THE OPENFOREST PORTAL AS AN OPEN LEARNING ECOSYSTEM: CO-DEVELOPING IN THE STUDY OF A MULTIDISCIPLINARY PHENOMENON IN A CULTURAL CONTEXT

Anu Liljeström, Jorma Enkenberg, Petteri Vanninen, Henriikka Vartiainen and Sinikka Pöllänen
University of Eastern Finland | Philosophical Faculty
Savonlinna Campus | School of Applied Educational Science and Teacher Education,
PO Box 86, 57101 Savonlinna, Finland

ABSTRACT

This paper discusses the OpenForest portal and its related multidisciplinary learning project. The OpenForest portal is an open learning environment and ecosystem, in which students can participate in co-developing and co-creating practices. The aim of the OpenForest ecosystem is to create an extensive interactive network of diverse learning resources. In this case study, primary school students (ages 9 to 12, $N = 15$) participated in a cross-curricular learning project, in which they produced video artifacts and published them on the portal. The goal of the study was to determine the types of learning practices and artifacts that would emerge from this learning project. The OpenForest portal served as an emerging learning ecosystem, for designing an artifact that represented bread made from pine-bark flour as a multidisciplinary, open, and complex phenomenon. Based on our findings, we argue that the questions that students jointly co-developed at the beginning of the learning project generated a shared learning task. The final artifacts, arising from a multitude of perspectives, provided complementary pictures of this shared phenomenon. Analysis of the student-generated data and video artifacts indicates that the students reflected design and learning processes that explained the study and nature of experts' work. We found that primary school students are capable of collecting large amounts of data and that their construction of the informative and fun video artifacts from these data represent a strong understanding of the phenomenon.

KEYWORDS

Design-oriented pedagogy; learning ecosystem; OpenForest portal; co-developing; participatory learning

1. INTRODUCTION

Knowledge and knowing are collective products of the activity, context, and culture in which they are developed and applied (Brown et al. 1989; Roth & Lee 2004). Collective intelligence emerges in cultures of participatory knowledge, where people work together to collectively classify, organize, construct, and evaluate information (Lévy 2013). This highlights the need to extend the scope of education to include learning in real-world communities and exposure to phenomena and complex problems usually found in unstructured contexts. Currently, many researchers emphasize the need for students to learn twenty-first-century skills to develop their creativity, problem-solving abilities, collaboration skills, and technological proficiency in order to adapt to the demands of changing circumstances (Binkley et al. 2011). For example, Fischer and Redmiles (2008) emphasized that educational systems should promote transdisciplinary competencies that will prepare learners for meaningful and productive lives. Unfortunately, school activities, practices, communities, and learning environments are usually carefully organized and structured in homogenous ways by teachers, which are insufficient for meeting the requirements of a changing world. Co-development and co-creation are the most prominent practices of members of participatory cultures.

In participatory learning, the same practices are considered to have central significance to the learning of multidisciplinary content or problem-solving. Ito et al. (2013) argued that school should provide learners with opportunities to pursue interest-driven, production-centered work and encourage them to interact collaboratively with peers and mentors in productive ways, either via the open web or face-to-face. Kim et al. (2013) stated that educators should encourage learners to create their own scientific ideas and negotiate meanings rather than simply focus on a predetermined body of knowledge. Learning by designing and learning through making usually involve the creation of new knowledge in real contexts; this is one way to achieve deep learning (Harel & Papert 1991; Fullan & Langworthy 2014).

