

Interdisciplinary E-learning: an engineering perspective

G. Le Bot

Post-doc researcher
KU Leuven, Faculty of Engineering Technology
Leuven, Belgium
E-mail: gaelle.lebot@kuleuven.be

L. Xue

PhD researcher
KU Leuven, Faculty of Engineering Technology
Leuven, Belgium
E-mail: lina.xue@kuleuven.be

W. van Petegem

Associate Professor
KU Leuven, Faculty of Engineering Technology
Leuven, Belgium
E-mail: wim.vanpetegem@kuleuven.be

A. van Wieringen

Full Professor
KU Leuven, Department of Neurosciences, Research Group Experimental ORL
Leuven, Belgium
E-mail: astrid.vanwieringen@kuleuven.be

Keywords: interdisciplinary, E-learning, higher education, lifelong learning

INTRODUCTION

With the development of information and communication technology E-learning has emerged as the paradigm of modern education [1]. E-learning as a novel technology for online and distance education was developed to improve the learning and teaching experiences [2] and in just over a decade the field has moved to questions and issues that are vastly more complex such as “the educational response to self-organizing and open online communities; and the challenge of authentically interdisciplinary inquiry into these phenomena” [2, p. 235].

This paper aims to present our European FP7 training network, iCARE (improving Children’s Auditory Rehabilitation) in which we are dealing with these more complex and challenging topics of interdisciplinary education and professional learning through E-learning technology in the health sector. Unique to this project is to provide an interdisciplinary E-learning training for junior researchers complementary to their individual PhD research projects into a specific community, iCARE.

Around fifteen senior researchers and industrial partners across Europe with different approaches and expertise in different fields and specializations (i.e. engineering, psychology, education, neuroscience, acoustics, cognition, audiology, speech and language) are supervising around fifteen junior researchers in those respective domains. People involved in the iCARE community aim at improving the auditory rehabilitation of children with hearing impairment. They specially focus on the development of communication and social skills of these children to facilitate later on their inclusion in the oral society.

According to this goal, the aims of this interdisciplinary E-learning training is to create a new generation of researchers 1) capable of exploiting the synergies between different disciplines, 2) capable of continually learning and dynamically adapting to changing circumstances and demands and, 3) capable of using E-learning technologies in their ongoing professional practices.

First, we present the benefits of E-learning technology in our context. Second, we introduce the interdisciplinary E-learning framework supporting our research project. Third, we present the interdisciplinary E-learning training we plan. We conclude with a summary of the research project.

1. E-LEARNING TECHNOLOGY

“E-learning is basically a web-based system that makes information or knowledge available to users or learners and disregards time restrictions or geographical proximity, permitting free interaction between learners and instructors, or learners and learners” [1]. This definition of E-learning pointing out the benefits of connectivity, flexibility and interactivity [3] seems to support our needs in an interdisciplinary and multiple locations context. We develop these three characteristics of E-learning in the following sub-sections.

1.1. Connectivity

E-learning can occur through the World Wide Web information system which permits users to have access to the information or knowledge available on the Internet from a wide variety of formats such as text, audio-video and images. This variety of resources available is restricted by our ability to select relevant information and to give it a meaning.

In iCARE, we aim to identify and create relevant information or knowledge for each discipline in auditory rehabilitation of children with hearing impairment and to clarify the connections between them through the interdisciplinary training and iCARE community. For example, what should we know on speech and language? What are the existing links between room acoustics, signal processing, speech, language and hearing loss? How are they related?

1.2. Flexibility

E-learning flexibility could be seen as the ability to adapt to change or constraints like time restrictions or geographical proximity. The flexibility of time, place, context and programs offered via E-learning technology is appealing to people who are not able to travel or to students who are trying to balance school with work and home responsibilities [1].

In iCARE, E-learning flexibility permits to work with people from multiple locations simultaneously (i.e. synchronous tools like web conference, chat...) and non-simultaneously (i.e. asynchronous tools like e-mail, forum...). The e-learning flexibility support the online collaboration in a variety of context and a variety of means.

