proposed that an investigation of only the material resources necessary for effective teaching and learning to take place is incomplete. For example, there are guidelines for the preparation of environmental educators (NAAEE 2010), state standards documents (e.g. *Wisconsin’s Model Academic Standards for Environmental Education*, Wisconsin Department of Public Instruction 1998), state policies, and curriculum materials such as Project WILD and Project Learning Tree.

However, if these material resources are not used effectively or viewed as being useful, then their utilization falls below that for which it was intended. Gamoran et al. suggest that an examination of human resources and social resources are also needed in the analysis. Thus, the research question posed in the introduction section can be refined to: What resources are being used in teacher preparation programs to prepare teacher candidates to teach about the environment?

Research methods

Descriptive case study approach

In this study, the status of implementing an EE teacher preparation policy was examined. The state of Wisconsin acted as a case study. The case study approach in educational research has a long tradition as a qualitative means for gathering and analyzing contextualized data of a limited number of events. It has been widely used to examine contemporary phenomena within its real-life context, when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used (Yin 2009). Many of the sources of evidence in a traditional case study were collected in this research, including documents, archival records, and interviews. A survey sent to a key individual within each teacher education program took the place of direct observations. Surveys from other research projects that looked to gather similar data about teacher education programs were examined. Items used in the dissertation from one of the co-authors proved to be very helpful as were discussions with colleagues who also have an interest in this topic. The primary analytic strategy involved a close examination of all relevant elements of the context and inner-workings of each teacher education program as provided by available documentation.

Survey and interview methodology

The goal of this study was to review the preparation of teacher candidates in Wisconsin with respect to EE. Using various professional networks and the website of the teacher education programs, the individual responsible for EE preparation at each of the 33 programs within the State was identified. For some programs, this was an identified environmental educator. For others, it may be a science education faculty member, a natural sciences faculty member, the teacher education program chairperson, or another administrator. Each program was sent a survey via e-mail (in 2009) or a link to an online survey (in 2013) where they were asked to provide a rich description of how their teacher education program prepares teacher candidates with respect to EE. (Note: In 2009, there were 32 teacher education programs in Wisconsin; in 2013, there were 33.) Respondents earned a small stipend for completing the survey. They were to address such questions as:

- Is there a specific course that is required? If so, how is it organized?
- Is EE integrated within another course? If so, in what ways? Please provide any syllabi where this occurs.
- Please describe any EE activities in which teacher candidates engage.
- Are presenters from the community involved in EE teacher preparation? In what ways?

- Are field trips involved? If so, where? What is the purpose, organization, and duration of each?
- Do you utilize school-based and/or community service projects? If so, please describe their purpose, duration, organization, supervision, etc.

Data from the surveys were augmented with data from interviews with representatives from an array of these programs. Selection criteria for inclusion in this interview round of data collection included (1) the degree of innovation in EE preparation as indicated from the survey results and (2) representation from a diversity of programs (public vs. private, large vs. small, course-based approach vs. experiential or competency approach, etc.). Interview questions asked these representatives to clarify certain responses to survey items and to elaborate further on the ways in which EE preparation was taking place within their program, with a specific emphasis on the resources that were used. An additional small stipend could be earned for participating in this interview.

In 2009, representatives from 16 (50%) of Wisconsin's teacher education programs both completed the survey and participated in an interview while five programs (16%) only completed the survey. In 2013, representatives from twenty of Wisconsin's 33 teacher education programs (61%) provided data for the online survey, and eleven individuals representing nine different programs participated in an interview (27%). During both data collection periods, an exploration of the university's and teacher education program's websites occurred for the remaining programs that did not respond to the survey request after it was sent twice.

The data from this study are limited to those programs within Wisconsin. Additionally, the study was limited by the number of teacher education programs that responded to the survey and request for an interview. Likely, those programs that feel confident about their EE offerings were the programs that responded. It is also possible that programs that did not respond were concerned about the use of the results, worried that they might be held accountable by the DPI for not including EE. The contact names and information that we were able to collect for the study was also a limitation. There may have been a person better suited to respond to the survey – relying on our contact to pass along the survey is a limitation of the study. Furthermore, it is assumed that survey respondents and interviewees answered honestly and to the best of their ability.

All data that were collected were considered qualitative – responses to the survey items, notes taken during interviews, syllabi and other course documents that were submitted, and information gleaned from program websites. As these data were being carefully read, codes were developed to note important elements. As described by Miles and Huberman (1994), coding is a qualitative data analysis method that assigns tags or labels as units of meaning to chunks of text. We used a grounded, inductive approach to coding so that the data were well suited to the codes that represent them. This provides for codes-in-use rather than a set of prefabricated codes generated prior to data analysis (McMillan and Schumacher 2010). Our codes were then used to organize data from multiple sources. Codes were revised as more data were read. Each co-author analyzed the data in this manner. A high degree of reliability (greater than 90%) was determined through the agreement of coding between the two researchers. Themes or patterns began to emerge that were then used as the basis for the findings of the study.