Participatory learning highlights students' self-organization in co-creation and other activities that utilize the ideas of all students (Lewis et al. 2010; Liljeström et al. 2014). Therefore, students should have opportunities to participate in co-developing and co-creation practices in extended and generative learning communities. According to Liljeström et al. (2013b), Finnish students are given very few opportunities to learn in diverse physical environments or in social and technological environments outside of the classroom. Learning usually takes place in formal school environments, mostly in classrooms involving the use of textbooks (NETP 2010). Apparently, in teacher education, the educational experiences of first-year students and their perceptions of the impact of diverse environments, communities, and technologies on their future careers as teachers are deeply connected (Liljeström et al. 2013b). This indicates a clear need to find new models for learning, particularly ones that involve students in real-life activities and communities situated outside the traditional classroom context and in activities that are supported by new technology. For example, NETP (2010) requires the building of learning communities consisting of students, fellow educators, and professional experts from museums, community centers, and other settings. Learning communities should be capable of facing complex and multidimensional challenges and phenomena and of addressing real objects outside the classroom. They should provide opportunities to articulate and formulate open learning tasks, to design and link their learning processes, and to construct and to share collaborative learning solutions (Vartiainen et al. 2012; Ito et al. 2013).

To address these challenges, teacher education at the University of Eastern Finland in Savonlinna integrates forestry-related phenomena and communities as a central part of learning and educational research (Vanninen et al. 2013). Forests are a natural theme in Eastern Finland, where they are rich from ecological, economic, and social points of view. This project has resulted in the construction of the joint OpenForest portal (www.openmetsa.fi). All students (from primary to university levels) can connect via the portal with professional forestry communities and share the products of their own forest-related learning projects. The main emphasis is on the multidisciplinary development and research of learning ecosystems and pedagogical models accessible via the portal. The ultimate goal of this case study was to develop participatory culture practices for learning. The primary school students who were observed took part in a cross-curricular project to study a multidisciplinary and complex phenomenon (bark bread). They were assigned an open learning task to design and produce video artifacts of the phenomenon and to share them via the OpenForest portal. The learning project was guided using the design-oriented pedagogy (DOP) framework. Previous publications have introduced the instructional model in more detail and have described case studies on its developed process. (Vartiainen et al. 2012; Liljeström et al. 2013b; Liljeström et al. 2014; Vartiainen & Enkenberg 2013a; Vartiainen & Enkenberg 2013b; Vartiainen & Enkenberg 2014, Vartiainen 2014).

2. THE OPENFOREST PORTAL AS A LEARNING ECOSYSTEM

As an open learning environment, the OpenForest portal was constructed as a web-based learning ecosystem for forestry education (Vanninen et al. 2013). The development of the OpenForest portal was strongly related to design-based research, in which the ultimate goal was to develop an instructional approach and pedagogical model of DOP. Its purpose was to expand and connect learning beyond the walls of schools or universities to authentic environments (especially natural and cultural ones) and related social networks in collaboration with people with shared interests and diverse types of expertise. The DOP model was tested and validated using several iterative design experiments and principles of design-based research (Vartiainen et al. 2012; Vartiainen 2014). The pedagogy was evaluated from multiple perspectives, with groups of learners with different backgrounds and using mixed-methods strategies (Johnson & Onwuegbuzie 2004).

The development of the OpenForest portal was built upon the three educational principles of DOP: (1) Participatory learning in extended and generative communities is a vital concept for learning; (2) Diverse technological resources and infrastructure are powerful social and personal tools; and (3) Co-development is a powerful social innovation for producing information resources that offer multiple perspectives on forest-related phenomena (Vartiainen et al. 2012). The OpenForest portal was designed to be a learning ecosystem that created space for learning that included participatory, complex, and multidisciplinary problem-solving. The portal offers information resources, community resources, and technological resources that support learning processes that focus on open-ended and whole learning tasks, as well as self-organization (Fig. 1) (Liljeström 2014).

