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A Comprehensive Approach to Fostering the Next Generation of Science, Technology, Engineering, and Mathematics (STEM) Education Leaders

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This paper describes an innovative education program launched in 2004 by Oregon State University Science and Mathematics Education Department, with leadership from Oregon Sea Grant, and funding from NOAA. Program development is described as well as the impact of it on participants. The program represents one vision for how to transform research and education practice to better support lifelong STEM learning.

> *There is always one unexpected little moment in life when a door opens and lets the future in.*
>
> Graham Greene

A quiet revolution in education is underway worldwide. Lifelong learning opportunities abound, supported by a vast infrastructure of learning organizations. Rarely acknowledged at policy levels though, the centers of this learning revolution are not the traditional educational establishment of schools and universities, but a vast network of informal education entities: museums, zoos/aquariums, nature centers, national parks and increasingly the Internet, podcasts, and other social networking media (Falk & Dierking, 2002; Pew 2006). This educational shift calls

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into question the school-first paradigm so pervasive in discussions of educational policy, the preparation of STEM educators and assessment (Falk & Dierking, in press).

Science, technology, engineering, and mathematics (STEM) learning is at the heart of this shift. People engage in STEM learning everyday, across their life spans—at home, at work, and out in their community and world (Falk et al., 2007; Dierking & Falk, 2009; NRC, 2009). Much of this learning is free choice[1] in nature and the learners are anything but the usual suspects. In addition to K-16 students, they include increasing numbers of home educators, post-high school adults, some of whom either are not privileged enough or do not choose to further their schooling at university or community college, adults who did not graduate from high school at all, increasing numbers of young elders, only rising in number each year, and school-age children during out-of-school time.

The traditional boundaries and roles that have distinguished various groups of science educators are also disappearing and those of us engaged in the work of developing a new generation of STEM educators need to take these changes into account as we design our "teacher" preparation programs. Whether someone is preparing to be a "teacher" in a K-16 classroom or at a museum or nature center, as s/he learns to develop STEM interest, knowledge, and understanding among the learners s/he will support, being aware of the vast number of ways, ages, and places in which a person learns STEM across their lifetime is an increasingly critical skill. The implication, of course, is that we need to create new "teacher" preparation programs that actually incorporate these emerging realities.

Oregon State University (OSU), Corvallis, OR, with leadership from Oregon Sea Grant, and initial funding from the National Oceanographic and Atmospheric Administration (NOAA), has taken on the challenge of preparing a new generation of STEM learning leaders by launching an innovative science and mathematics education graduate program in 2004. Initially begun in the OSU College of Science, this program is now a partnership between OSU College of Science and College of Education. The program's premise is that as the world transitions into a STEM-dependent learning society, citizens of all kinds need ever better STEM learning support, not only at K-16 levels, but throughout their lifetimes. This is the first STEM education graduate program in the country to provide such a comprehensive approach to science and mathematics education. In addition to K-12 teacher preparation, the program offers two additional areas of concentration for graduate study, Collegiate Teaching and Free-Choice Learning (FCL).

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[1] **About a decade ago, John Falk and I began advocating free-choice learning as a preferred term to the more commonly used informal learning. We recommended this change for two reasons: (1) political—"informal" connotes potentially unimportant which was perhaps why this learning was under-valued and under-investigated, and (2) conceptual--we chose to define the learning by its characteristics--non-linear, personally motivated and involving considerable choice on the part of the learner as to the "what, why, when, where, and with whom" of learning, rather than by what it is not (formal), or where it occurs. Good classrooms employ free-choice learning principles and not all "informal" learning experiences really are!**

The program offers 3 degree options: (1) a M.S. in Science Education or Mathematics Education with a teaching credential for grades 6–12; (2) a M.S. in Science Education or Mathematics Education, with either K-12 or FCL focus; (3) a Ph.D. in Science Education or Mathematics Education with a K-12, FCL, or Collegiate Teaching focus. Recognizing that teachers working in all parts of the educational infrastructure can benefit from understanding some basic principles about the nature of learning and how it occurs and connects across settings, ages, and time of day, core Master's and Ph.D. courses are taken by all graduate students together, whether they are K-12, FCL, or Collegiate Teaching. This fosters a community of educators and researchers that crosses settings, ages, and backgrounds, fostering cross-disciplinary and cross-institutional learning. Students in each area of concentration (K-12, FCL, or Collegiate Teaching) also build specific knowledge and expertise. The program represents a vision for how to transform research and education practice in order to better understand and support lifelong STEM learning.