1.3. Interactivity

E-learning connectivity and flexibility permit to have access to information or knowledge at any time, from anywhere. In the health sector, the interactivity of e-learning technology gives the opportunity to network with other like-minded professionals for prevention, training and innovation [4].

In iCARE, the interactivity sought after is interdisciplinarity. It's not only between learners and instructors and learners and learners, it's between learners and instructors and learners and learners from different disciplines. Usually, online professional communities are open to a wide variety of people in the same related theme and are more homogeneous. It is not often the case to create a professional learning community deliberately selected to be complementary [5].

The advantages of connectivity, flexibility and interactivity are good ingredients to support an interdisciplinary E-learning training for junior researchers in the iCARE community. But they are only ingredients, they don't certify its success or usefulness. Even so, being aware of these three characteristics of E-learning is important to integrate the variety of possibilities in the design of the learning process.

2. INTERDISCIPLINARY E-LEARNING FRAMEWORK

Interdisciplinary refers to combining and exploring the interconnections between new and different approaches in different research fields and specializations, whereas multidisciplinary refers to simultaneous trying to respect the multiplicity of differences that can separate one research approach from another [2]. In iCARE, we don't focus on one single and authoritative perspective or knowledge form that we juxtapose upon others. Instead we focus on a combination of not always consistent points of view that represent a range of disciplinary and methodological possibilities.

Indeed, it is generally required nowadays that the researcher is conversant with more than one disciplinary body of knowledge and research method [2]. That's why iCARE is meant to train a new generation of researchers involved in auditory rehabilitation for children with hearing impairment into an interdisciplinary E-learning framework. In the following sub-sections we present our interdisciplinary E-learning framework including social-constructivism, community of practice and social network analysis.

2.1. Social-constructivism principle

The constructivism principle particularly in its social forms, called social-constructivism or collaborative constructivism, supports our educational conception of an interdisciplinary E-learning. Social-constructivism "emphasizes the active involvement of the learner with the teacher and peers in creating (constructing) knowledge" [6, p. 254]. With respect to that principle, learning content will not only be delivered to learners but co-constructed with them. Under that principle, peer dialogue is encouraged and learners can develop a much greater level of autonomy and self-organization compared to a traditional behavioural principle. Furthermore, nowadays in a company, collaboration among multiple teams from different departments is usually required to produce solutions for product or service innovation [7].

Into this conception of learning, two aspects are highlighted. In the first one, learning is viewed as a social activity where interactions, connections and relationships are used as human resources to solve a problem. In the second one, learning is viewed as a collaboration activity where expertise, knowledge and work experience are shared as learning resources to solve a problem about a particular topic. These two aspects are strongly supported by the social network analysis and the community of

practice concepts. Even if we present them separately in the next section, following the example of Wenger, Trayner and de Laat [8] we propose an interdisciplinary E-learning framework which is a combination of these two concepts, supported by the social-constructivism principle [9].

2.2. Community of practice concept

According to Wenger [10], a community of practice is a group of people who share a domain of interest for something they do and learn how to do it better as they interact regularly. As already mentioned, in the iCARE community junior and senior researchers have to improve auditory rehabilitation for children with hearing impairment. To solve such a large problem in our society with a holistic approach, we need many people with many different backgrounds [11].

By combining a variety of disciplines related to auditory rehabilitation, we expect from junior researchers they will not develop a restrictive view of disciplines but have an open mind to new ideas and expertises especially valuable to co-construct new forms of meaning and to complete their view and understanding of the auditory rehabilitation' issues as a societal challenge.

In addition, we expect the researchers to benefit from multiple perspectives and diversity of ideas between each other but we don't expect they will acquire the same body of knowledge at the same time. In a community of practice it is not necessary that each member assimilates everything that the community knows, but each should know who within the community has relevant expertise to address any problem [12]. Hence the importance of a social network.

