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Interdisciplinary e-collaboration tools

Narzędzia interdyscyplinarnej e-współpracy

Key words: interdisciplinary collaboration, online collaboration, Moodle, e-technologies, professional development, lifelong learning.

Słowa kluczowe: współpraca interdyscyplinarna, współpraca online, Moodle, e-technologie, rozwój zawodowy, uczenie się przez całe życie.

Streszczenie. W projektach interdyscyplinarnych niezwykle ważnym czynnikiem jest aktywne konsultowanie i bezpośrednie zastosowanie relatywnie nowo powstałej dziedziny zwanej współpracą interdyscyplinarną. Nawiązywanie interdyscyplinarnej współpracy przynosi wiele korzyści, jednakże niejednokrotnie wiąże się z licznymi problemami i niedogodnościami, a także koniecznością ciągłego doszkalania się i rozszerzania kompetencji zawodowych. Na podstawie przeglądu dostępnych programów oraz różnego rodzaju platform wspierających współpracę i edukację online dokonano porównania dostępnych narzędzi współpracy i zaproponowano rozwiązanie opierające się na platformie LMS Moodle. W celu sprawdzenia przydatności i poprawności działania wybranego rozwiązania nawiązano współpracę z przedstawicielami środowisk technicznych, medycznych i biznesowych w celu utworzenia grupy testowej. Zebrane informacje posłużyły do sformułowania wniosków oraz do powstania instrukcji przygotowującej wybrane oprogramowanie do potrzeb e-współpracy interdyscyplinarnej.

Introduction. Rapid technological development in recent years has contributed to numerous changes in many areas of life. It is now required to apply broad knowledge from various fields, that are not always related. In interdisciplinary projects, an extremely important factor is the active consulting, lifelong learning and direct application of a relatively new field, called interdisciplinary collaboration [1].

It was researched and proven that the possibility of conducting consultations positively affects the creation process, while team working increases the sense of security, reduces stress and stimulates creativity [6, 9]. It also increases the awareness of mistakes and opens people's minds to look at the subject from a completely different angle, which is extremely important in interdisciplinary projects.

Establishing interdisciplinary cooperation brings many benefits, however, it is often associated with numerous problems and inconveniences, as well as the need for changes in the adult education model, constant improvement and continuing professional development (CPD). Living in a constant rush makes time a key aspect and more and more projects are being done virtually, using multiple online tools [1, 7].

Interdisciplinary collaboration issues. Although many advantages of collaboration have been mentioned, many people are still concerned about certain aspects of interdisciplinary working. Some have a sense of rivalry that makes them think that they can do everything by themselves and do not need anybody to look over their shoulders and criticize their work. Additionally, the lack of consultation may lead to dangerous and even harmful situations. Even a little mistake may cause a serious disaster. The comfort of independence is not worth risking human safety [7, 8]. Different specialists pay attention to different parameters and one may notice an abnormality in a sector that the other one would never consider checking.

Misunderstandings between different specialists often discourage them from working together. Even between two different fields of one scientific discipline, there are differences in terminology and procedures that cause people speaking the same language to not understand each other. Interdisciplinary collaboration requires much patience and mutual respect [9].

E-collaboration tools. Rapid technical and technological development makes many things easier to be handled over the Internet. That led to the hypothesis that using appropriate online collaboration tools would make interdisciplinary working faster and much more efficient [7]. Different aspects of the ideal e-collaboration software had been taken into consideration. The optimum solution would need to be intuitive, available worldwide, multilingual and compatible with popular computer software as well as with different versions of itself. Based on engineer-physician case study, the choice of cloud-based collaboration environment consisting of Autodesk Fusion 360 and LMS Moodle has been proposed [7].

Autodesk Fusion 360, as stated in their own literature, is a cloud-based CAD/CAM tool for collaborative product development [3]. It is the next-generation industrial and mechanical design tool. One of the biggest advantages of the F360 is the fact that it is free for start-ups, students, educators, and academic institutions as well as hobbyists and enthusiasts. Using Fusion 360, students can develop their skills in order to become tomorrow's engineers, product designers and industrial designers. Fusion 360 enables discovery and development of product ideas and cooperation within a team of developers. It combines mechanical design, organic shapes modelling and manufacturing in one comprehensive package. The preview of a design is also available through a smartphone application.

Moodle stands for Modular Object-Oriented Dynamic Learning Environment which is one of the popular Learning Management Systems [4]. This multilingual open-source software is available in most countries, accessible through an Internet browser and compatible with different computer software.