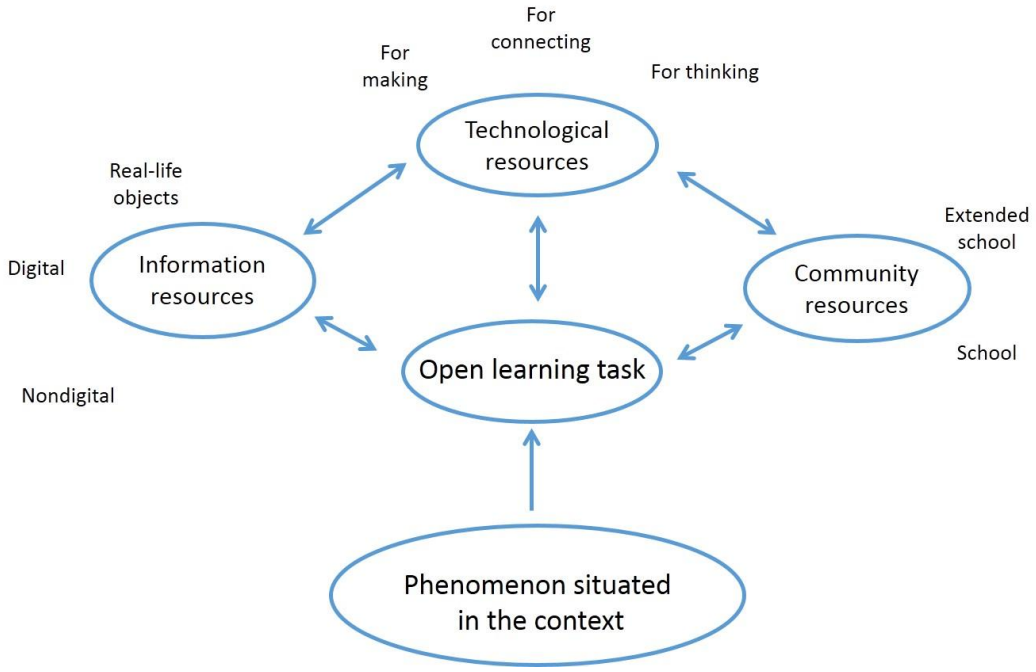

Figure 1. Conceptual structure of a learning ecosystem in OpenForest portal

It was hypothesized that by learning forest-related phenomena and participating in open learning tasks, students would create their own learning ecosystems that were interactive and part of an extensive network of diverse learning resources. The learners, who worked together in small groups, chose learning resources based upon personal preferences. They were encouraged to supplement their learning ecosystem through the use of their personal social networks, tools, or information resources.

The OpenForest portal offers information resources produced by experts in forest research, ecology, culture, and education. The contents of a Wiki may include diverse media, such as audio; 360-degree panoramic photos; and related virtual forest tours, pictures, videos, and texts, in any combination. OpenForest is related to the Finnish Forest Museum Lusto exhibitions and the database collections of several museum objects. The portal provides connections to real objects of the forest. Learners can navigate through the portal using the OpenForest mobile geographic information system using precise and informative maps. Wiki articles are usually situated according to the location of the Research Park and Punkaharju esker (ridge area) or the Savonlinna town area. The technology environment of the OpenForest portal provides a tool for learners undertaking their own projects. The portal can function, for example, as a tool for communicating (through sharing and publishing) and for thinking (through searching, organizing, presenting, and reflecting data). It offers space for presentations of digital productions and designs (e.g., simulations, models, and prototypes). When using the portal, students are able to explore and work with models, real research data, and tools that various experts use in their work.

ISBN: 978-989-8533-30-2 © 2014

3. THE CASE OF THE BARK BREAD PROJECT

The OpenForest portal includes productions of heterogeneous learner communities; e.g., the shared constructions of learning projects ranging from preschool to university endeavors. The aim is to always produce and share outcomes from education projects. This function accumulates learning resources and provides starting points for others pursuing their education. The portal's Wiki environment combines expert knowledge and personal perspectives to break down the boundaries of traditional school learning. These projects can also serve as models and examples of learning projects related to forest phenomena for teachers, teacher-students, and other learners.

In this case study, students in a rural school in Eastern Finland (ages 9 to 12, $N = 15$) designed five videos that portrayed pine-bark bread as a multidisciplinary phenomenon. Although pine-bark bread is not a typical phenomenon in the school context, it is one subject from a cultural and historical era offering a number of approaches over time periods to be explored in a multi-disciplinary manner. The learning project consisted of 25 lessons over a 2.5-week period in parallel with other school activities. The videos were published on the OpenForest portal as learning artifacts and information resources that other students could later utilize in their own projects (see www.openmetsa.fi).

