Dialogue between Research Solar Practices and Training Activities: Interactive Webinar by Integration of ICT in Education

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Abstract

An educational Webinar targeted to students, architects and professionals, has been organized in the context of the European research project ConstructPV and the bachelor course of Architecture of SUPSI to stimulate a discussion on the role of solar energy in buildings. The main feature of innovation of our Webinar has been to combine the traditional method of live conference with computer-mediated to allow the interaction with all participants of other institutions and other learning environments. This has greatly encouraged the participation and generated a wealth of feedback for ConstructPV by making a direct survey on several key-topics thus increasing effectiveness in knowledge transfer

Keywords: solar education, building integrated photovoltaics BIPV, ICT technologies, blended e-learning

1. Introduction

Building-integrated photovoltaic (BIPV) systems are the main elements of the architecture, delivering solar generated electrical power that replace conventional building materials as part of the building envelope. BIPV uses in construction have been increased slowly in recent years and are still considered a niche product trying to grow towards a wide mass market (Delponte et al. 2015). In new building developments and in renovations, BIPV are the most effective installation delivering renewable energy since the cost of customized product that improved the overall aesthetic have been reduced (Bonomo et al., 2017 and Zanetti et al., 2017). When compared to non-integrated systems, BIPV initial cost can be offset by reducing the materials and labour cost of the building elements. It is noted that general cultural resistance still exists in the use of BIPV among building industry professionals, including architects, planners, engineers, builders, clients and end-users. Thus education and effective knowledge transfer solutions are needed to improve BIPV adoption. As recently remarked (Tabakovic, et al., 2017), activities in the technical, legal, and , not least, in the educational areas will be necessary to foster the adoption from architects, professional operators and students, dedicated to the needs of each target audience.

2. Knowledge transfer for BIPV exploring the pedagogic use of ICTs

Nowadays, Internet and the Word Wide Web support collaborative work and e-learning environments almost everywhere, without time and location restrictions. Use of computing platform is widespread and moved from "central computing" to more distributed "networked computers". Given the excellence diffusion of internet and connectivity, e-learning environments are well position to provide a student-centric service at high level education (Gomes and García-Zubía, 2007).

Solar energy education is a topic covered only in few international programs (e.g. IEA SHC task 51, IEA SHC task 41) and research projects. But today many international associations such as International Solar Energy Society, offer already free online courses and webinars related the renewable energy sector trough a Renewable Energy Platform (https://www.ises.org/webinars/439). CHEETAH PVirtual Academy has also launched in January 2018 the Knowledge exchange Platform (KEP) that has become EERA Knowledge Exchange Platform for PV Technology (KEPT-PV) since May 2018 (CHEETAH project FP7-Energy-2013, http://www.cheetah-project.eu). The PV Knowledge Exchange Portal of CHEETAH and EERA-PV offers day-by-day lecturers and short “virtual” on-line courses focused on the best practice utilization of infrastructures, equipment, experiments and test procedures or technical-scientific aspects. In addition, webinars, conferences, workshops, or technical meetings are organized and reported with the aim to introduce scientists/students/experts/stakeholders concerning strategy in PV RTD, market and interaction with industries, as key action in Science and technology dissemination. An innovative approach is used in the European research project Dem4BiPV (http://www.dem4bipv.eu/project/, Figure 1) with

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the aim to develop innovative and multidisciplinary courses on BIPV to train professionals utilizing ICT platforms (van Sark, 2016, 2017). Within the project major knowledge gaps and target audiences from stakeholder perspectives has been identified to define specific courses.