2.3. Social network analysis concept

In the social network analysis concept, a social network refers to the set of relationships, personal interactions, and connections among participants who have personal reasons to connect, whether or not these connections are mediated by technological networks [8]. The work of social network is to optimize the connectivity among people. As mentioned by Aboelela, Merrill, Carley & Larson [13]: "Many of the challenges inherent in interdisciplinary research emanate from the isolation of disciplinary experts, resulting in knowledge silos. Viewed in this way, accomplishing interdisciplinary research becomes, at least in part, an issue of social interaction and the creation of integrated social networks" [13, p. 63].

Furthermore, "experts must continually construct and reconstruct their expertise through lifelong learning process [...] they work in teams, share knowledge and apply it, revise and transform it through discussion, application and analysis" [14, p. 572]. It is an iterative process. Being more interconnected increases the sense of community, and a desire to learn about a common topic motivates people to seek connections. In other words, it's a dynamic interplay of both community and network processes [8]. In iCARE, to foster the interdisciplinary E-learning, we need to take advantage of this complementarity.

Finally, our motivation was to present our interdisciplinary E-learning framework which is used as a conceptual framework to design and develop an online interdisciplinary training. We assume that this framework can be combined to E-learning technology. Following Kurtz [6] assumptions, socio-constructivism approach where learners interact together in sharing and creating new knowledge typically support online communities of practice and social network. "In online-supported collaborative learning, the mutual relations among learners are assisted by technology, which combines learning activities with an online learning environment" [6, p. 254].

3. INTERDISCIPLINARY E-LEARNING TRAINING

In order to develop an interdisciplinary e-learning training into a PhD' program, we are planning an online learning environment supporting our goal. First of all, we present the online learning environment we are planning. Then, we present the online learning activities we develop. At the end, we present the professional development perspective in which this training is taking part.

3.1. Online learning environment

Based on our aims of the interdisciplinary E-learning training for junior researchers, we develop an online learning environment supporting interdisciplinary research, continuing education and E-learning technology. Through this online learning environment, we want to offer a secure intellectual and emotional learning environment in which our learners will be able to experiment new ideas even by doing mistakes which are part of any success. According to Canboy, Montalvo, Buganza & Emmerling [15] and Johnson [16], safety and trust within a community of practice are important for developing a learning environment. It's allowing risk and encouraging creativity and innovation in order to facilitate researchers in developing novel methods and products improving auditory rehabilitation. For that purpose, we propose to have a private community within the online platform in which all the activities developed inside iCARE will be reported and shared. Keeping it private in the first stage permits the community to grow in a safe environment and to develop enough evidence-based knowledge to share later with a broader community.

The challenge in a such online learning environment is to support junior researchers' professional development by designing activities and interactions that are appealing and valuable for each of them. Xue, Le Bot, van Petegem & van Wieringen [17] proposed an educational model supporting that purpose. This educational model is constructed around Biggs' model of constructive alignment in order to have a strong coherence between the learner needs, the interdisciplinary competencies expected in iCARE project and the activities we will provide to reach our aims.

3.2. Online Learning activities

As educational researchers, our role in the iCARE project is to be the orchestrators of the interdisciplinary E-learning training. We have a mediating function [11]. We facilitate the process of cross-fertilisation by planning learning activities enabling partnerships between junior and senior researchers from different disciplines. We provide them the opportunity to integrate knowledge obtained from other disciplines during the development of their own individual projects. That means the learning activities we plan respect as much as possible the different milestones and deliverables junior researchers have to reach in their individual PhD's projects. Our role is also not to give them too much work, but rather to integrate interdisciplinary E-learning training as a professional development opportunities profitable for their individual project.