This overall vision was created in a highly collaborative manner with all members of our department but it took a few years to envision fully. Initially, when I came to OSU from the east coast of the U.S in 2006 along with my husband and colleague, John H. Falk, the task was far more focused--to further develop an FCL area of concentration within the Science and Mathematics Education Department which our colleague, Dr. Shawn Rowe, Assistant Professor, had begun (though both John and I had been working with OSU from afar since 2001 to help conceptualize and develop the program; I was on the search committee that had hired Shawn). This opportunity was a dream come true for John and me—he had recently stepped down as Executive Director of the Institute for Learning Innovation, a not-for-profit research and development organization in Annapolis, MD that he had founded, with a mission of understanding, facilitating, and advocating for free-choice learning. I also worked at the Institute as a Senior Researcher and Associate Director for Strategic Initiatives. Both of us were looking for the next professional challenge and when the opportunity came along to further develop a graduate program focused on free-choice STEM learning, we jumped at the chance to play a role in fostering the next generation of FCL leaders. We also were pleased by the university commitment to the idea—we accepted Full Professor positions (with tenure) in the College of Science (thanks to the leadership of Oregon Sea Grant and initial seed monies from NOAA).

Soon after arriving in Corvallis though, we discovered that there was a great deal of work to do, even more than anticipated initially. Although it existed on paper, and students were already enrolled in the program, there were only two introductory courses in place and the program as a whole was not "officially" present in the university catalog. We were consumed the first year by the tasks of developing courses and creating a full-fledged, Graduate School-approved program.

We made a strategic decision at that moment to focus on the development of the Master's program and to develop it as an online program. This decision was due in part to the availability of funding; OSU's Extended Campus was offering competitive grants to departments throughout the university in FY 2006–2007 to fund the development of new online programs. We collaborated on the writing of a proposal with our K-12 colleagues and successfully procured funding ($75,000) to support the development of an online Master's of Science degree program with two options: one that would serve K-12 science and mathematics teachers in schools and another that would be for mid-career professionals working in free-choice learning settings (science centers, museums, zoos and aquariums, national and state parks, nature centers and other outdoor settings, STEM-based positions in new media, university outreach programs, and family- and youth-serving organizations). We also chose to make the program online because of the history of the existing K-12 program, which required an on-campus presence, thus limiting its pre-eminence regionally, nationally, and internationally. We felt that an online Master's of Science in Science Education and Master's of Science in Mathematics Education degree would make the program uniquely competitive and extend its intellectual reach to students in the region, specifically in rural areas of the Pacific Northwest, and throughout the country and world.

We knew that an online degree was particularly critical for the FCL option, since earlier research conducted when John and I were still at the Institute for Learning Innovation approximately five years before had suggested a need for a graduate and research/development program in free-choice learning with high interest from a national and international pool of mid-career professionals. More than half of those participating in the Institute study indicated that either they, or someone they knew, would be interested in pursuing such a degree and participating in research and development in this arena. One-fifth of the people interviewed specifically indicated the need for a master-level program.

The existing on-campus Master's degree program had always served a variety of educational professionals other than K-12 teachers, community college, and university faculty. However, the courses were not designed to accommodate the specific needs of the diverse learners FCL educators serve. In the course of a day, she/he may interact with youth in a Boys and Girls Club afterschool program, seniors in an Elderhostel program, and family members of various ages attending a Math Activity Night at a local science center. Because of the diversity of learners and FCL settings and configurations, educators focused on facilitating FCL need to learn about how people of a variety of ages, backgrounds, and interests learn, how an educator appeals to an individual or group interests, personal curiosities, and motivations for learning, and ultimately how one creates learning experiences that are self-directed, voluntary, and lifelong.

Given these parameters, it was important to us that the FCL option be a dynamic and vibrant learning experience—online and in the real world—that

deeply engages students in the program. Consequently, we designed the program with a working professional in mind, purposefully building strong ties to their day-to-day workplace activities so they would be able to apply and shape what they were learning. The degree also has a project option—rather than a thesis, students complete a final project which though theoretically grounded, is a more practical, hands-on activity such as completing an evaluation, developing a new program or creating a professional development activity for staff in their institution. As with our on-campus degree programs, we worked closely with our K-12 colleagues who were creating the online K-12 option to ensure that core courses could be taken by both FCL and K-12 students together.

