Building Human Infrastructure through Programming and English Education in Rural Japan

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Abstract

As Japanese Ministry of Education educational mandates for implementation by 2020 press on public school administrators, teachers, students, and communities, the Sustainable Programming Education proposes strategies for addressing English and programming education curricula in the elementary and middle schools. Sustainability resides in the retraining of teachers, working with university undergraduates who can be technologically savvy as they network in the rural community, and using existing resources wisely. Over a period of two years, the Sustainable Programming Education (SPE) model has emerged based on a community action model with university administration support in the northern rural Japanese prefecture of Akita.

Keywords: Sustainable; programming; education; professional development; rural infrastructure.

Introduction

As Japanese Ministry of Education (MEXT) educational mandates for implementation by 2020 pressure public school administrators, teachers, students, and communities, the Sustainable Programming Education (SPE) proposes strategies for addressing English and programming education curricula in the elementary and middle schools. Sustainability resides in the retraining of teachers, working with university undergraduates who network as they work in the rural community, and using existing resources wisely.

Over a period of two years (2017-2019), the (SPE) model has emerged based on a community action model with university administration support in the northern rural Japanese prefecture of Akita. Initially, the project impediments were traced to the over-busy schedule of public school teachers, administrator fears to disrupt the routines of the school week, as well as teacher insecurities with concepts of computer programming and English education.

As the ideas for teacher, parent, and student training were disseminated in the community, parents and students became very interested in the potential of students learning English while mastering computer programming, concepts, language, and skills. As teachers understood that they already teach logical thinking, creativity, and problem solving, they became more relaxed. Finally, administrators realized that university students can provide much needed technical knowledge in the community.

Purpose

Sustainable Programming Education (SPE) in Akita, in rural northern Japan, will collaboratively develop sustainable pedagogical approaches multi-generationally, particularly regarding Instructional Technology expertise and integrated studies based on teacher knowledge, skills, and needs. Teachers will disrupt current practices by re-positioning themselves with pedagogical and programming strengths through SPE to ensure their compliance with MEXT 2020 mandates.

Objectives

The objective of this project and the action research model implemented to both document and improve the professional educator-private sector-and public school effort to build information systems through the Sustainable Programming Education (SPE), an initiative that integrates multi-generational English and Programming Education through teacher professional development. This collaborative model will strengthen professional relationships amongst individual teachers, as well as train university students to become scientific communicators while engaging parents with a public school and private business sector to contribute to local rural educational and economic strength. Relying on free-use web-based programs, "unplugged activities", private sector technology, teacher expertise to teach logical thinking, problem solving, and creativity, as well as providing experiences for Akita International University students to teach peers, professional teachers, and public school students, a sustainable programming education program is being developed.

Background

Why SPE? As public school administration face the challenges of depopulation of small towns and the countryside, stagnant economic conditions, and the need to adapt locally, nationally, and internationally to a globalizing world, the MEXT has high expectations for Japanese schools. Further professional pressure on public educators by MEXT 2020 curriculum reform ensues from the need to prepare digital "natives" to become proficient in computer programming. Increasing Japanese students' English language abilities has also been the main focus by MEXT. Rural areas of Japan such as Akita are examples of many communities facing these challenges. Teachers are the social and educational connection between educational mandates and student learning. Yet, over the years, teachers find themselves at a crossroad of personal language development need. Additionally, their knowledge and skills in IT will be put to the test from 2020. Working with educators to develop professional proficiencies in both English and computer programming through SPE will help address the heavy burden that teachers face during the preparation and the initiation of MEXT 2020 reform. By tapping the talents of university students and training them to work in schools with teachers and public school students in collaboration, a digital and linguistic inequality gap problem will begin to be lessened. Additionally, university students' expertise will be engaged to address needs of local rural communities.

Through a series of progressive steps, we are providing on-going support to school teachers and students in rural areas in northern Japan for the 2020 requirements of the new educational policies in programming and English. This support will help collaboratively developing pedagogical approaches with local communities and teachers that are sustainable, particularly regarding instructional technology (IT) expertise and integrated studies based on their knowledge, skills and needs. Through teachers re-positioning themselves with confidence in their expertise and revisiting their pedagogical strengths through the SPE project, their art and science of teaching both programming and English will increase. This collaborative model will strengthen professional relationships amongst individual teachers, as well as train university students to become scientific communicators. Original in concept, no other projects in Japan have tackled such issues. Anticipated results and effects of two workshops delivered in November 2017 and January 2019 have led to communication networks developing in rural settings where linguistic and technology expertise are in demand.