For example, one of the themes that emerged from our data was course-based or activity-based ways that programs met the DPI requirement. This theme is elaborated upon in the next section where we will first present examples from the data that illustrate some of the themes we noted in the analysis. Then a description of four trends in the data will be followed by a discussion of five teacher education programs that were identified as doing more than most programs with respect to EE. We then probe into whether these five programs have anything in common using our analytical framework. Finally, we test a hypothesis about social resources by examining two program that are not part of the five for evidence of social resources.

Findings

According to the Wisconsin DPI, teacher education programs should be designed to enable all students to demonstrate knowledge and understanding of the following: EE including the conservation of natural resources for licenses in agriculture, early childhood, and middle childhood to early adolescent teaching licenses for both science and social studies. As one might expect given the manner in which this requirement is written, there are many ways in which this component of teacher preparation is being met. Data from the surveys and an investigation of websites can be classified into two categories: course-based and activity-based. Broadly defined, *course-based* ways mean that EE components are included as part of a course and the completion of the course satisfies the DPI requirement. An *activity-based* way means that engaging in an activity (or set of activities) that may either be a part of a course or not will meet this requirement. Table 1 displays the ways in which teacher candidates are meeting the DPI requirement, as reported by a representative from the program or from their website in 2009. Data from 2013 varied little from these.

Examples from the data

While it is difficult to describe the ‘typical’ way in which teacher candidates are being prepared to teach about the environment, there are some interesting examples that emerge from these data. For the purposes of this study, ‘typical’ was defined by exploring the data and attempting to find a mid-point between those programs that were doing very little with respect to including EE in teacher preparation (e.g. showing a video with a corresponding activity) and those programs that were doing the most (e.g. requiring more than one course in EE). Let us examine more closely two of the more common course-based ways and one popular activity-based way from typical programs.

Course-based: biological sciences course requirement (most with a lab component)

A common way for teacher candidates to meet the EE component is for the teacher education program to identify a biological science course that, if successfully completed with a ‘C’ or better, will satisfy the DPI requirement. This course is typically lecture-based, but many have a laboratory that may include a field trip. Most of these courses are touted as being rigorous in their syllabus, with exams being the primary form of assessment. Since it is a science content course, teaching methods are rarely, if ever, included as a topic, so students are left to make connections for themselves between the topics they are learning and how to effectively teach them.

Table 1. The ways in which the environmental education requirement is being met.

Ways in which the environmental education requirement is being met	Number of programs
<i>Course-based</i>	
Biological sciences course requirement (most with a lab component)	15
Environmental education is integrated into a science methods course (many include peer teaching experiences)	14
Separate environmental education course	8
Select from a menu of science courses (most are biology)	7
Environmental conservation course requirement (could be a geography course)	6
Physical sciences course requirement (most with a lab component)	5
Earth science course requirement (most with a lab component)	3
Environmental education is integrated into a social studies methods course	1
Tutorial	1
<i>Activities in which teacher candidates engage (as part of a course/workshop or as stand-alone activities)</i>	
Field trip participation	17
Standards are used in a course (either as part of an instructor's presentation and/or integrated into an activity)	12
Project WILD training	9
Presenters from the community (usually as part of a class)	7
Project Learning Tree training	6
Observe public school students on a field trip to a natural area	5
Design and teach a mini-unit in a public school	4
Complete an environmental case study	4
Participate in a service learning project	4
Exhibition of teacher candidate's work	3
Project WET training	3
Watch a video/take a test	1

Note: Some programs have multiple options

The course usually counts towards both the EE requirement and as fulfilling a general education requirement for graduation.

Course-based: select from a menu of science courses in combination with EE being integrated into a science methods course

In this approach, students are required to select a course from a menu of possibilities, chosen most of the time by teacher education faculty in collaboration with faculty from the disciplines. Although the list can change over the years, many of the options are science content courses, and most of these are biology-related. The vast majority are 3-credit courses, and many can be counted as part of the students' disciplinary preparation. In addition to this, methods instructors are asked to integrate EE content into their coursework. As one respondent stated,

This was done briefly, idiosyncratically and, in some cases not at all. My sense of this situation, as a recent newcomer to the department, is that there was an initial push to include EE content followed by a steady drift as other priorities competed for time and space in the curriculum, and faculty and staff rotated through the teaching methods courses.