The students were offered a diverse learning ecosystem: they could choose community, technology, and information resources to answer research questions. For example, they found and connected with new experts, discovered new books and websites, and asked about and found new kinds of tools for performing the necessary tasks. The students worked in three small groups. Each group used digital cameras that were owned by group members and the school, and was offered the use of desktop and laptop computers, as well as a variety of books and various tools, both during the workshop and later in their own studies. All of the groups participated in a workshop led by a museum expert on making pine-bark flour and baking bark bread.

3.1 Research Questions

The research questions addressed in this paper are the following:

1. What kind of learning process emerged?
2. What kind of data did the students produce?
3. How did the designed and constructed video artifacts answer the students' informal questions from the beginning of the learning project?

3.2 Research Data

The research data consisted of the students' produced data (photos, video clips, audio files, and other products), their 52 informal questions about the phenomenon, and their produced and published video artifacts. All five of these videos were published in 2011 on YouTube and were later transferred to the OpenForest portal and translated into English.

3.3 Research Methods and Data Analysis

The data was analyzed using qualitative deductive methods. First, all the students produced data categorized according to the use of the produced media, its meaning (learning ecosystem), and basic information (date and length). Second, a theory-dependent deductive method was used to categorize the emerging learning projects and ecosystems. The categorization was based on the DOP instructional model (Vartiainen et al. 2012) and the structure of the learning ecosystem (Fig. 1; Liljeström et al. 2014). The aim of the analysis was to deconstruct and then reconstruct the emerging learning ecosystem and learning process using qualitative content analysis (Mayring 2000). The data and final video artifacts provided digital narratives of the students' agency, research objects, and inquiry procedures. It was assumed that the video artifacts would represent the phenomenon in a manner similar to how the students actually experienced and perceived it. In this way, the data also served as reflective stories of the students' learning. Accordingly, the applied narrative thematic analysis placed emphasis on what the students said and demonstrated (Bryman 2004).

Third, a deep analysis was conducted of the students' informal questions related to the phenomenon from the beginning of the learning project in comparison to the final video artifacts.

3.4 Findings

3.4.1 Emerged Learning Process

The open learning task was presented to the students as follows: "Your task is to study the phenomenon of bark bread, design and construct digital videos as learning objects of this process, and share them on the OpenForest portal, which is a common nature and culture Wiki environment. The overall purpose of this project is to produce a video that other students can use in their own learning." At the beginning of the project, the students familiarized themselves with the phenomena by talking with their teacher and researching bark bread on the Internet and in books. They discovered that bark bread was culturally and historically made from pine bark.