We began program development in Winter 2007 and completed it in Fall 2008, conducting an initial evaluation in Fall 2009. With the focus in the FCL program on learning rather than teaching, we needed to work with our K-12 colleagues to revise core courses and create new FCL courses to emphasize the personal, socio-cultural, and physical dimensions of learning across the lifespan. To this end, we developed three core FCL courses, which serve as electives for K-12 students, which focus on an in-depth look at one of the aspects of free-choice learning (personal, socio-cultural, and physical). The three courses were envisioned to support future education leaders' understanding of the critical and unique ways in which individuals come to know and utilize STEM in their daily lives.

In the pilot year, there were 5–7 students enrolled per course, three of whom were enrolled in the FCL Master's program option. FCL Doctoral students, Environmental Sciences, and Marine Resource Management (MRM) Master's students were also enrolled. Most of these pilot students were on campus so we were able to receive on-going feedback from them, both online and in person. The first official cohort of 8 began in the fall of 2008. This group included a diverse group of FCL professionals from science centers, outdoor schools, environmental centers, national parks, and even a veterinary assistant who quipped that she spent most of her time "educating her patients' owners about their pets health!" She clearly needed to understand something about learning, but did not need to know how to design a lesson plan or a test. Students in this year were primarily from OR, but but there was one student each from Virginia and Montana as well. There were also students enrolled in the fall course offering who were "trying out" the program, as well as two FCL doctoral students and two K-12 Master's students. A few of these students were on campus also, so we continued to receive on-going feedback to improve the courses and communication among students.

In fall 2009, another cohort of 7 students began the program. Again, it was a diverse group from Florida, New Mexico, Massachusetts, and Nevada and included professionals working in science centers, marine education centers, national parks, home education and online learning venues. The first cohort of students was also completing their final projects, and the first three FCL students graduated this past academic year. One student completed a front-end evaluation

project at the Oregon Zoo, another worked with children in a local one-room schoolhouse in Friday Harbor, San Juan Islands to develop a marine invertebrate guide using a community of practice model and Personal Meaning Mapping assessment tools, in collaboration with the San Juan Nature Institute and University of Washington's Friday Harbor Lab, and the third student completed a project investigating emotions in the *Goosebumps: Science of Fear* exhibition at the California Science Center in Los Angeles. Another cohort of approximately 8 students will begin this fall, again a diverse group, professionally and geographically. Enrollment is on-going throughout the year so many students start in January or even in the spring quarter.

Our major concern as new online instructors was whether the online-only format would afford the kind of vigorous interchange of ideas we believe is essential for graduate study, as well as build a community of learners among each cohort of students. We have been pleased that students are very engaged and find the classes highly interactive even though they are not face to face. Some of our students who are geographically close have managed to connect, including students from Seattle, WA and Portland, OR meeting midway. Three educators from Great Basin National Park in Nevada are all enrolled in the program and they work together on some assignments and have also expanded their community of learners to include others in their workplace by conducting seminars and involving other staff in projects. We even had a student drop out of the program last year because "it was too interactive." In probing a bit more, I discovered she was expecting a more traditional distance program with taped lectures and a series of tests.

Given the success of the program, we were able to hire a new faculty member (non-tenure track) in spring 2009 to assist with the coordination and further development of the program. Dr. John Baek, Assistant Professor and Senior Researcher, oversees the coordination, advising, and teaching within the FCL option of the online Master's Program. With Dr. Baek's arrival and leadership (he is a distance learning expert), we have been able to add and experiment with many more interactive elements including an opening conference call to provide a more personal course orientation, discussion of syllabus, introduction to instructors and other students, live chat sessions with guest speakers using Blackboard's chat feature, periodic conference calls with as many students participating as is able, as well as "virtual group" projects and feedback sessions.

The live chat sessions using Blackboard's chat feature did not work well, so with Baek's guidance and piloting by him and Rowe in the fall, this past year we introduced a live web-based radio program into each course. These occur every two weeks throughout the course and include invited guest speakers, some of whom have been international guests. Students can participate live, even calling into ask questions should they choose, and the programs are also archived for students unable to participate during the "live" program. These radio programs have introduced a degree of fun, spontaneity, and interactivity into courses, as well as

provided additional opportunities for students to personalize their own learning experience.

