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Using Moodle as a Solution to Interdisciplinary E-collaboration Issues

Abstract

Rapid technological development in recent years has contributed to numerous changes in many areas of life, including education and communication. Establishing interdisciplinary collaboration brings many benefits, it is, however, often associated with numerous problems and inconveniences, as well as the need for constant improvement, lifelong learning, professional development (CPD) and finding an effective way of information transfer. Living in a constant rush makes the logical order of information transfer become a key aspect, as more and more operations are being done chaotically, using multiple online tools. Although collaboration happens to be complicated even for colleagues specializing in different aspects of the same profession, establishing cooperation between specific groups of interdisciplinary specialists, such as engineers and physicians, has a significant impact on modern diagnostics and medical treatment development. Based on some selected case studies investigated at Gdańsk University of Technology and Medical University of Gdańsk, supported by an overview of available education and collaboration tools, a solution based on the Moodle LMS platform has been proposed, implemented, and analyzed.

K e y w o r d s: Moodle, interdisciplinary collaboration, e-collaboration, medical engineering

Interdisciplinary Collaboration Issues

Lifelong learning and the direct application of a relatively new field called interdisciplinary collaboration is now required to apply broad knowledge from various fields which are not always related. In interdisciplinary projects, active consulting with the use of appropriate and efficient collaboration tools is an extremely important factor which abounds in many benefits (Augustine, 2018).

It has been researched and proven that even the mere possibility of conducting consultations positively affects the creation process, while teamwork increases the sense of security, reduces stress and allows for the exchange of ideas which can lead to novel solutions. Active collaboration increases the awareness of mistakes and opens people's minds to perceive the subject from a completely different angle, which is extremely important in interdisciplinary projects (Howard, 2015).

Establishing such cooperation brings many benefits. However, it is often associated with numerous technical problems and inconveniences, as well as the need for changes in the adult education model, constant improvement, and continuous professional development (CPD). The time constraints of the modern day are compounded by the need for projects to be consulted at every step. Moreover, the problems of distance, delays and the high cost of traveling make conventional consultations prohibitively expensive and ineffective. Yet, effective consulting does not require being in the same room. The key objective is to communicate and share information effectively. With time increasingly being of the utmost importance, more and more projects are conducted over the Internet using multiple online tools instead of organizing long and often inefficient office meetings (Kozłowska, 2017).

Despite many advantages of online collaboration, there are those who are still concerned about certain aspects of online projects and interdisciplinary work in general. Is it overconfidence and a sense of rivalry which makes some think that they can do everything by themselves and resent anybody looking over their shoulders or criticizing their work, or, is it a completely different reason? Misunderstandings between specialists of different fields often discourage them from working together. The problem is that a lack of consultation may lead to dangerous and even harmful situations, whose effect might become apparent only after some time. Is the illusion of independence worth risking human safety? Definitely not! We need different specialists to pay attention to different parameters and consider factors not strictly associated with their field. One professional may identify problems another would never consider. Communication problems can also occur between specialists of different fields of the same scientific discipline, where differences in terminology and procedures cause serious misunderstandings, even

when the same native language is spoken by all involved. Interdisciplinary collaboration requires much patience and mutual respect.

Engineers and Physicians – How It All Started

Establishing interdisciplinary cooperation between engineers and physicians brings many benefits and has a significant impact on modern diagnostics and treatment development. However, engaging in such cooperation often causes many problems and inconveniences. Medical engineering requires a great sense of responsibility. Even a small mistake may cause serious consequences. Proper and effective collaboration between different specialists who are focused on different aspects is a significant factor with regard to the patient's safety and recovery (Morschauser, 2014).

It all started with an engineering diploma thesis which was carried out at Gdańsk University of Technology, Faculty of Mechanical Engineering. As a graduate engineering student of Mechanical-Medical Engineering, I was assigned to a project to design a device for children learning to walk (an improved baby walker). A few years earlier, a similar project was carried out and produced a baby walker which received great media success and a patent. However, subsequent research revealed that the baby walker concept in general was, in fact, extremely harmful to toddlers. Based on collected publications, research results, statistical analysis, and legal regulations, it was established and proven that baby walkers are harmful and do not hasten the learning process of walking.