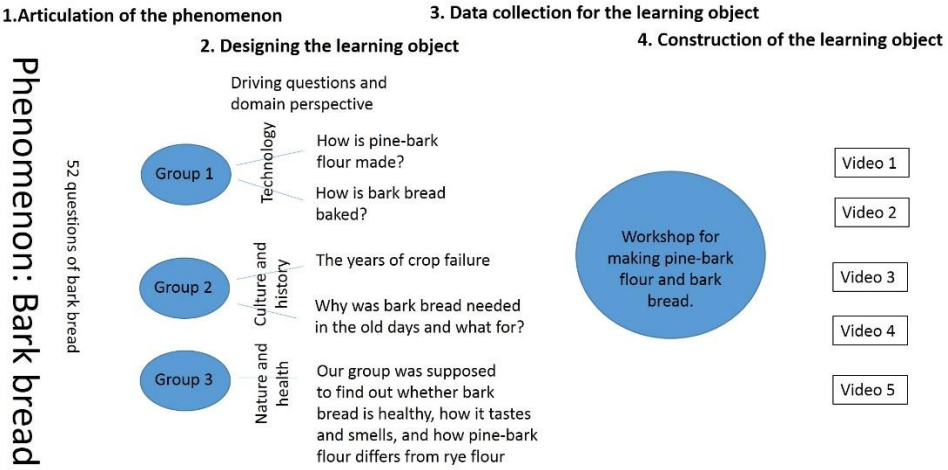

Figure 2. The emerged Learning Process

The students then came up with 52 questions about bark bread; the questions functioned as expressions of the students' informal ideas regarding the phenomenon. They categorized their questions according to culture and history, the process and technology used to make bark bread, and nature and health. The students continued to work in three small groups to choose a perspective for the project, determine their research tasks, design their own learning ecosystem, and establish methods for data collection. They also all participated in a pine-bark flour and bark bread workshop, which was guided by a forest museum expert. The small groups collected their own data (e.g., photos, video clips, audio files, and interviews) and constructed their own videos. The result was five video artifacts on the phenomenon of bark bread from different perspectives (Fig. 2).

3.4.2 Collected and Produced Data of the Learning Process

Altogether, the students collected and produced 113 video clips, 472 photos, 44 audio files, and 11 other file types (texts, pictures, and documents). The length of the video clips ranged from 3 s to 7 min 23 s (all together, 2 h 35 min 35 s). The data were categorized according to the meaning of the file (See Table 1).

Table 1. Number of students' data

	Video clips	Audio files	Photos	Other
Designing	3		58	2
Making	52	43	315	1
Studying and explaining	25		25	3
Reflection	24		8	1
Other	9	1	83	4

There were also the final video artifacts. The students constructed the videos using previously presented data, including video clips, photos, pictures, and audio files. There were five videos in all: the first two videos demonstrated how pine-bark flour is milled and baked into bread, the third video was a drama set in the time period in which a real need existed for baking and eating bark bread, the fourth video clip provided a deeper insight into that time, and the fifth video described bark bread from a perspective focused on nature and health (see_http://www.openmetsa.fi/wiki/index.php?title=Bark_Bread). The length of the final video artifacts varied from 2 min 51 sec to 6 min 47 sec (mean = 4 min 16 sec).

3.4.3 Informal Questions Regarding the Phenomenon and Produced Video Artifacts

The students categorized their informal questions into three different classes and perspectives: culture and history, the process and technology of making bark bread, and nature and health. An analysis revealed that many of their questions overlapped between these categories; for example, many of the questions could be answered from both the perspectives of the process and technology used for making bark bread and nature and health. Seven of the questions applied to all three categories.

When comparing the informal questions and the produced video artifacts, it is clear that the dominant question was "What is the value of bark bread?" Many of the other questions were actually sub-questions of this overarching query. All of the video artifacts described the value of the bark bread from various perspectives. On the other hand, the videos proposed many new questions and issues that needed to be clarified and answered, pertaining to subjects like tools and their uses, explanations of the processes and studies, the nature of the experts' work, and the use of all the senses for studying and reflecting in and on the design process. The analysis of the designed video artifacts revealed that the learning ecosystem in which the learning processes were situated was the same for all the small groups.

4. CONCLUSION

This case study, using the example of the bark bread project, has demonstrated how heterogeneous learning and extended learning communities can be connected in the OpenForest portal. As previously mentioned, different domain experts produced information resources for the portal. However, the ultimate goal of OpenForest portal is to create ways for experts to work, think, and produce information and to challenge students to develop their tacit knowledge by participating in the activities in which the experts are engaging (Bransford et al. 2005).

Based on the findings of the case study, we argue that the use of students' co-developed informal questions for a learning project can initially generate a shared learning task that can—through the final artifacts—provide complementary pictures of the shared phenomenon. Additionally, it is interesting that this type of design process seems to raise the need to shed light on the principled knowledge that experts use to solve complex tasks. This was revealed in the students' in-depth descriptions of their studies.

It can be concluded that students' own informal questions at the beginning of the learning project helped to make the open learning task a mutual project and helped in efforts to study the phenomenon in a holistic manner. Students used innovatively offered learning resources and the project met the challenge of collecting an amazing amount of data. The construction of the video artifacts from such a large amount of data required a strong understanding of the phenomenon. Moreover, the quality of the video artifacts is high, they are informative and fun, and they present the phenomenon from diverse perspectives. The findings suggest that this study succeeded in ways similar to the ways described by Ackermann (2004), referring to Seymour Papert's pioneering work in learning: "Becoming one with phenomenon under study" and as "a key to learning."