Engineer-Engineer case study. Collaboration might be complicated even for colleagues specialising in different aspects of the same profession. Interdepartmental PhD research can be given as an example. The subject matter connected with heat transfer and material sciences and surface modification required collaboration between the Department of Energy and Industrial Apparatus and the Department of Materials Engineering and Bonding. Both are part of the Faculty of Mechanical Engineering at

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Gdańsk University of Technology. Because of prosaic inconveniences the work had been going slow, mostly because of the lack an exchange of proper information. Once the research had moved to a Moodle working area, communication rapidly improved which resulted in better understanding of the subject and, therefore, an increase of research efficiency.

Engineer-Physician-Business case study. Medical device designing requires a wide range of expertise in various fields of medicine and engineering. According to the development of technologies used in Diagnosis, Implantology, Rehabilitation, etc., cooperation between engineers and physicians is a very important factor, such as the direct application of a relatively new field of science called Medical Engineering [6, 11]. Establishing interdisciplinary cooperation between engineers, physicians and businesses brings many benefits and has a significant impact on modern diagnostics and treatment development [8].

The research and experiments have been conducted establishing interacademic cooperation between adult learners from Gdańsk University of Technology (GUT) and the Medical University of Gdańsk (MUG) with the support of the SP4CE ERASMUS+ program [2, 7].

SP4CE stands for Strategic Partnership for Creativity and Entrepreneurship, a project which was funded with support from the European Commission under the ERASMUS+ Programme in the period of 1st September 2014 – 31st August 2017. The main purpose of the SP4CE project was to design innovative e-learning tools for collaboration between students or adult learners, enterprises and teachers. It was concentrated on identifying users' needs and supports the development of relations between them by means of mentoring and consulting activities. The SP4CE project involved six partner organizations from four countries, including Poland, Slovakia, Greece, Hungary [3].

- PIAP – the project leader is a research institute that has rich experience in coordination and participation in several different vocational education and research projects.
- PRO-MED – a company experienced in developing an innovative approach to teaching and learning based on e-learning, LifeLong Learning in European countries, collecting and implementing different methods used for educating the staff and learners.
- TUKE – a technical university dealing with international cooperation in the area of research and education, fostering links with institutions in private and public sectors.
- ASTRA – an organization with significant experience in conducting training for managers.
- IDEC – a project partner experienced in consultancy regarding developing quality management systems in training centers in Greece.
- TREBAG – an expert in innovation chain management, also involved in technology transfers.

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The SP4CE program is dedicated to companies and young people who want to enter the labor market. The scheme of the interdisciplinary e-collaboration using dedicated software, Autodesk Fusion 360 and LMS Moodle is shown in figure 1.

Fig. 1. Scheme of the SP4CE – GUT – MUG online collaboration

The SP4CE portal supports the following actions:

- Coaches from within companies formulate and submit the problem.
- Students situated in different locations choose problem(s), look for a solution and send a short proposal.
- Based on the proposed solutions, teachers are allocated to students and they assist the problem-solving process within so called Learning Rooms (LR).

Training. In order to achieve a good collaboration between all target groups, volunteers have been trained in the scope of the chosen software [2].

The first Autodesk Fusion 360 training workshop called *DesignNown* was organised in January 2017 at the Gdańsk University of Technology. All the preparations had been done using Moodle platform. The main layout of the learning room for organizers is shown in figure 2. Figure 3 shows the learning room for participants [10].