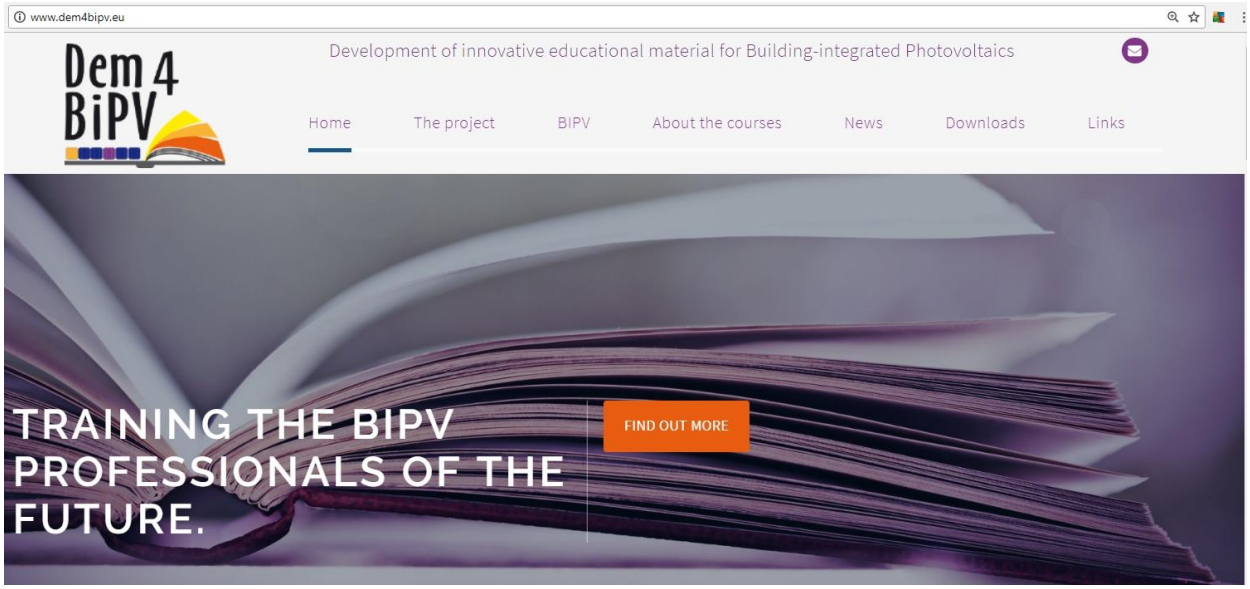

Fig. 1: e-learning environment of Dem4BiPV Web Platform (source: http://www.dem4bipv.eu/)

As BIPV may bring significant contribution to reach EU energy challenges and benchmarks for 2020 and beyond, education and training should play an important role to enhance the skills of the professionals, but also for high quality employment in the BIPV industry by increasing the efficiency of higher education on sustainable energy. In this field, the combination of innovations that explore the pedagogic use of ICTs(as for example, smartlabs, e-learning experiences, WebLabs or Virtual Learning Environments (VLE)), is as important as the need to enhance the partnership between research higher education institutions, industry and other stakeholders. It is possible to perform an interdisciplinary training scheme with the technical knowledge and competencies to deliver specialised workforce required for the successful implementation of BIPV projects.

ICT alone does not ensure effective teaching, but nevertheless in the 21st-century teachers and educational trainers need to be equipped with Technological Pedagogic Knowledge, TPK (Mishra and Koehler, 2006) to know how to proper use the available ICT tools making profitable use of specific educational contents. The same authors (Koehler et al. 2013) considers that the teacher knowledge for technology integration (i.e. technological pedagogical content knowledge TPACK) enables teachers to relate creative ideas using ICT tools in the educational process to improve competences and learning outcomes. The role of experimentation is key concept.

3. Research practices vs. training and dissemination activities, an experience of interactive Webinar

This paper presents an example of successful collaboration among scientists and teachers to create greater links between research and education, strengthening the knowledge and competence of relevant stakeholders in solar energy also in order to obtain a useful feedback to improve some contents/process of the research. The European project Construct-PV (FP7-ENERGY-2011-2, http://www.constructpv.eu/) developed and demonstrated customizable, efficient and cost-effective Building Integrated Photovoltaics (BIPV) for the opaque building envelope. The demonstrative target of the project makes tangible the results and the potential transfer of PV technology in the built environment developing new promising technologies with an advanced design. To be attractive to both the building and PV market, Construct-PV systems are multifunctional, integrating the most promising PV technologies.

With the aim to present the main achievements on solar BIPV technologies reached within the project, a conference was hosted at SUPSI Campus, in Lugano, Switzerland (see, Figure 2). About 50 people attended the event in classroom and on the web platform. Architecture students of the last-year bachelor program together with professors, architects, engineers and other members of companies working on PV field (80%) attended the conference in site while the other participants (20%) attended the conference by Internet through the interactive Webinar platform, specifically created for this event.

Fig. 2: Promotional flyer developed for this special event (source: SUPSI)

The purpose and main innovation of this interactive Webinar has been to combine the traditional method of a frontal live conference with computer-mediated activities in blended learning allowing the interaction with remote participants in other institutions or in other learning environments: e learning, video conferencing, for example. Some authors describes blended learning as the fusion or convergence of face-to-face and online learning experiences (Graham 2006 and Vaughan, 2008) but also other combinations of technologies, locations or pedagogical approaches (Mason and Rennie, 2006). However, and despite the fact that online learning, e-learning or flexible learning concepts are associated with an electronic environment, the term blended learning, intended as combination of virtual and physical environments, recognizes the potential of a positive relationship between online and face-to-face environments for both learners and their teachers (Stacey and Gerbic, 2008).