Sustainability literature

Wiek, Withycombe, and Redman (2011) conducted an extensive literature review across disciplines in order to identify competencies necessary for solving sustainability problems particularly in urban settings. They found transformational action connections in participatory, deliberative, and adaptive settings identified by Bäckstrand (2003). In educational literature, there is an extensive body of problem solving literature perhaps made most well-known by John Dewey's pragmatism of education as schooling an integral part of society, rather than separate from it In his most famous

treatise on education, Democracy and Education (Dewey, 1923), he illustrates vividly the need for collaborative problem-solving to be achieved in communities. The precepts of sustainability reside in collaborative, problem-solving, and transformative models of education and goal achievement. Many angles of sustainability have been and will continue to be studied—for we know that water will sustain the planet, as will agriculture; yet, we also recognize that we need technological knowledge and the ability to communicate globally in order to solve some of humankind's most pressing issues, including how best to educate the young to become the problem solvers of tomorrow. Thus, we cannot separate the "hard sciences" from the social and behavioral realm of teaching and learning in order to tap our most precious human resources in the effort to sustain social systems within sustainable environments.

Building from years of sustainability research and curriculum innovation efforts informed by Dewey, the researchers have considered the green built environment (Darwish and Agnello, 2011), water as the key to survival of the planet as a curricular mainstay (Doue, Agnello, & Morgan-Fleming (2008), as well as the use of a participatory action model of research for problem solving (Agnello, 2006, 2007; Agnello & Lucey, 2007; Agnello & Todd, 2008). Participatory action research models along with professional development workshops helped educators in Japan in particular when English as a foreign language education was introduced to elementary school curricula for the first time (Araki & Senior, 2015; Araki, 2012 a, b; Araki, 2011). Another aspect developed by researchers through the years is university students' involvement and training, especially in research development (Domenach & Rajabi 2017) or as links to industry (Savva, Hadjidakis, Domenach & Stylianou 2015, Domenach, Charmarai, Savva & Christou 2015). Such academic knowledge building became the backdrop of the current research focused on a participatory action research model, as well as the focus on environmental and social sustainability.

In rapidly expanding fields of sustainability wherein international educational programs have been founded and curricular focus at such institutions of higher learning as Akita International University have been established, the groundswell of emphasis on educating current and future generations to solve sustainability problems warrants the need for the SPE. We see the need for the foundations of a sustainable computer programming education, as well as more and improved English skills in the northern rural prefecture of Akita, Japan where human resources are dwindling due to rural flight of the young and the paucity of economic alternatives to the once highly successful agricultural economic sector in the area.

The overarching framework posited by Wiek, Withycombe, and Redman (2011) provides problem-solving capacity supported by analysis leading to sustainability solutions, anticipation and preparation for future challenges of sustainability. Addressing the need for more and better English skills in rural Akita, as well as competencies leading to computer science expertise, the teachers, AIU students, and existing IT resources provide a linchpin for future development and growth as described by Wiek et al. (2011) who articulate five key competencies in sustainability that can be applied in university curriculum in urban settings although they are also highly relevant to rural university sustainability curriculum as well. They include systems thinking competence, interpersonal competence, anticipatory competence, strategic competence, and normative competence. Such acumen allows for in-depth understanding of present systems, generating several alternatives for future sustainable visions—both interventionist and non-interventionist, in addition to group dynamics fueled by collaborative and cooperative individuals intent on goal achievement that depends on acquired normative knowledge reliant on concepts of justice, equity, social and ecological integrity, and ethics (Wiek et al., 2011; Darwish and Agnello, 2011). Wiek and fellow researchers, as do all researchers cited here, emphasize that sustainability efforts link knowledge to action, depending on the co-construction of knowledge and practical solutions.

Methodology

The first trial SPE workshop was held in Akita on a Saturday to encourage educator participation in November 2017. A second trial workshop was held in early January 2019 on a

Saturday similarly so that regular work and school schedules would not interfere. The local Ministry of Education in the Akita prefecture provided their continuous support for these trials, along with that of Akita International University administration. Based on the findings from the trials, a participatory action research (Problem, Actions/Solutions, Assessment) will be incorporated for planning and implementing the full SPE project beginning in January, 2019. The project will engage an action research model combining pre-assessment, intervention preparations, intervention, and on-going assessment, as well as project evaluation. The objectives of the three-part professional development initiative includes three phases (Research, Education, and Social impact) illustrated in Figure 1. The training and implementation period will be tailored to school commissioners' and teachers' needs to adapt their views of teaching two required curricular subjects in an integrated manner—English and programming (See Figure 2). University students will develop and improve their skills to deliver the instruction. In turn, the PI and co-Is, with students, will deliver more workshops in schools of Akita, as well as disseminate the findings of their project work as depicted in Figure 3.