All of these are efforts to build community and increase the interactive nature of the learning, critical to model for FCL professionals. Despite this positive feedback, we continue to work on building community and interactivity within the program. For example, we have contemplated offering the program to a core set of staff at an institution; for example, we discussed this idea with Oregon Museum of Science and Industry (OMSI) at one point, with the thought that if there were 5 students or more, we could envision FCL faculty making at least one physical visit to the institution, regardless of where the program is (we were only thinking of domestic travel though).

FCL students also have had successful experiences in some of the elective courses, particularly the *Inquiring into Science and Mathematics Learning and Teaching* course, which engages students in designing their own inquiries into science and mathematics learning and teaching and is a flexible-enough course to accommodate the needs of both K-12 and FCL students. As the program matures, we also anticipate that the *Engineering and Science in the Lives of Students, the Science Materials and Labs: Nature of Science, and the Designing of Problem-Based Curricula* courses will also be good options for FCL students depending upon their specific interests, backgrounds, and career trajectories.

The FCL option is also adding depth to the overall Master's program. Students in both the K-12 and free-choice learning options take some of the same core courses, and K-12 teachers also have been encouraged to take FCL courses as electives, which they have. Collaboration between FCL and K-12 faculty has integrated free-choice learning principles, content, and activities into relevant course syllabi and assignments. This has helped to expand K-12 teachers' ideas about the personal, socio-cultural, and physical dimensions of learning, while also helping them to think about the experiences their students bring to the classroom from interactions with their families, friends, and other significant adults (scout leaders, neighbors, and so on) during their out-of-school time. It has also helped them think of themselves as lifelong learners, as well as teachers.

FCL courses are also being taken regularly by Master's students in the Environmental Sciences program at the College of Science, MRM program at the College of Oceanic and Atmospheric Science, and the Design and Human Environment Department at the College of Health and Human Sciences. These students are expanding the organizations and institutions with which our program is connected and some of these, though getting a degree in a different program, are asking FCL faculty members to sit on their committees, and in a few cases, particularly with environmental sciences and MRM students, actually asking FCL faculty to chair their committee.

This has been an intensive experience for the FCL faculty involved in designing and offering an online master's program. We have had to learn many new skills

with respect to the use of Blackboard (our only platform option for the program given a contract that OSU has with Bb) and in the design of learning experiences that do not include face-to-face interaction and discussions. We have also enjoyed the collaboration with our K-12 colleagues, which this program necessitated. One issue that did arise for the FCL program, as it was piloted, was the need for some of the core courses to have special sections for free-choice learning students. In particular, the assessment course, SED 595, and the curriculum course, SED 598, did not work as well for FCL students, since not all FCL professionals deal with schools and teachers at all, or find themselves in a traditional teaching role that requires lesson planning and traditional assessment. Last fall, FCL faculty created special sections of these two core courses with the needs of FCL professionals more central; for example, alternative assessment was one small component of the existing assessment course but such assessment is critical to FCL experiences and so makes up most of the course; and FCL curriculum includes exhibition and radio program scripts among others, depending upon the venue in which the professionals work. In addition, FCL faculty plan to work to make some of the elective courses more accessible and meaningful to FCL students, particularly *Engineering and Science in the Lives of Students, Science Materials and Labs: Nature of Science, and Designing Problem-Based Curricula*.

Because of faculty connections and the fact that students conduct course projects and their final master's projects in a variety of settings, the program is building strong relationships with a number of FCL institutions and organizations in the state, region, and nationally. Dr. Rowe is housed at the Hatfield Marine Science Center campus of OSU in Newport, OR, and many of our students have conducted research there. In addition, students are helping to build relationships with the Oregon Aquarium in Newport, OR; the Oregon Zoo, Portland, OR; and OMSI, also in Portland. Students have also conducted projects at Science Factory, Eugene, OR; the Boys and Girls Club in Corvallis; the backyard of students (for a project that focused on home education); the Franklin Institute Science Museum, Philadelphia, PA; Pacific Science Center, Seattle, WA; Virginia Science Museum, Richmond, VA; the Smithsonian Marine Ecosystems Exhibit, Smithsonian Marine Station, Fort Pierce, FL; the Nashua River Watershed Association, Groton, MA; Glacier National Park, MT; Great Basin National Park, NV.