The in-site live conference was specifically design to introduce the process of blending (the online and face-to-face environments) but also has been the basis for an interactive and participatory Webinar with the aim of involving, with the IT e media support, other university bodies, researches or professionals at local level and abroad in a questionnaire on research findings. During the event has been shown real case studies and the main outputs on solar BIPV product development research results has been presented to students, professionals and members of the industry. The blend of technologies with face-to-face interaction using webinars/workshops, also in a professional context where personal relationships can be established, with an online community encourage critical reflection and discussion of practice setting the basis of much effective professional development (Garrison and Vaughan, 2008).

3.1. Interactive survey: two-way exchange of knowledge

Currently, there is not an all-in-one tool or resource containing all of the information to consider when determining an appropriate participatory approach for a specific educational workplace. This event was organized through the platform Swiss E-Learning Community, with the SWITCHinteract Adobe Connect tool specifically custom redesigned to reach the blended e-learning outcomes pursued and organizational needs.

In this case the instructor/lecturer guides the learning process delivering content on research results which is at the same time guided by a master conference manager taking charge of the overall organization of the tool. Participants to the interactive Webinar access the content also via the network (Internet) and the management system engage learners and track informally the learning activities through the in-live survey regarding the contents of the conference acting as a Learning Management System (LMS). This e-model scheme follows the delivery model for blended e-learning suggested by Al-Huwail et al. (2018) which play a key role in creating a successful collaborative environment by avoiding substantial cross-cultural differences in interaction and communication (see Figure 3).

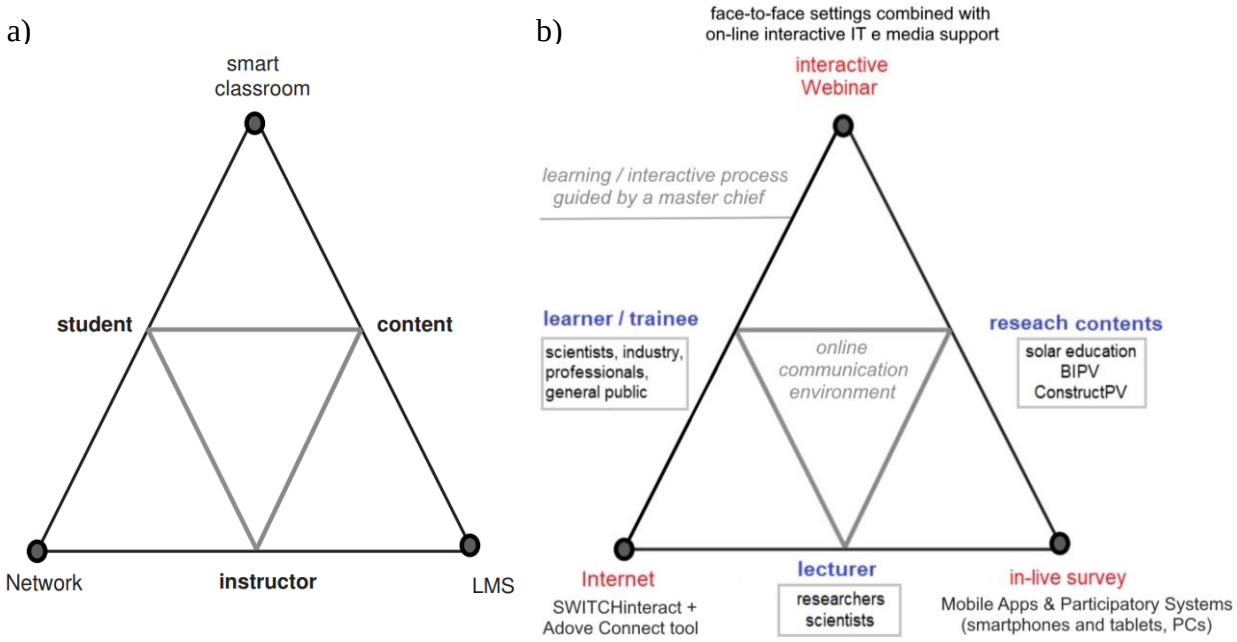

Fig. 3: e-model scheme: a) Delivery Model for Blended E-Learning (source: Al-Huwail et al., 2018); b) Adapted e-learning Environment Framework (source: authors)

A focal point of this Webinar has been to include and to use a participatory systems, driven by mobile systems (such as smartphones and tablets, PCs), in live via Wi-Fi among the people attending conference and also remotely on the web platform to enable the participation of a large external public (Figure 4). This approach had the intention to foster the integration of ICT (information and communications technology) into learning activities concerning solar buildings in an efficient and fruitful way.