As seen in this case study, learning should be situated in a diverse and extended learning ecosystem in which heterogeneous participants share different ways of working together, thereby mediating and enhancing their individual and communal expertise. For example, if our future society depends on innovation and design, we should situate learning in environments that challenge students with activities that involve innovation and design (Bereiter & Scardamalia 2003). Learning through the use of the resources available on the OpenForest portal stresses the approach to mediating tacit knowledge and expert problem-solving (Thomas & Brown 2009; Liljeström 2013a; Liljeström 2013b). Furthermore, as Wells (2008) argued, participatory learning is oriented toward outcomes that are both personal and collective.

This case study has demonstrated that students at the primary level can produce high-quality content to share with others, thereby cultivating future learning resources in a variety of ways. The aim of sharing and publishing the products of learning on the OpenForest portal is to provide outcomes that can serve as new learning resources for future users. Therefore, the outcomes of learning can become new cultural property that can be meaningful for individuals, groups, and a wider audience.

ACKNOWLEDGEMENT

This study was supported by EU rural funding: "Forest as a Learning Environment," grant no. 807784

REFERENCES

Ackermann, E., 2004. Constructing Knowledge and Transforming the World. In M. Tokoro and L. Steels (Eds.), *A Learning Zone of One's Own: Sharing Representations and Flow in Collaborative Learning Environments* (pp. 15–37). IOS Press, Amsterdam, Berlin, Oxford, Tokyo, Washington, DC, USA.

Binkley, M. et al., 2011. Defining 21st Century Skills. In P. Griffin, B. McGaw, & E. Care (Eds.), *Assessment and Teaching of 21st Century Skills* (pp. 17–66). Springer, New York, USA.

Bransford, J. et al., 2005. Theories of Learning and Their Roles in Teaching. In L. Darling-Hammond, J. Bransford (Eds.), Preparing Teachers for Changing World. What Teachers Should Learn and Be Able to Do (pp. 40–87). Jossey-Bass A Wiley Imprint, San Francisco, USA.

Bereiter, C., & Scardamalia, M., 2003. Learning to Work Creatively with Knowledge. In E. De Corte et al. (Eds.), *Powerful Learning Environment: Unraveling Basic Components and Dimensions* (pp. 55–68). Elsevier Science, Oxford, UK..

Brown, J. S., Collins, A., & Duguid, P., 1989. Situated Cognition and the Culture of Learning. *Educational Researcher*,Vol. 18, pp 32-42.

Bryman, A., 2004. *Social Research Methods.* 2nd ed. Oxford University Press, Oxford, UK.

Fischer, G., & Redmiles, D., 2008. *Transdisciplinary Education and Collaboration, Contribution to the Human Computer Interaction Consortium (HCIC) Workshop 2008.* Retrieved January 22, 2011 from http://l3d.cs.colorado.edu/~gerhard/papers/hcic2008.pdf

Fullan, M. & Langworthy, M., 2014. A Rich Seam: How New Pedagogies Find Deep Learning. Pearson, London, UK, pp 68-73. Retrieved August 8, 2014 from: http://www.michaelfullan.ca/wp-content/uploads/2014/01/3897.Rich_Seam_web.pdf

Harel, I., & Papert, S., 1991. Software Design as a Learning Environment. In I. Harel & S. Papert (Eds.), *Constructionism* (pp 41-84). Ablex Publishing Corporation, New Jersey, USA.

Ito, M. et al., 2013. *Connected Learning: An Agenda for Research and Design*. Digital Media and Learning Research Hub, Irvine, CA, USA.

Johnson, R. B., & Onwuegbuzie, A. J., 2004. Mixed Methods Research: A Research Paradigm whose Time Has Come. *Educational Researcher*, Vol. 33, No. 7, pp 14-26.