Activity-based: field trip participation combined with observing public school students in a natural area

The purpose for many of the teacher education programs that use field trips as part of their EE program is to help teacher candidates better understand the resources available to them as they teach primary and secondary students about the environment. Specifically for one program, the goals of having teacher candidates accompany primary and secondary students on an EE field trip were to help them understand the logistics and processes associated with planning, implementing, and assessing the effectiveness of a field trip experience; evaluate the specific EE program they observed; become familiar with the available EE resources in an area; and to develop an understanding of how various subject matters can be addressed while participating in an EE field trip.

Trends in the data

There were four interesting trends or themes that emerged from investigating data from all 33 teacher education programs:

They can choose to, but they do not have to

The first trend is related to the 24 teacher education programs that do not have a separate EE course. (Note: Most of the teacher education programs that do have a separate EE course include a teaching experience.) Many of these programs will fulfill the EE requirement by having their teacher candidates enroll in a science course, which, as described above, usually means that teaching methods are not included. However, each of these teacher candidates does need to enroll in at least one science or social studies methods course at some point. An investigation of the syllabi of these methods courses shows that the teacher candidates are usually asked to peer teach, develop a unit to teach to primary or secondary students, and/or investigate an issue. Rarely, however, is the teacher candidate required to use an environmental topic for these activities. When asked about this, a widespread response from the teacher education program representatives was, 'They can choose to, but they do not have to select an environmental topic.' It is up to the individual teacher candidate, and those who are not overly interested in environmental issues usually choose another topic. Thus, those teacher candidates who could benefit most from an EE teaching experience can go through their entire teacher education program without one. Even when institutions claim that EE is integrated into the science methods course, there are times when EE is not included in the list of topics covered in the course or in the list of objectives for the course in the syllabus. This leads one to believe that the primary way in which EE makes its way into the course is if individual students choose to use it as the context for completing an assignment.

It depends upon the instructor

College instructors, including methods course instructors, are given much freedom to include what they deem appropriate within their courses. In particular, they can place great emphasis on some topics while glossing over others. 'The use of the environment in the context of teaching methods can and does happen, but it depends

on the instructor' was a common response by the teacher education representatives when asked how thoroughly EE concepts were taught. Many described situations where in one semester, teacher candidates were provided with a wide variety of high-quality EE experiences, activities, and assignments by one instructor, but then the next semester when another instructor taught the course, EE was given very little attention. This leads to unevenness within the program. Many programs were developed with a scope and sequence of topics and activities, but as one respondent noted, 'Both courses included strong environmental education themes at the time of their design (they were constructed by a collaboration of teachers, science faculty, and science education faculty) though there is certainly some drift in focus as instructors change.' A lack of coordination among methods course instructors was also noted by some as leading to this unevenness.

Weak connections to social studies

Other than geography, there is little mention of social studies concepts in EE preparation. Science concepts and topics dominate. As one teacher education representative said, 'The perception with both many faculty and most students is that environmental education is a natural science.' Thus, there is little EE preparation in social studies methods courses. In fact, there was only one teacher education program in Wisconsin that explicitly stated on their website that EE was integrated within their social studies methods course and not their science methods course. The focus of almost all social studies methods courses is mostly on history, since many social studies teacher candidates are history majors. While some believe the *content* of EE issues rests squarely in the sciences and the *processes* of what action should be taken lie within the realm of social studies, it seems the connections between the environment and history are not transparent enough to be included in many social studies methods courses.

Where's the proof?

By and large, teacher education programs do not track the impact of their teachings on the classroom practices of their graduates. This holds true for all topics, including EE. For example, some programs use Project WILD, WET, or Project Learning Tree training as part of one of their teacher education courses. Respondents claimed that overall the teacher candidates found the training beneficial (even fun), were grateful for the resources provided, and made statements such as, 'I can't wait to do these activities in my own classroom someday.' But do they? No data were collected in this study from any teacher education program that indicated any systematic follow-up with graduates to see if, and how, the graduates were integrating EE topics and activities in their classroom practices. This begs the question, 'What impact is pre-service environmental education preparation having on what occurs in classrooms?' Undoubtedly, there is some, but to what extent is unknown.

Programs that are doing more than 'typical'

Using the analytical framework described above, namely an examination of not only materials resources used in a teacher education program, but also including human and social resources, five teacher education programs were identified through the

2009 data gathering process as doing more than ‘typical’ when it comes to preparing teacher candidates with respect to EE. These five programs either engage in multiple ways of preparing their teacher candidates and/or the quality of the experiences offered are very high. (These programs are described in alphabetical order.)

Edgewood College

Teacher candidates take a natural science course and a science methods course in the fall semester and follow-up courses in each in the spring semester (four courses total). EE is integrated within both the natural science and science methods courses. The two instructors, one from the sciences and the other from the teacher education program, meet each week to discuss the weekly topics and to integrate the natural science concepts into the science methods course.