As defined by Bousset et al. (2005), *"participatory methods are methods to structure group processes in which participants play an active role and articulate their knowledge, values and preferences for different goals"*. In are suggested as key factor for innovations success favouring dissemination process the users relevant point of view, citing *"The assessment of defect and advantage of innovation is wholly in the users' hands : it depends on their waiting, their interests, the problem they are taking"* (Akrich, et al., 1988a; 1988b). These studies suggest that an innovative object or innovative features of a product are not only the result of technical decisions, but also from the interaction with involved social groups and stakeholders, some as allies (forces in favor), others as opponents or sceptics (forces against). In this way, the social environment where this object will move and where it will impact can be assessed.

In our case, a participatory and interactive approach was used to test end-users commitment and interest with research findings, and to check learning skills acquired during the conference. A shift of written or visual elements (scrolling titles, slideshows or flash elements) together with a live survey appeared at time of the speakers' presentations to track the answers for specific questions and to achieve results for the survey simultaneously to presentations. In this way, it has been possible to see the direct response of the public, encouraging participation of students and different stakeholders thus stimulating the fair competition among the participants in order to obtain a greater response in the survey (for example by displaying the a minimum threshold of participants and the total number of people responding to each possible answer). It was also possible to integrate in real-time the direct visualization of the flow of participants and the answers to the online questionnaire on the project. It was also available the use of blogs to post comments that interface directly with the lecturers (Figure 5).

Fig. 4 – Adove Connect Mobile App have been used in this interactive Webinar. This Mobile Apps can be used to host or attend online meetings, webinars and virtual classes anytime (source: SUPSI)

Fig. 5: Lecture session during the interactive frontal live conference and Webinar (source: SUPSI)

3.2. Results

The e-learning platform has allowed collecting all useful data from the interactive survey divided by different aspects (i.e. by attendees, by sessions, by questions) for the synthesis of the information obtained based in the most important indicators and filters for the research project, according to the main topics scheduled (see Figure 6 and Figure 7). An open discussion with a survey results analysis of the poll questions was performed at the end of the lecture session among the in-site participants while the chat allow interaction the with the webinar participants by reaching a greater audience (beyond SUPSI students). In this way, professionals could follow the lecturer sessions directly from their own workstation saving time and limiting unnecessary commuting with a good interaction with the audience in the classroom and the lecturers through chats, blogs or video conferencing features.

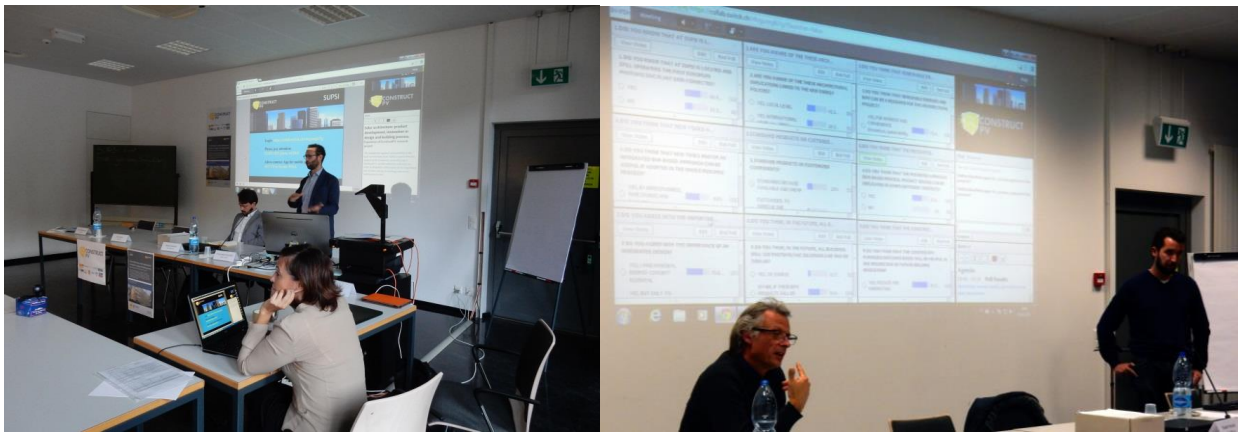

Fig. 6: Open discussion and survey results analysis at the end of the lecture session.