One other interesting finding has emerged. Although from the start we had envisioned the program's primary audience to be mid-career professionals who are interested in becoming more knowledgeable and research-based practitioners, two other types of students have emerged. First, about a third of our students are choosing this program as an entry point into the field. Some of them are former (or in one case current) K-12 teachers, interested in a career change, but the vast majority are science majors interested in teaching, but not in traditional classrooms. Interestingly, the other group of students is emerging from the program itself. Although few in number, these are students who are "catching the research and

evaluation bug" as we call it. They are deciding to pursue careers as evaluators and researchers. One Master's student who just graduated in June 2010 is doing contract museum evaluation while she seeks a position in a museum or evaluation firm and two students have chosen to pursue doctoral programs in science education research (one starts this fall at OSU). Both of these groups have slightly different needs than the students for whom we conceived the program, and we have had to adapt some of our courses and develop others to meet their specific needs.

As suggested, this initial effort to create an online Master's program provided a rich context in which to collaborate with our K-12 and Collegiate Teaching colleagues, and in doing so, spawned the idea to not merely add FCL as an area of concentration in isolation, but to take the opportunity to step back and rethink the Department's mission and approach. Consequently, in the midst of the intense development of the online Master's with K-12 and FCL options, Department faculty also engaged in a number of discussions and two retreats in the first year of my arrival focused on how to articulate, and most importantly, "walk the talk" of a STEM Department committed to lifelong STEM learning. It was important to involve our doctoral students in this effort and so in spring 2007 John Falk and I led a doctoral seminar entitled: *What Role Can Lifelong Learning in Science and Mathematics Play in Building Vibrant Sustainable Communities?* Participants included all doctoral students (K-12, FCL, and Collegiate Teaching) and all faculty members. Through background reading, presentations by two panels of experts from the university and greater community (one panel focused on unpacking sustainability and the other on lifelong learning), discussion, and group work focused on these presented ideas and readings, the group explored and developed a new mission/vision and policy statement for our Department, outlining lines of research and theoretical frameworks that could support a better understanding of the ways in which lifelong science and mathematics learning can support the development and maintenance of vibrant sustainable communities. This work resulted in a new Department mission: "Better understand and facilitate the variety of ways in which people of all ages and backgrounds engage in science and mathematics learning throughout their day and lifespan." To this end, our Department is committed to understanding the role of lifelong science and mathematics learning in the development and maintenance of vibrant sustainable communities and strives to foster scholarship, openness, intellectual stimulation, flexibility, and a sense of community around these ideas.

This may seem like a subtle difference but it has been a sea change, requiring rethinking and changing the syllabi and readings of all the core doctoral courses and learning how to respectfully incorporate and discuss the ideas and learning principles of K-12, FCL, and Collegiate Teaching throughout all of our Department's programs. One of the courses that benefited from this comprehensive approach is the *Learning Theory* class, a core course taken by all doctoral students regardless of focus. Rich discussions and projects have resulted as students in the three areas of

concentration read about, think about, and talk about learning theories and their application to the specific learning settings of interest to each of them. The final project requires that they develop a position paper that presents *their* theoretical stance on learning, an approach appropriate to each student's research interests and supported with key empirical research findings. The conclusion needs to make a clear argument for why this approach to learning is relevant to his/her research interests and what the implications of this approach are for practice. These papers have been greatly enhanced by the cross-fertilization of ideas across the areas of concentration.

Another course that has benefited from this partnership is the one offered in collaboration with OSU's Physics Department, a four-credit physics course in which the emphasis is on questioning, predicting, exploring, and discussing what one thinks of and why. It is a class that pre-service teachers are encouraged to take. Through the leadership of one of our FCL Master's students, some of the assignments in the course were designed to involve friends and family in ways that were expected to enhance the prospective teachers' competence and confidence. For example, at the beginning of a new topic, prospective teachers were asked to interview two friends or family members about their current understanding of the science topic. The prospective teachers created the questions and decided how to respond to the answers given. In addition, at the point when students began to feel comfortable with the new material, they were asked to conduct an experiment with friends and family members and had the choice to conduct a similar experiment to the one done in class or to create their own. They were in total control of how they approach teaching the material and with whom they facilitate the exploration, thus integrating "free-choice" elements into their own learning. The assignments represent one way to begin helping science learners to use their knowledge across contexts in appropriate ways. The notion was that because these experiences outside of class are facilitated with friends and family, learning to teach science does not seem as intimidating as being in front of a class full of students. The notion was that prospective teachers could potentially be more comfortable testing this new role of facilitator in a more informal setting. The student used this experience as a final project for her Master's in Science Education and the study documented the influence that these kinds of assignments can have on student learning..