The teacher candidates are paired with first grade students twice in the fall to collect seeds from the rain garden plants on campus, examine the seeds microscopically, and in the spring, plant the seeds that were collected in the fall. The teacher candidates are expected to make this activity into an inquiry-based environmental exercise, and they are to practice their open-ended, productive questioning skills when they meet with their partners. The students, young and old, gain an understanding, purpose, and appreciation for rain gardens.

In the natural science course, teacher candidates are required to do an original Watershed Research Project that includes an abstract, introduction with hypothesis, methods, experimentation, results with graphs/charts, analysis of data, and a complete discussion of the results of their independent study. These projects are then presented at the Edgewood Science Night. Since this science night is for all ages, teacher candidates must adapt their scientific findings for all levels of students. As such, they must come up with activity-based exhibits that will involve all ages in their research.

Students in the natural science course must participate in at least two environmental activities outside of the classroom during the semester. This might include attending a seminar or hearing an environmental speaker. The teacher candidates must submit a summary and a reflection on how this issue impacts them and why it is an important topic. Speakers are invited into both the natural science class and the science methods class during the year, and field trips are always included within the curriculum. Some students are also involved in the Spring Harbor Elementary School, a Madison charter elementary school involved in environmental studies, for their science practicum.

As one can see from these descriptions of the activities, there is great emphasis based on critical thinking skills, developing and testing a hypothesis, working effectively in groups, and preparing oneself for work within the community. On a weekly basis, teacher candidates are involved with making observations, making predictions, drawing conclusions, and revising their understanding of the environmental concepts covered. These required courses span an entire academic year because it is strongly felt by the two instructors that these process skills and broad environmental concepts cannot be covered in a one semester course. The natural science course and the science methods course are taught concurrently in order to achieve this dynamic integration for elementary education majors.

Northland College

Northland College is an environmental liberal arts college that began as a school for the children of loggers. EE is taught beginning in the first year block courses and continues in many other courses in most majors. There are strong connections to the Native American tribes in the region, concepts related to community sustainability, local businesses and organizations (like the fish hatchery), and the park service. Civic engagement with respect to the environment is high and is incorporated in the activities of many classes. Community members acting as guest speakers are frequent. As the teacher education department chairperson stated, 'It's difficult to isolate where environmental education is offered as it's offered in many places.'

It is within this context that teacher candidates enroll in an EE course designed specifically for education majors. At this point in their college career, *learning about* the environment is far from unique, but *learning to teach about* the environment might be. This course is actually offered through the Department of Outdoor Education, and according to the syllabus 'provides a broad survey of environmental education including historical, philosophical, and theoretical foundations, current research, debates, critiques, and practices. Course work prepares students to develop effective programs in environmental education. It provides exposure to a spectrum of EE curriculum and provides opportunities to practice planning and facilitating EE experiences.' The first several class sessions focus on historical, philosophical, and theoretical perspectives. The goal of these sessions is to provide a framework to aid in evaluating curriculum, activities, and experiences that will occur later in the course. Most of the semester balances 'lab' days (where practical experience is gained in a variety of available EE curriculums) with classroom 'theory' days (where critical questions, current research and debates are examined). The course ends with opportunities to synthesize course concepts through the design, facilitation, and evaluation of an EE activity or lesson with a community group. Some of the power from these experiences comes from the level of detail. For example, when planning an activity that could be used with primary or secondary students, teacher candidates are even asked to consider the disposal of any materials that are used, such as the recycling of paper or how birds could be fed the soft-boiled eggs from an egg-drop demonstration.

UW-River Falls

In many ways, the EE component of this teacher education program is closely connected to community resources, and the EE course encompasses a wide variety of activities that take advantage of these resources. The course includes Project WILD, Aquatic WILD, Project Learning Tree, and Population Connection workshops. The teacher candidates teach these activities to the class as group presentations and to local school students (as an EE program at the respective schools). Field trips are included to the University farm, a state park and its nature center, a landfill, a woodlot, the city water treatment facility, and the University heating plant. The teacher candidates also complete an EE journal assignment and a resource assignment that has the students discuss how the selected resources can be infused into their teaching area(s) and how they can address the relevant Wisconsin DPI Academic Performance Standards.

The purposes of the multiple field trips are to enable the teacher candidates to get some first-hand exposure with actual primary and secondary students (and their reaction to the EE activities), to explore community resources which will thereby enhance their understanding of them, and to become better aware of related environmental issues. The public school programs are organized during lab time with the teacher candidates selecting the activities that they will be presenting. For tours, the tour guides and/or college course instructor take the students around the resource's facility and discuss its operation and issues. The duration of the field trips are within a 110 min lab period.