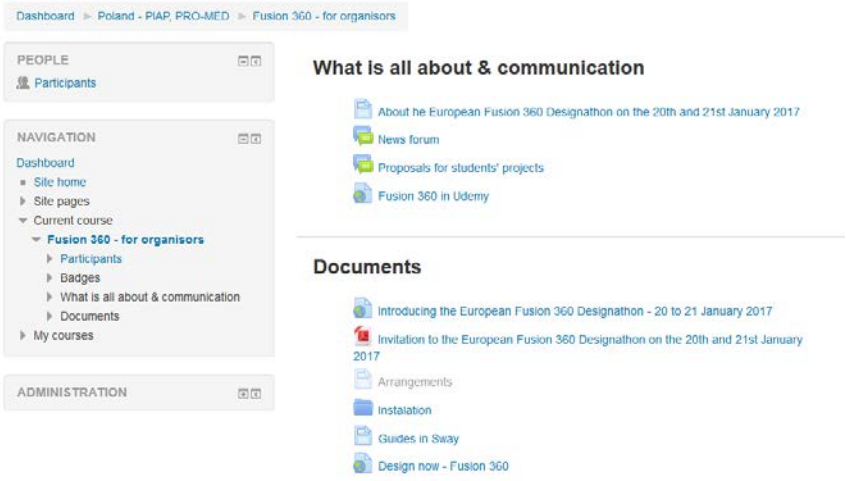

Fig. 2. DesignNow – LR for organizers

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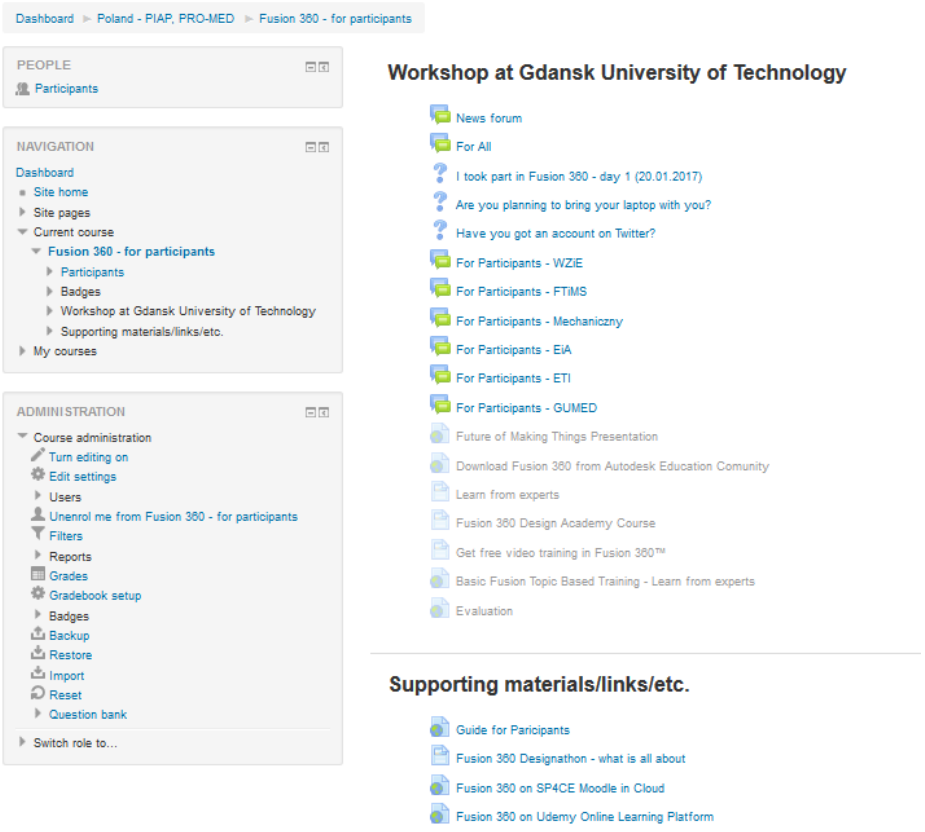

Fig. 3. DesignNow – LR for participants

The workshop gained the interest of students from both universities and also some PhD students and academic teachers from different departments, as it is shown in figures 4.

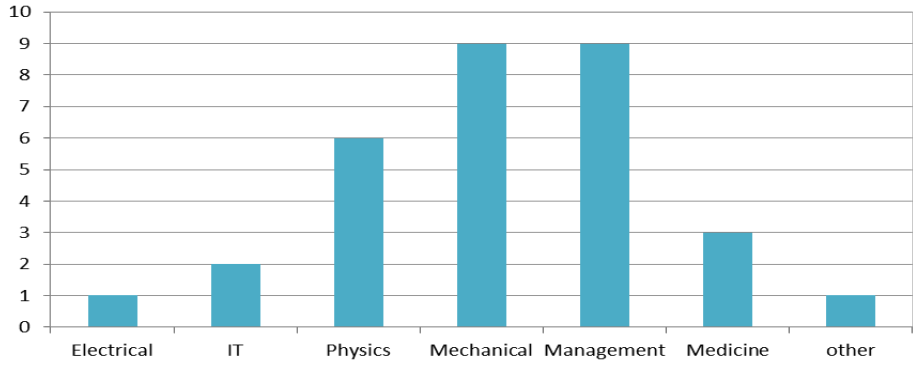

Fig. 4. DesignNow – participants' faculties

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As a result of the training, participants were awarded with a certificate of completion. In the evaluation questionnaire, 40% of them declared their satisfaction level as very good, 50% as good and the rest of them stayed neutral. 90% of the participants were likely to continue learning the software.

Implementation. The students that were most engaged formulated small groups that were given their own Learning Rooms to work on selected interdisciplinary projects [10]. Many different organizations got involved in the projects, including:

- Autodesk Authorised Training Centre at the Gdańsk University of Technology
- Mathematics Teaching and Distance Learning Centre at the Gdańsk University of Technology
- European Multiple MOOC Aggregator
- Scientific Circle at the Department of Radiology at the Medical University of Gdansk
- Integrating Technology & Moodle for Teachers Network
- PRO-MED sp. z o. o.
- Students' Maxillo-facial Surgery Scientific Circle at the Medical University of Gdańsk

Numerous Learning Rooms were used by students for university group projects, med-tech consulting, organising students' apprenticeships in companies that they were willing to work at after graduation, research, writing articles, preparing training MOOCs and much more [10].