Of course the addition of the FCL option to the Department has also supported the preparation and research of doctoral students committed to lifelong learning. Current or recently competed research projects by FCL doctoral candidates include a study of (1) handheld use in a marine science center, (2) STEM learning across a range of home-educating families, (3) Koi fish hobbyists, (4) whale-watching tours in the context of ecotourism, (5) a citizen science project, and (6) informal staff-family interactions in a science center. One of these students has already graduated and is working in the Evaluation and Research in Learning Division of the Science Museum of Minnesota. Another student will graduate this fall.

Now that work to transform the Master's and Doctoral program is well underway, we are undertaking the next challenge, the Department's Master's of Science in Professional Teacher Education Licensure program, which prepares science and mathematics teachers in grades 6–12, emphasizing the development of research-based teaching strategies that make science and mathematics accessible to diverse learners. The program results in (1) a Master's of Science degree in Science Education or Mathematics Education; (2) an Oregon Teacher Standards and Practices (TSPCs) Initial License with authorizations to teach at the middle and high school levels; (3) one or more subject matter endorsements which can include the following: Biology, Chemistry, Physics, Integrated Science, Basic Mathematics and/or Advanced Mathematics. This is an intensive year-long program with an introductory summer that includes three practica: one involves a quarter in which students do their student teaching and the other two are introductions to teaching. FCL faculty members are working with Licensure faculty to make one of these practica more free choice in nature, building on the successful partnerships we have fostered with organizations in our community. For instance, we have an on-going relationship with the Boys and Girls Club in Corvallis and this represents a valuable venue in which a preparing teacher can learn about their future students in an informal, out-of-school context. Hatfield Marine Science Center or the Oregon Aquarium in Newport, OR also would be great practicum locations. We have piloted this idea with a few licensure students who were interested in exploring FCL. I worked with one student, in particular, who tried to expand the science fair experience by creating an after-school club designed to support students' ideas and abilities to create a science fair project of quality. It was an excellent experience for this student and demonstrated the application of FCL principles into the regular activities of schooling.

As we have done with the core courses in our Master's and Doctoral programs, we are also helping licensure faculty integrate FCL principles into the curriculum of the program. We have conducted (or provided resources in support of) sessions about conducting effective field trips and using other community resources in teaching, organizing family science/math nights, and generally improving parent involvement. We are also trying to share our resources throughout the department. For instance, this past spring, Dr. Janette Griffin, a visiting scholar from the University of Technology, Sydney, Australia, worked with me and Shawn Rowe. Janette has worked internationally in the informal learning field and has taught students from K to 12 in schools, museums, environmental, and science center venues. Her research interests include learning in informal settings, teaching and learning science in and out of the classroom, and teacher professional development. She was a guest speaker in the licensure program and also conducted a brown-bag discussion for the whole Department and worked with Shawn at Hatfield on a Mathematics-Science Partnership project funded by the U.S. Department of Education.

Our future plans include contemplating the creation of an undergraduate degree in FCL, as well as further integrating FCL into science and mathematics teacher preparation programs for K-5 teachers, as we work to build our nascent partnership with OSU College of Education. The university has approved the hire of a faculty member with elementary science expertise and we want to include a preference for someone who has some out-of-school experience or research interest in the position description. We also will be hiring another mathematics educator and hope to find someone with research interests in both K-12 and after-school venues. We also have plans pending at the university level to create a Center for the Study of Lifelong STEM Learning. This center would operate at the university level and would enable us to collaborate with interested faculty in other colleges, institutes, and units across campus, all of whom are engaged in lifelong STEM learning research though they may not use that term.

As stated at the beginning of this article, this partnership is attempting to position OSU faculty members, and most importantly our graduates, as future learning leaders who have a broad understanding of the nature of lifelong learning, and of where, when, how, and with whom it occurs. We have just begun this great experiment but feel that our program represents a potential model that other science and mathematics education departments might choose to replicate, if only portions of the grand design. I invite visits, feedback, and also would be delighted to be a resource if other teacher preparation programs are interested in pursuing this idea or others discussed in this special issue of *The New Educator*. I feel passionately that as educators we need to create new models and this program represents one possible vision of how to transform research and education practice in order to better understand and support *lifelong* STEM learning. Most importantly, we need to work together to educate administrators and politicians about this broader perspective of lifelong science learning. By more clearly identifying and describing the vast number of ways and places in which people of all ages learn STEM, we stand a much greater chance of transforming education and subsequent learning to meet the demands of a changing world.

Everything you can imagine is real.

Pablo Picasso

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