In addition, the teacher education program also spends time exploring (a) the local school district's sustainability framework that guides decisions related to curriculum, instructional strategies, and district operations; (b) the local Powerful Choices Initiative which is a community-wide effort to instill a strong conservation ethic while demonstrating the effectiveness of energy efficiency, conservation, and renewable resource development; and (c) the Eco Village Project – a sustainable community-based neighborhood development project of 18 net-zero homes being built to demonstrate efficient, ecological building practices and sustainable living that includes community gardening, edible landscaping, rainwater harvesting, renewable energy options, and shared electric cars.

UW-Stevens Point

UW-Stevens Point also has an EE course that includes a wide variety of experiences that were specifically designed with respect to the DPI EE requirement and the Guidelines for the Preparation and Professional Development of Environmental Educators (NAAEE 2010). It is a combination of 2 h of lecture focusing on environmental content and 2 h of discussion – focused on EE theory and teaching strategies. Early childhood, elementary, and middle school teacher candidates are in discussion sections together and secondary science and social studies teacher candidates are in a separate discussion section. All students take the same 2 h of lecture.

All students complete the following assignments:

- Visit a nature/environmental center/school forest where public school students are engaged in learning. The teacher candidates need to spend the day at the facility, observing instruction, and then write a reflection report that addresses several questions.
- Complete an EE resources assignment that requires students to find a teaching resource, evaluate it using the *Environmental Education Materials: Guidelines for Excellence* (NAAEE 2009), and share it with peers
- Team teach a Project WILD or Project Learning Tree activity
- Develop a nature journal. They are encouraged to try various journaling techniques weekly throughout the semester.
- Investigate an environmental issue, develop and implement a personal plan as to how they can address the issue, and then develop a lesson plan on the same topic.

Wisconsin Lutheran College

EE is viewed by the teacher education department as a topic to be covered not solely to meet the requirements of DPI via required coursework. Instead, EE is covered in

multiple courses in multiple departments to ensure teacher candidates are exposed to EE on multiple levels (i.e. literature courses, field trips, lab experiments on the island of Jamaica during a travel course, etc.). The campus is small and autonomous, so things can get done rather quickly once a decision has been made. The teacher education department has been very proactive with respect to EE. Many of their ideas have been acted upon since they (a) have a strong relationship with the science department, (b) collaborate well with others on campus, and (c) have a commitment to ongoing communication with key decision makers and stakeholders.

EE is integrated into each of these courses, so by completing at least some of these courses (which all teacher candidates do), they come away with a comprehensive view of EE:

- ESS 182 Environmental Science.
- BIO 283 Marine Ecology (a travel course to Jamaica).
- HIS 342 Colonial Latin America.
- BIO 372 Developmental Biology.
- BIO 331 Cell Biology.
- BIO 360 Genetics.
- BIO 201 Principles of Biology I.
- BIO 380 Ecology.
- COM 101 Introduction to Communication.
- ENG 210 American Literature I.
- ENG 211 American Literature II.

In addition, the science methods class includes an environmental workshop, which is primarily Project WILD training. However, other activities are also included in this workshop, such as measuring the effects of CO₂ on the cooling rate of a container, playing a predator-prey tag game in which toxic chemicals (popsicle sticks) move up the food chain, modeling how everything is connected when students take a particular animal or plant (one is the Sun) and form a web of connections using yarn, viewing videos of environmental problems, visiting the rain garden that has been constructed on campus, demonstrating the capture of solar energy by running a little motor with it, and reviewing some of the research that has been done by students on campus, such as calculating the amount of food waste.

Updates

Since the 2009 study, there have been a few events that had the potential to modify the ways in which EE is being integrated into teacher preparation programs. These include:

- (a) The hiring of an EE consultant at the Wisconsin DPI
- (b) The re-establishment of TENFEE (Teacher Education Network for Environmental Education) where all teacher preparation programs are invited to share in discussions, an annual face-to-face meeting, and share resources about how to best prepare teacher candidates with respect to EE.
- (c) Turnover in faculty at teacher preparations programs, with some new faculty having fresh ideas about EE

- (d) Regular curricular changes that occur in every teacher preparation program over time.

There have been changes in various teacher education programs that can be directly linked to items (a)–(d) above, such as:

- New ways for teacher candidates to meet the EE component by having the teacher education program identify different biological science courses that, if successfully completed with a ‘C’ or better, will satisfy the DPI requirement.
- Changes in the menu of science courses teacher candidates can select from. These courses are chosen most of the time by teacher education faculty in collaboration with faculty from the disciplines. The teacher candidate selects one of these science courses from the menu and also learns about EE concepts in a teacher education course, typically a science methods course. In fact, one program stated that their direct involvement with TENFEE has caused them to re-visit long held assumptions about their curriculum.
- Changes to field trip participation combined with observing primary and/or secondary students in a natural area. The purpose for many of the teacher education programs that use field trips as part of their EE program is to help teacher candidates better understand the resources available to them as they teach primary or secondary students about the environment.