Consequently, for the iCARE project, we plan three kind of online learning activities: webinars, e-learning modules and social media discussions. First of all, we plan five webinars bimonthly spread throughout 2015 for the first year of the interdisciplinary e-learning training. The webinars have the advantage to create routine by the members because they have to attend the webinars regularly in a long-term period. We plan two interviews of experts in one relevant domain of iCARE and three presentations by junior researchers on their respective project. The main focus of these webinars is to learn across disciplines from each member of iCARE and to foster interaction and connection between junior and senior researchers. We

organize each webinar for one and a half hour with one (or several) speaker(s) and one (or several) moderator(s). The aim is that each junior researcher could participate one time as a speaker, one time as a moderator and the rest of the time as a participant. We expect on the one side to develop their communication skills and on the other side to foster peer-dialogue and collaboration.

Secondly, we plan to implement six e-learning modules from the end of 2015 till the end of 2016. We are still designing them in collaboration with senior researchers. The e-learning modules will investigate more deeply a specific topic in each discipline involved in improving auditory rehabilitation for children with hearing impairment. We expect from the junior researchers participating that they will improve auditory rehabilitation by finding new solutions through collaborative work across disciplines.

Finally, we use social media in two different ways – one between junior researchers themselves and one between junior and senior researchers – to foster discussion on organisational or content aspects for example of the interdisciplinary e-learning training. We expect from junior and senior researchers by using these social media to ask questions and interact with people from different disciplines. Furthermore, by using and facing e-learning technologies within the online activities planned we expect from junior and senior researchers to be able to use these novel technologies in their ongoing professional teaching, learning and research practices.

3.3. Professional development perspective

Learning is a process rather than a one-time event [18]. Specifically in higher education within a PhD program, we predominantly use a professional development perspective for supporting lifelong learning process. Through the interdisciplinary E-learning training we are planning, we hope to provide junior researchers valuable professional development opportunities to share practices, exchange ideas, debate principles, build skills and develop networks with their peers from cognate disciplines involved in improving auditory rehabilitation for children with hearing impairment.

Actually, “the best neurosurgeons don’t rely simply on their own brilliance; they read peer-reviewed journals, attend conferences in which their colleagues discuss new research, and travel great distances to work alongside surgeons who are developing innovative techniques” [19, p. 141]. According to the authors, communities of practice are particularly effective for fostering professional development as well as E-learning technology to support communities of practice and social network. For instance, “In an online environment, the technological tools can be harnessed to provide social support through online discussion forums, group dialogue and feedback processes” [14, p. 581]. That’s why, we are developing in the iCARE context, an interdisciplinary E-learning training into a professional development perspective for researchers working in auditory rehabilitation field.

CONCLUSION

In the iCARE project we aim to design, develop and implement an Interdisciplinary E-learning training to create a new generation of researchers able to share and combine research outcomes across disciplines for improving auditory rehabilitation. For this purpose, we will use 1) the connectivity, flexibility and interactivity characteristics of E-learning technology for multiple distance locations, 2) the socio-constructivism principle as well as the community of practice and social network concepts into a conceptual framework in order to design our 3) interdisciplinary E-learning training. This training is structured by a specific online learning environment composed by three main online learning activities supporting the

interdisciplinary component and the professional development perspective of our project.

This project is composed of around ten different disciplines: speech sciences, social sciences, engineering (acoustics and signal processing), educational sciences, psychology, neurosciences (auditory and cognitive), medical sciences, psycholinguistics, applied linguistics and audiology. For the inclusion of children with hearing impairment in the oral society, researchers from each discipline pursue – with different levels of expertise and experience – a common goal: the development of communication and social skills in these children.

One interesting part of this project is to investigate how engineering junior researchers will take benefit from this interdisciplinary E-learning training. We also want to further explore in the iCARE context with which disciplines engineers working in this field have stronger links. In other words: which disciplines will foster learning and collaborative work among engineers? In the end this research project will contribute to document better from an engineering perspective how interdisciplinary education takes place in an online and distance environment related to auditory rehabilitation.

Acknowledgements

This research is supported by the FP7 people programme (Marie Curie Actions), REA grant agreement no FP7-607139 (iCARE).