Kim, B., Lossman, H. G., & Hay, K. E. 2012. Learners' informal ideas and model creation for conceptual change. In Lee, C. B. & Jonassen, D. H. (Eds.), *Fostering Conceptual Change with Technology: Asian Perspectives* (pp. 119-140). Singapore: Cengage Learning Asia.

Lewis, S., Pea, R., & Rosen, J. 2010. Beyond participation to co-creation of meaning: mobile social media in generative learning communities. *Social Science Information*, 49(3), 1–19.

Lévy, P., 2013. The Creative Conversation of Collective Intelligence. In A. Delwiche & D. Henderson (Eds.), *The Participatory Cultures Handbook* (pp 99-108). Routledge, New York, USA.

Liljeström, A., Enkenberg, J., & Pöllänen, S., 2013a. Making Learning Whole: An Instructional Approach for Mediating the Practices of Authentic Science Inquiries. *Cultural Studies of Science Education*, Vol. 8, No. 1, pp 51–86.

Liljeström, A. et al., 2013b. First-year Teacher Education Students' Reflections and Interpretations About Sustainable Development and Enhancing Learning Practices. In T. Issa et al. (Eds.), *Proceedings of the International Conference on Sustainability, Technology and Education* (STE2013) (pp 53-63). IADIS Press.

Liljeström, A., Enkenberg, J., & Pöllänen, S., 2014. The Case of Design-oriented Pedagogy: What Students' Digital Video Stories Say About Emerging Learning Ecosystems. *Education and Information Technologies*, Vol. 19, No. 3, pp 583-601.

Mayring, P., 2000. Qualitative Content Analysis. *Forum: Qualitative Social Research*, Vol. *1*, No. 2. Retrieved July 25, 2013 from http://www.qualitative-research.net/index.php/fqs/article/view/1089/2385.

National Education Technology Plan (NETP), 2010. *Learning Powered by Technology.* Retrieved October 2, 2010 from www.ed.cov/technology/netp-2010

Roth, W. M., & Lee, S., 2004. Science Education as/for Participation in the Community. *Science Education,*

88, 263–291.

Thomas, D., & Brown, J. S., 2011. *A New Culture of Learning: Cultivating the Imagination for a World of Constant Change.* CreateSpace, Lexington, KY, USA.

Vanninen, P., et al., 2013. Forest in Teacher Education: The Open Forest Portal as a Novel Resource for Learning. In T. Issa et al. (Eds.), *Proceedings of the International Conference on Sustainability, Technology and Education* (STE2013) (pp 111-114). IADIS Press.

Vartiainen, H., & Enkenberg, J., 2013a. Learning from and with Museum Objects: Design Perspectives, Environment, and Emerging Learning Systems. *Educational Technology Research & Development,* Vol. 61, No. 5, pp 841-862.

Vartiainen, H., & Enkenberg, J., 2013b. Reflections of Design-oriented Pedagogy for Sustainable Learning: An International Perspective. *Journal of Teacher Education for Sustainability,* Vol. 15, No. 1, pp 43-53.

Vartiainen, H., & Enkenberg, J., 2014. Participant-led Photography as a Mediating Tool in Object-oriented Learning in a Museum. *Visitor Studies,* Vol. 17, No. 1, pp 66-88.

Vartiainen, H., Liljeström, M. A., & Enkenberg, J., 2012. Design-oriented Pedagogy for Technology-enhanced Learning to Cross Over the Borders Between Formal and Informal Environments. *Journal of Universal Computer Science,* Vol. 18, No. 15, pp 2097-2119.

Vartiainen, H., 2014. *Principles of Design-oriented Pedagogy for Learning from and with Museum Objects*. Publications of the University of Eastern Finland. Dissertations in Education, Humanities, and Theology, no. 60. University of Eastern Finland, 2014.

Wells, G., 2008. Dialogue, Inquiry and the Construction of Learning Communities. In J. N. B. Lingard, *Transforming Learning in Schools and Communities: The Remaking of Education for a Cosmopolitan Society*. Continuum, London, UK.