However, the approach used to prepare teacher candidates at the broadest level (course-based or activity-based) described by the 2009 data has remained largely unaltered.

Discussion and implications

The above descriptions are full of examples of material and human resources playing important roles in the preparation of teacher candidates with respect to EE. Curriculum materials, field trip sites, community-based resources, etc. are prominent material resources while knowledgeable instructors, interested students, individual commitments, etc. are key human resources in the stories of these teacher education programs. There is also some role for social resources in the above descriptions, but these resources tend to be more hidden than the obvious material and human resources. This does not, however, mean that social resources play a lesser role. In fact, they can play a very important role, if one does a little digging into the data.

A question that was posed during the analysis of all data gathered in this study was, ‘Do these five programs that “stand out” from the others in the state have anything in common?’ The most obvious answer was that they do, namely that each has at least one committed, talented individual who has championed EE on their campus (a human resource). However, some other teacher education programs also have this individual, yet not as much is happening on their campus. What else do these five programs have in common? A close examination shows that each also has a *driving force at the institutional or department level* that facilitates the development of high quality EE activities by individual staff or faculty. While each of these driving forces (a social resource) is different for each institution (as depicted in Table 2), each acts similarly in facilitating EE efforts.

The primary implication of this finding is that the teacher education program (and quite possibly the college or university) must make a commitment to effectively prepare teachers to teach primary and secondary students about the environment. Having a committed, knowledgeable, talented environmental teacher educator is essential, but not enough. Just as having access to effective curriculum materials, nearby zoos or nature centers, and other material resources appear to be essential, but not enough. It takes all three types of resources (material, human, and social) working together to effectively prepare teacher candidates with respect to EE. This is no small task, but it is well worth addressing since the consequences of not having an environmentally literate population can have huge, devastating effects.

Another implication of establishing social resources such as shared visions and goals within a teacher preparation program is related to the ‘trends’ found in the data. The ‘they can choose to, but they do not have to’ trend is common in teacher education programs that do not have a separate EE course. This trend leaves it to the teacher candidate (a human resource) to determine the extent to which he or she will involve EE concepts into their preparation. The ‘it depends upon the instructor’ trend applies to many of the course-based approaches to EE teacher preparation. Usually this means a variety of instructors (a human resource) can be charged with teaching teacher candidates about the environment. Typically, these instructors will ‘teach to their strengths and interests’ which may or may not include EE. With respect to both of these trends, if there is not a common vision, commitment, and shared norms and expectations (such as the Balkanized structure of education described by Fullan 1993) for EE within the teacher preparation program to provide guidance to individual instructors, then it is easy to see how some courses (and student choices) can include much EE while others contain very little, if any. On the other hand, if the social resources of a common vision, commitment, collaboration, and shared norms and expectations for EE do exist, discussion concerning, for example, how to effectively connect EE to social studies concepts are more likely to occur among teaching faculty as well as the development and implementation of a plan to evaluate the impact of EE preparation on the classroom teaching practices of the program’s student teachers and graduates.

Table 2. Institutional or department-level driving forces.

Institution	Institutional or department driving force (in addition to an individual who champions environmental education)
Edgewood College	College facility with both a primary and secondary school attached so students are readily available for teacher candidates to work with. Also there is strong support and working relationships between natural sciences faculty and teacher education faculty
Northland College	Institutional mission and history in environmental education. Close connection to the Native American tribes and their environmental ethic
UW-River Falls	Community resources that are easily accessible and are of interest to teacher candidates. Strong collaboration, networking, and common understandings exist between the community and University
UW-Stevens Point	The Wisconsin Center for Environmental Education is located on this campus with its vast set of social (e.g. networking and collaboration) and human resources
Wisconsin Lutheran College	This is a faith based institution with a strong stewardship ethic towards the Earth and its resources

Two test cases

We decided to conduct a limited test of these ideas by selecting two programs that are not from the list of the five described earlier and interview faculty involved to ascertain the extent to which social resources exist within their program with respect to the integration of EE. Each of these programs have knowledgeable and skilled faculty members and many material resources dedicated to pre-service preparation in EE. But do they have social resources in place to make EE preparation effective for all of their teacher candidates? Two faculty members and one instructor were interviewed from the first program, and two faculty members were interviewed from the second. Each was asked to describe their view of the integration of EE in their respective programs.