REFERENCES

- [1] Violante, M. G., & Vezzetti, E. (2014), Implementing a new approach for the design of an e-learning platform in engineering education, *Computer Applications in Engineering Education*, Vol. 22, No. 4, pp. 708-727.
- [2] Friesen, N. (2009), *Rethinking E-Learning research: Foundations, Methods and Practices*, Peter Lang Publishing, New-York, pp. 265.
- [3] Knight, S. (2004), *Effective Practice with e-Learning*, JISC, Bristol.
- [4] European commission (2012, December), eHealth Action Plan 2012-2020, Innovative healthcare for the 21st century, Communication from the commission to the European parliament, the council, the European economic and social committee and the committee of the regions, Brussels.
- [5] De Souza, C. S., & Preece, J. (2004), A framework for analyzing and understanding online communities, *Interaction with computers*, Vol. 16, No. 3, pp. 579-610.
- [6] Kurtz, G. (2014), Integrating a Facebook group and a Course Website: The effect on Participation and Perceptions on Learning, *American Journal of Distance Education*, Vol. 28, No. 4, pp. 253-263.
- [7] Zou, T. X., & Mickleborough, N. C. (2013), Promoting collaborative problem-solving skills in a course on engineering grand challenges, *Innovations in Education and Teaching International* (ahead-of-print), pp. 1-12.
- [8] Wenger, E., Trayner, B., & de Laat, M. (2011), *Promoting and assessing value creation in communities and networks: a conceptual framework*, Ruud de Moor Centrum, Amsterdam.
- [9] Le Bot, G., Xue, L., van Petegem, W., & van Wieringen, A. (2015), *A value creation framework for an online professional learning community*, EDEN conference, Barcelona.

- [10] Wenger, E. (2011), *Communities of practice: A brief introduction*, Retrieved on 04/15 from <http://wenger-trayner.com/wp-content/uploads/2012/01/06-Brief-introduction-to-communities-of-practice.pdf>.
- [11] O'Neill, G., & McNamara, M. (2015), Passing the baton: a collaborative approach to development and implementation of context-specific modules for graduate teaching assistants in cognate disciplines, *Innovations in Education and Teaching International* (ahead-of-print), pp. 1-11.
- [12] Bielaczyc, K., & Collins, A. (1999), Learning communities in classrooms: A reconceptualization of educational practice, In C. M. Reigeluth (Ed.), *Instructional design theories and models*, Vol. 2, Lawrence Erlbaum Associates, Mahwah.
- [13] Aboelela, S. W., Merrill, J. A., Carley, K. M. & Larson, E. (2007), Social network analysis to evaluate an interdisciplinary research center, *Journal of research administration*, Vol. 38, No. 1, pp. 61-75.
- [14] McLoughlin, C., & Luca, J. (2002), A learner-centred approach to developing team skills through web-based learning and assessment, *British Journal of Educational Technology*, Vol. 33, No. 5, pp. 571-582.
- [15] Canboy, B., Montalvo, A., Buganza, M. C. & Emmerling, R. J. (2014), 'Module 9': a new course to help students develop interdisciplinary projects using the framework of experiential learning theory, *Innovations in Education and Teaching International* (ahead of print), pp. 1-13.
- [16] Johnson, C. M. (2001), A survey of current research on online communities of practice, *The internet and higher education*, Vol. 4, No. 1, pp. 45-60.
- [17] Xue, L., Le Bot, G., van Petegem, W., & van Wieringen, A. (2015), *Applying Biggs constructive alignment to online interdisciplinary education*, EDEN conference, Barcelona.
- [18] Teräs, H. (2014), Collaborative online professional development for teachers in higher education, *Professional development in education* (ahead of print), pp. 1-18.
- [19] Wenger & Snyder (2000), Communities of practice the organizational frontier, *Harvard business review*, Vol. 78, No. 1, pp. 139-146.