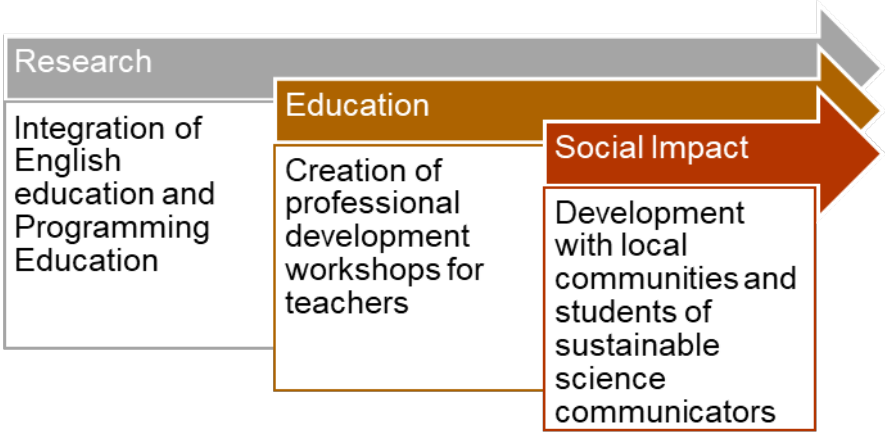

Figure 1: The implementation of Sustainable Programming Education.

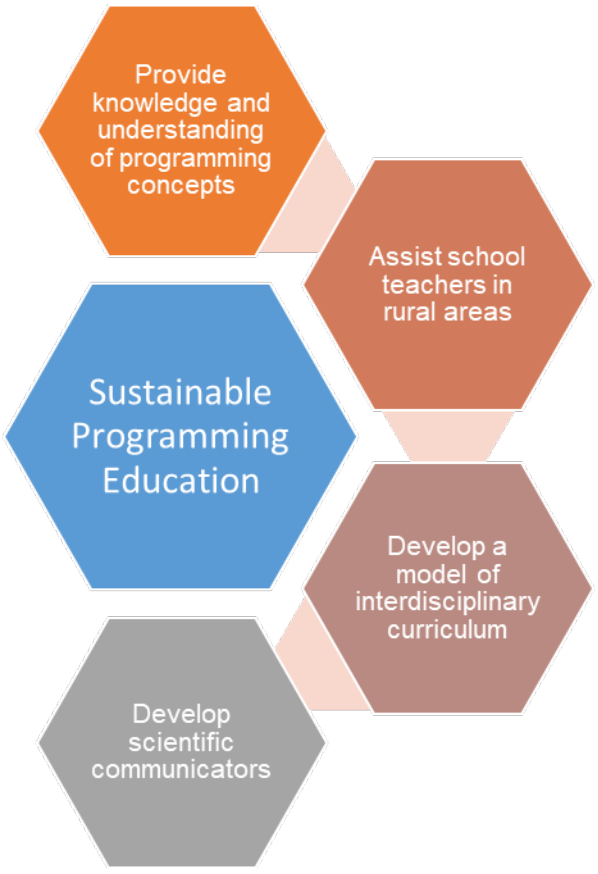

Figure 2: Objectives of the Sustainable Programming Education (SPE) effort.