The first program

This program separates elementary teacher preparation from secondary teacher preparation, with different faculty teaching at each level. At the secondary level, teacher candidates enroll in a three credit Letters and Sciences course on conservation/natural resources, and EE topics are integrated into a science methods course. In the methods course, one or two trips are taken to a local nature center to explore pedagogical strategies, and the teacher candidates complete Project WILD and Project WET training for a total of approximate twenty clock hours directly related to EE. Much less EE is included at the elementary level, and there are no joint efforts and little communication between the faculty members who teach at the two levels. A one credit EE workshop at a local nature center was offered for the early childhood teacher candidates to explore various curricula. This included an observation of elementary students on a field trip and class presentations. However as of last year, this one credit workshop was no longer required; the concepts are now being incorporated into an existing class on campus, in an effort to reduce the number of credits to degree.

It is evident from the interviews that one secondary methods instructor has a passion for teaching about the environment and regularly uses examples in his courses to show teacher candidates how the various sciences are embedded within environmental issues. When asked if he thinks his colleagues share his passion, he responded:

No, I don't. I think they will verbally tell you, 'Oh yeah ... that's important, but we don't have time for that.' They see it as a content thing. 'They don't teach too much environmental stuff in elementary or middle school.' So they don't see it as something needed to be scientifically literate. This is something that is more important than – Can you remember the parts of the cell? Because if you need that, you can always go look it up. But when you have to make a decision at a voting office deciding if they should sign or not sign this legislation, you can't find that in a textbook.

The topic of EE is not often discussed at faculty meetings, and it is not viewed as an interdisciplinary concept, but instead some faculty want to categorize it as a content (just like physics or chemistry) which means it gets lost in some discussions among all of the other topics needed to be addressed in a teacher preparation program. It is not seen as a way to connect academic content with societal or personal issues/examples. According to one instructor, there is no common vision within this program about the role EE plays in teacher preparation.

Some of them very much think it is an important thing to do, but some of the newer faculty who I have not had as much interaction with, when we had a meeting about a year and a half ago, I did not get the sense that they were as into it as some of the faculty that I have been working with for years.

When another secondary science methods faculty member was asked about how much concern faculty who teach other secondary methods (English, mathematics, social studies, etc.) have about EE, he responded, 'I'd be surprized if they had any.' It is apparent that a shared sense of purpose about EE and other related social norms are lacking in this program.

The second program

A faculty member at another teacher preparation program not from the list of five above told a similar story at his university. He claimed that EE was rarely discussed at faculty meetings and that he had a hard time finding a colleague in the program to discuss EE ideas. A major reason behind his decision to begin attending TENFEE (the statewide EE organization for teacher education faculty – a social resource) was to find individuals with whom to discuss EE. 'How does EE become meaningful to our teacher candidates?' is a question that drives his efforts, but this drive is not shared by many of his colleagues. A day long EE experience for teacher candidates at a local school has been diluted down to a visit by the teacher candidates to teach pre-determined activities to primary and secondary students without, in some cases, substantive discussion of effective pedagogy surrounding the activities. When another faculty member tried another approach one semester by taking his students to a local marsh for an integrated concepts/pedagogy/assessment experience in a natural environment, he was chastised by a colleague for doing so. Many of the important social resources needed to foster and sustain effective EE (shared values, trust, open lines of communication, a shared vision, etc.) are not evident at this program.

Connections to the literature

The findings from our limited data gathering in the two test cases are consistent with other studies that explored social resources and their impact on teacher preparation. Wilson (2012) identified *drivers* and *blockers* (each a form of social resource) to embedding education for sustainability (EfS) across a primary teacher education program at an Australian university. Examples of drivers included widespread emphasis on sustainability, common values, a commitment by faculty and lecturers to include sustainability concepts in courses, and collegiality. Blockers included multiple priorities and scattered efforts with the program, conservative collective thinking of what is possible in a teacher education curriculum, resistance by some to change, an unmet need for curriculum mapping across units, and an overcrowded curriculum. An analysis of unit outlines and surveys of lecturers found a foundation of EfS principles across a course with multiple sections taught by six different lecturers, but the teaching of the principles was discrete and not coordinated.

A range of EfS principles and content were addressed by existing units; however, there was no organisational framework, and individual lecturers were not fully aware of the principles and content of EfS covered by other lecturers. Lecturers saw a need for tracking of students' exposure and engagement with EfS, to ensure that it was

coordinated, and that students' experiences in lectures or assessment tasks were connected to ensure that students received a cohesive picture to direct their EfS learning. Current practices do not involve such detailed tracking. (49–50)

Similar statements could be made about our two test cases in Wisconsin.

Why might this be? Greenwood (2010) critically analyzed the bureaucracy of schooling and found that the field of teacher education has been largely non-responsive to the inclusion of EE. He claims that teacher education needs to be more of a field of cultural and ecological inquiry.