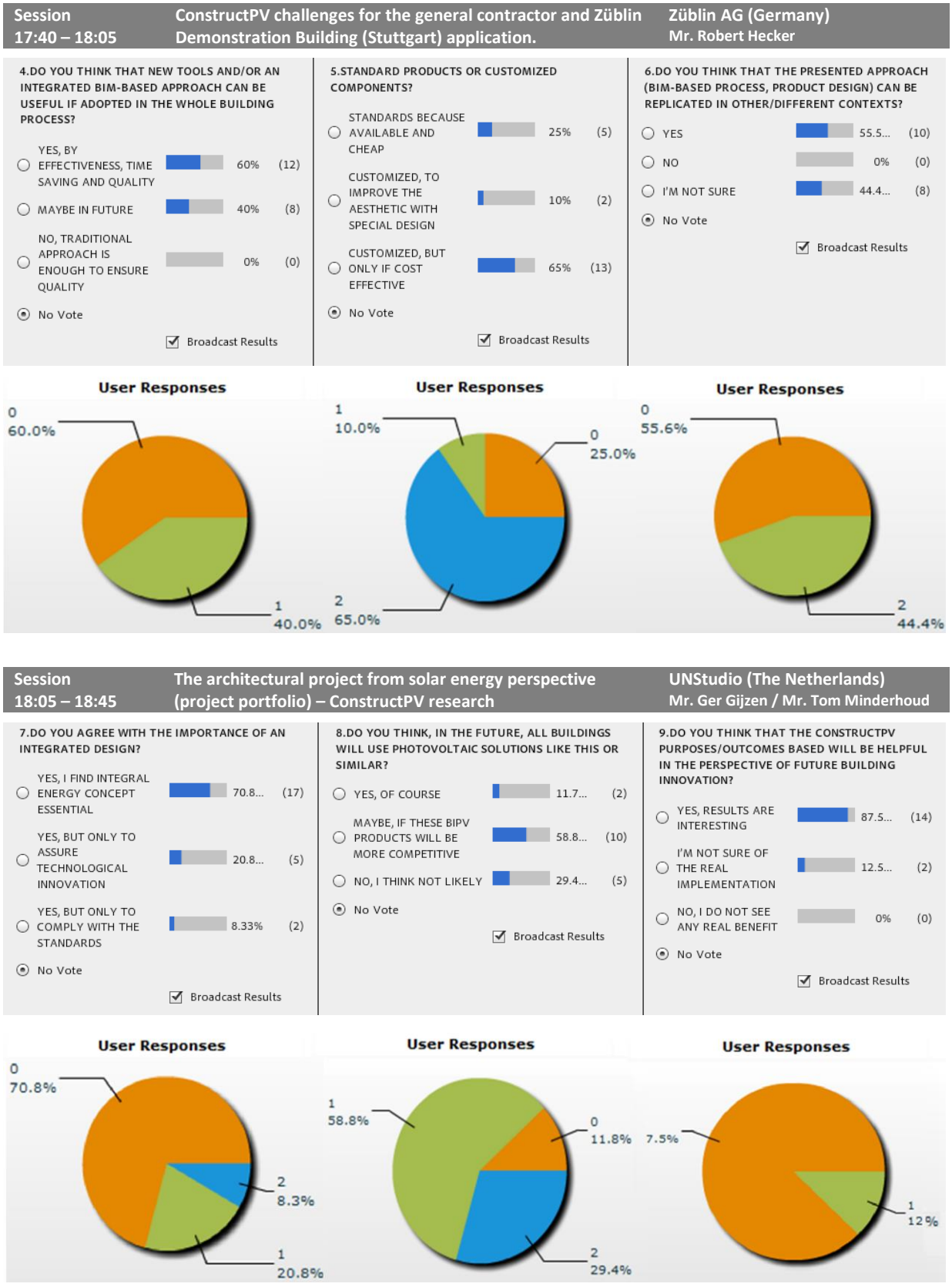

Fig.7: Example of live- survey questionnaire held during the interactive Webinar.

The event tracking feature allows knowing the most interesting information gathered during the session, by custom dimensions: class of participants and users, answers to specific questions, traffic flow visualization, etc. Furthermore, to facilitate the creation of reports in the perspective of dissemination activities borne by SUPSI in WP7 of ConstructPV research project, all the information have been gathered to develop a brief summary report of the interactive webinar. The whole event was recorded and monitored thanks to the Adobe Connect SWITCHinteract web platform.