One of the most successful projects carried out and completed with the usage of selected interdisciplinary e-collaboration tools was the engineering diploma thesis titled *Design and material selection for the jaw implant after bone resection* [5].

The project was conducted by two students of Mechanical-Medical Engineering from Gdańsk University of Technology with the involvement of a student of Dentistry from the Medical University of Gdańsk and a private limited company – PRO-MED. As a result of the collaboration, they not only prepared the design and material selection, but also produced a 3D printed prototype, as shown in figure 5.

Fig. 5. 3D printed mandible implant prototype

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The collaboration between engineers and medical academic centers led to an innovative implant design based on an individual computer tomography examination and reconstruction with the usage of 3D printing [5, 7].

Based on that project, an Engineer-Physician collaborative e-designing scheme was created as shown in figure 6. It can be used as an algorithm for future implant designing projects.

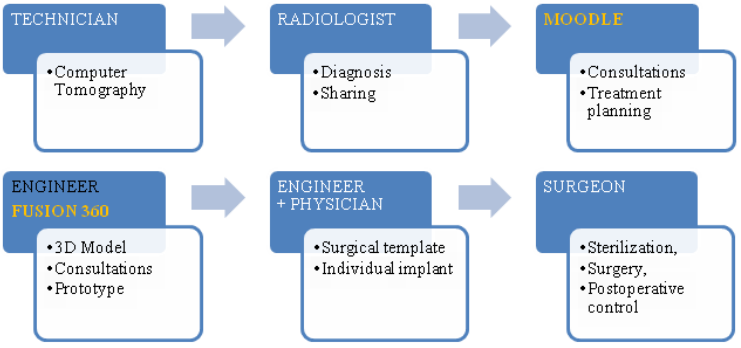

Fig. 6. Engineer-Physician collaborative e-designing algorithm

Designing implants in the cloud and using the idea of distance communication, implements a new level of diagnostics and medical consultation, conservative and surgical treatment planning, creating new solutions and methods, discussing the use of biocompatible materials etc. Transferring the communication and designing work to the cloud also reduces the time of the project's creation and realization.

Summing up. The summing up workshop took place at the Gdańsk University of Technology as a part of the E-Technologies in Engineering Education conference (eTEE) in April 2017. Representatives from all of the project's partner organizations took part in the event, as well as many of the students, teachers and business consultants from Poland and abroad (figure 7).

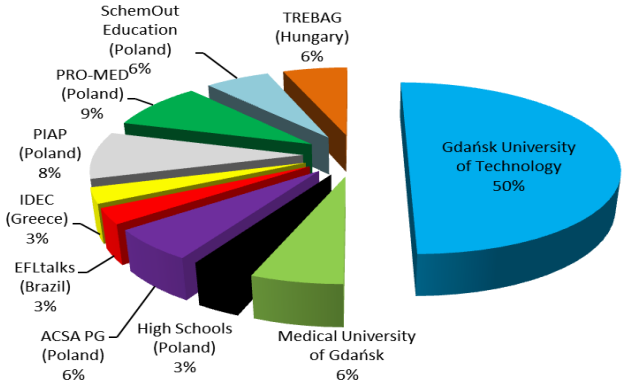

Fig. 7. Participants of the eTEE workshop

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At the end of the project, over 500 registered users were enrolled in 124 Learning Rooms. While 60% of the participants were from Poland, the other 40% were representatives of foreign countries, among them: Austria, Belgium, Brazil, Bulgaria, Croatia, France, Germany, Greece, Hungary, Netherlands, Norway, Portugal, Romania, Russian Federation, Slovakia, Spain, Sweden and the UK. The results of the interdisciplinary e-collaboration project have been presented as articles, posters, speeches, webinars or workshops at 17 conferences in one year.

Although the SP4CE project has officially ended, following the idea of lifelong learning and CPD, and as an example of the ERASMUS+ project's sustainability, after the acceptance of the final report, many Learning Rooms are still being used and more are being created.

Conclusions. Based on the overview of the available programs and various platforms supporting collaboration and online education, a comparison of the available cooperation tools has been made and a solution based on the Moodle LMS platform has been proposed.

In order to check the suitability and correctness of operation of the chosen solution, cooperation with representatives of technical, medical and business environments has been established and an experimental group has been created. The information gathered was used to prove the hypothesis that using appropriate online collaboration tools makes interdisciplinary working faster and much more efficient, and also, to provide adult learners and educators with instructions for preparing selected software for the needs of various interdisciplinary e-collaboration projects.

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