Simply put, environmental and sustainability education have never been central to the culture of teacher education, if they have been part of it at all. Very few faculty members have deep academic or practical experience with the complex interdisciplinary work of sustainability. What this means is that there is an established set of norms and ways of doing business in teacher education, what Foucault called disciplinary practices and what Bourdieu called habitus, that make it exceedingly difficult to deeply examine the practices of a field and the assumptions upon which they are based. (142)

This view is supported by Fien and Maclean (2000) who also advocated for an 'ecology of professional development, curriculum development and practitioner research' (48). The professional autonomy of committed, talented faculty combined with enlightened policy level changes over time and deep conversations with teachers (Hart 2003) may be the best route to placing EE at the core of teacher preparation. 'It is possible to work within the state-regulated system to create change, but first individuals and groups need to build relationships, demonstrate credibility, and then respond strategically to whatever openings exist' (Greenwood 2010, 151). These ideas are supported by Inwood and Jagger (2014) who provide some guidance about how to develop social resources within a faculty of education by (1) developing EE courses and asking all interested faculty to join in the work, (2) developing co-curricular learning opportunities for teacher candidates focusing on EE and connected to other programs or courses in the teacher education department, (3) developing an EE certificate program, (4) facilitating faculty professional development with the goal being to build awareness of how the environment can be connected to almost all areas of teacher preparation, (5) building EE into the faculty's infrastructure, (6) supporting EE through continuing education, and (7) investigating EE through research.

Conclusions and recommendations

The primary takeaway for us from this study was that every teacher education program, even those that are doing more than 'typical,' could be doing more with respect to including EE in teacher preparation and that the likely candidate(s) for why more is not being accomplished is the absence of a resource – material and/or human and/or social.

This research leads us to several recommendations for teacher education and EE.

Application for teacher education programs

While we are hopeful that the program descriptions spark ideas for other teacher education programs, we expect teacher education faculty members will consider their own resources and how to make the best use of their resources. Teacher

educators should consider the material and human resources available for EE. They should then look to see what social resources they are already using or could use in the future. How might teacher education programs utilize and leverage these resources? Our recommendation is to ‘start small, do it well,’ which is echoed by the researchers from Canada who developed the Deepening Environmental Education in Pre-service Education Resource (DEEPER) (Inwood and Jagger 2014). With respect to the development of social resources, the authors of DEEPER suggest identifying partners who are interested and may have already completed work on this topic, supporting existing relevant institutional visions, collecting baseline data, making EE explicit in your own work, establishing a network, locating funding, connecting with external partners, and sharing successes. Reviewing case studies of other teacher education programs can also prove instructive (Dippo 2013; Fien 1995; Powers 2004). Examples include:

- The work of teacher candidates at an Australian regional university to develop integrated unit plans with an environmental focus has shown to provide opportunities for school students to develop critical reasoning skills and act in environmentally responsible ways (Gooch et al. 2008).
- Efforts in India to create curriculum and support materials for introducing EE in all levels of teacher education in the country, which involves negotiating issues related to content, learning and teaching methodologies, materials development, and capacity building for implementation (Ravindranath 2007).
- Ways of integrating biodiversity concepts in curricula developed by teacher candidates in European nations (Lindemann-Matthies et al. 2009).
- Progress in helping teacher candidates in England, Denmark, and Germany make sense of conceptions of sustainable development and the task of education for sustainable development by helping them develop the key notions of ‘taking’ responsibility and ‘having’ responsibility to interpret their professional role and student learning with respect to education for sustainable development (Nikel 2007).
- Institutionalizing EE in teacher preparation in two Belgian teacher education colleges where personal and organizational obstructions existed (Van Petegem, Blicck, and Boeve-De Pauw 2007).

Teacher educators should consider the trends in the data from this study and how this compares to their own institution. How can teacher educators address the four trends: students can choose to include EE but they don’t have to, it depends upon the instructor, weak connections to social studies, where’s the proof that graduates are including EE? For example, teacher educators can make explicit connections to EE by requiring student assignments in methods courses (both science and social studies) to include EE.

Research

This research provides an example of collecting and analyzing baseline data for our region (Wisconsin), and we would encourage others to do the same in their regions with follow-ups conducted periodically to monitor changes. Additionally, it is recommended that teacher education programs connect with their graduates to better understand how they are using EE in their classrooms. A current study by one of

the authors of this project includes interviewing and surveying teachers who practice EE to better understand how their teacher education program prepared and influenced them to include EE in their classrooms. Other ideas for research studies include examining the ways in which EE can best be integrated into a variety of teacher education courses, finding ways to integrate EE research with existing faculty initiatives, exploring ways of implementing a variety of pathways to include EE into teacher education, and getting the local community and its environmental resources involved in teacher preparation.

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