4. Conclusions

Truly successfully e-learning environments need a blend of both the new technology and traditional learning, by means of using its successful learning principles. Profiting from networking and communication technologies advances, multimedia applications (audio/video conferencing, interactive elements, live video streaming) reshape the learning and educational system (Al-Huwail et al., 2018). However, new learning technologies including also social networking as blogs or wikis, pod/vodcasting as internet based audio and video communication tools, synchronous and asynchronous communication, are contributing in create new blending potentials for web-based instruction.

The experience carried out in SUPSI within the activities of ConstructPV research project has demonstrate the validity on using blended e-learning environments in solar education. The use of ICT web-based computer systems to better transfer research contents on new solar BIPV systems has allowed to reach in a more effective way a wider audience, with different levels of expertise, promoting an open dialogue and two-directional exchange of knowledge, for mutually beneficial collaboration among researchers, students and the public, by using an interactive process and implementing new methods of teaching, promotion and dissemination of research. This kind of interactive ICT approach, particularly significant in this multidisciplinary BIPV field, encouraged the participation /attention of the public (students, professionals and business sector) to achieve more direct results with also an immediate impact on research activities thanks live polls as inputs for the project. The use of new ICT blended instruction methods as a mix of different learning environments is possible also to communicate and disseminate the research results in a fruitful way by directly to test public opinion and interested stakeholders profiting from the research results.

The main results and findings were:

- ITCs and interactive participatory methods can be used to transfer knowledge from research to public changing relationships between people as technology mediates interaction and learning between the virtual and the physical environment and creating a new landscape of educational technology;
- The active e-learning method used, based on blended learning approaches and ITCs, has allowed good communication and feedback channels with students, researchers and professionals. The network and ITCs technologies have been used for delivery educational contents on solar BIPV, facilitating access to the information on cutting edge research worldwide and to create multi-directional interaction and exchange of knowledge among different stakeholders.
- The in-live survey test based on a set of poll questions served as a way of sounding out public opinion, to get an audience interacting with the webinar presenter and their content, as well as, to generate and to stimulate the dialogue and to gather useful information on the matter.
- The adaption of educational and training innovative methods to research field in photovoltaics (BIPV) by using computer-mediated communication (CMC) tools to build online communication environments, as well as at the same time, using a blended approach with appropriate face-to-face meetings with researchers seems to be more relevant to create attraction, allowing discussion for bi-directional exchange of knowledge and experiences from research to public and vice versa with a possible uninterrupted and iterative application again to reach findings.
- This kind of co-learning method built around an e-learning situation have favored the information exchange (electronic meeting systems) to reinforce the influence of informed stakeholders to follow the changing definition of knowledge from scientific-oriented to consensus oriented (Geurts and Joldersma, 2001) where social interaction facilitate participation of non-scientific experts, citizens, users, and other policy actors in the research process.
- This e-learning activity allows creating a flexible learning environment based on the concept of concept of network management. This concept is based on the assumption of the model of "co-production of knowledge" (Callon, 1999): by means of identifying the key actors or stakeholders in the system, and assessing their respective interests to be even more and more present in the process of research and development activities. Theories that see in the exchange of information and the collaboration between specialists, researchers, and stakeholders involved as fundamental actors in this collective process of production and circulation of knowledge to be considered as a source of experiences and ideas.
- Such event represents a good experience of successful model on publicizing and effective communicating of research results to a wide public, contributing to solar education not only for bachelor ongoing students (architects or engineers) but also for continuing professional development (scientists, professionals, BIPV industry members).

5. Acknowledge

In this case, the use of ICT has improved the teaching and learning process. However, it would be necessary to making use of the in-service training on the tools organized by the school (e-Lab service of USI/SUPSI). We thank the eLab eLearning Lab members, in particular, Mr. Stefano Tardini and Mr. Christian Milani which have given a very important contribution and technical support for the Webinar preparation to achieve the goals of this interactive event. For the same reason we want to remember Mr. Pierluigi Bonomo and Ms. Erika Saretta for their contribution in the organization phases. We also make an special mention to the partners of ConstructPV EU research project (Grant Agreement no.: 295981), Mr. Tom Minderhoud and Mr. Ger Gijzen (UNS UNStudio Architects, NL) and Mr. Robert Hecker (Ed. Züblin AG, GE) for their valuable contribution to this event.

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