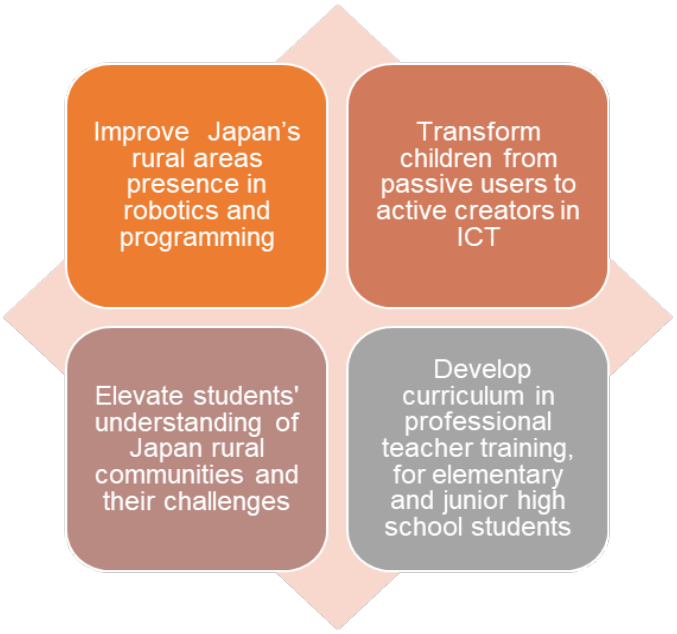

Figure 3: Outcomes of the Sustainable Programming Education (SPE) implentation in Akita, Japan.

Findings—Three facets of building sustainability

University students

Since the focus of computer programming is taught in the university, and the English curriculum is the instructional medium at AIU, the students are well positioned to become experts and teachers. As demonstrated in both the December 2017 and January 2019 teacher workshops, the university students were both necessary and integral to the three-partite program in development. The participating students are personable, know programming techniques, and speak English, and perhaps even more remarkable is that they are collaborative problem-solvers. They were able to ensure that all participants in the simultaneous adult/student and teacher workshops were able to follow and engage in the activities—instructing, demonstrating, redirecting, correcting, and trouble-shooting when they were needed to oversee the unplugged, computer, and robotic activities. Further, they were logistical assets—directing participants where they needed to be, making signs for clarity, and getting the participants from the greater community familiar with the university campus environment. The president of the participating private sector instructional technology company, EK Japan, remarked both in person and in post-workshop email communications how much knowledge that the students have of English, computers, and pedagogy to connect the public school students, teachers, and parents from the community with the desired learning outcomes of each activity. In many ways, the young adults are the foundations of the proposed sustainability effort.

Public school teachers

The teachers in attendance at both the 2017 and 2019 workshops expressed the desire to know more about how to address the students' and teachers' needs in order to be in compliance with the MEXT 2020 curriculum change mandates. They realized after they started participating in the unplugged and computer-based learning sessions that they already do much of what is being repurposed and reframed in the name of computer programming; that is they already impart logical thinking, creativity, and problem-solving to their students every day in routine teaching. As they began to comprehend how to reframe, redirect, and re-establish their knowledge frameworks, they were able to see that there is not much new to consider as necessary to the preparatory programming that they are responsible to teach. They have much of what they need in their pedagogical repertoire. They just need to master some new vocabulary, re-imagine what they do in the various disciplines in the contexts of the programming guidelines, and implement instruction that engages all of their students. If they had doubts about the resources needed to achieve this goal before the workshop, they were assured that they have some resources that can be shared in effective teaching practices that they implement routinely with no cause for panic.

Resources—using and stretching what we have

Because many rural schools lack up-to-date hardware and software, administrators and teachers expressed that they felt overly challenged to meet the computer coding curriculum. Yet, as they saw the workshops being implemented, they witnessed the kinds of turn-taking and rotations that they use in the classroom in order to provide interest for the students, in order for all the students to be able to engage in the activities, and in order to have the students take turns in various classroom stations in rotation fashion. Although the computer labs in many of the rural schools date back to the 1980s, there are many ways that an internet connection can afford the accessibility to needed resources online. The hourofcode.com for example provides many short computer programming lessons building from simple to more complex concepts. Using pencil and paper can also achieve many of the goals of the programming instruction detailed in the MEXT 2020 mandates. Thus sustainability can be achieved by relying on existing resources without expending large sums of money in order to accommodate elaborate computer laboratories. Also, the few existing computers in classrooms will be shared among the students in order to ensure that all students will have opportunities to work hands-on with computer technologies.

Major conclusions

A three-phase educational and professional development effort will address needs of schools, teachers, and students to fulfill local and national directives of ministries of education. We aim to support teachers to incorporate and upgrade the technology and programming education for curricula in the elementary and junior high schools. This will be achieved by introducing an interdisciplinary approach to programming education with the emphasis on English language education since English is the core language in programming. Such efforts are aimed at building the foundations for information systems to enable future international communications and local prefectural information systems infrastructure. Such knowledge foundations will contribute to rural Japan's participation in robotics and programming, as well as establish curriculum to further technological goals with and for local teachers and their students.

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