In some countries, such as Canada, they are now classified as illegal. Using, producing, buying, or importing baby walkers in Canada is forbidden by law. Moreover, baby walkers seriously delay a child's physical development. They can cause lumbar spine deformation, balance disorders, flat feet and other health issues. Based on professional literature, the required mechanism of a child learning to walk was illustrated. On the basis of the collected data and consultations with doctors and physiotherapists, the dangers of placing children in baby walkers were described. It was also explained how baby walkers can hinder the child's development. The harmfulness of walkers has been analyzed in the context of general development, orthopedics, and neurology. It was concluded that baby walkers have no positive effect on the child's process of learning to walk. Furthermore, they are harmful and can lead to many developmental disorders that may stay undisclosed and asymptomatic for many years and suddenly appear in adulthood or even in one's old age, such as the lack of proper safety reactions when falling, which can result in serious bone fractures (Kozłowska, 2016).

The mechanical parameters of baby walkers fulfill basic mechanical requirements regarding, for instance, robustness and durability, which are the main preoccupations of a mechanical engineer. Yet, if it had not been for the multidisciplinary

approach to the subject matter and consultations with physicians, another harmful device would have been designed.

Another issue connected with the collaboration between engineers and physicians is the time-consuming and inconvenient need for constant mutual supervision. Medical device designing requires a wide range of expertise in various fields of medicine and engineering, including the rapid development of technologies used in diagnosis, implantology, rehabilitation, etc. Moreover, collaboration should be consistent because it is usually most effective when it is carried out throughout the entire designing process.

An example of the consequences of the lack of collaboration is the rehabilitation robot Renus-1 (Dunaj, Klimasara, & Piłat, 2017). Renus-1 was designed by an engineer, based on his own rehabilitation experiences. The designing process was carried out without any participation of a medical specialist or an institution. Although a prototype of the robot has been built, it cannot, unfortunately, be used for any rehabilitation purposes. The problem is the lack of collaboration in the designing process, which resulted in many complications during the implementation. First, it is very difficult to obtain the approval from the ethics committee for tests on patients. Moreover, the control system designed by engineers was not intuitive for non-technical staff. The presence of a medical specialist in the project group would have helped in overcoming of many barriers.

E-Collaboration Issues

Interdisciplinary collaboration takes time and, apart from knowledge, requires a lot of patience, dedication, and involvement. Since conducting consultations is usually associated with long waiting periods in hospital corridors and sometimes entails frequent appointment rescheduling, transferring the collaboration aspect to a wisely chosen online tool saves time and also protects project participants from health hazards of hospital premises.

Naturally, there are always some cultural differences, individual habits or personality differences which may cause numerous misunderstandings. Well-organized online work also needs a good schedule and a set of rules which every team member clearly understands. The key aspect is selecting the most appropriate tools to meet the specific requirements of the project.

First, one needs to determine what programs are to be used, the deadlines for each stage of work and the communication procedures between participants. Let us imagine a situation when member A uses only e-mail messages to get in touch with member B, who checks his mailbox only once a week but keeps calling member C to get information about the progress, which C does not have because he is not on A's mailing list. One is an early bird while all the others are night owls and always get angry when forced to answer an early morning call. Moreover, one

participant uses a special program which is not compatible with any of the others' operation system. Even worse, a discussion which is important to the whole group is conducted between individual members using various platforms and messaging tools at various times. At one time, they might be communicating via Facebook Messenger or WhatsApp, at another writing SMS messages or e-mails (with or without the proper use of a "reply to all" button or using it only sporadically), and then again they might be communicating via group chat or video conferencing. The multitude of electronic channels of communication can later cause problems with retrieving or referring to important data. This does not facilitate collaboration but rather sows disorder, which leads to frustration (Kozłowska & Howard, 2019).

It should also be clearly defined how often the email box should be checked, what time and day is usually convenient for live sessions, how often a progress report is to be submitted, what kind of software is going to be used and what types of files are compatible with everybody to share and work on. Roles and tasks should be allocated to the members in accordance with their specific skills, competences and availability. All to maintain the appropriate pace of work.

Another important issue is that of cultural differences. Some cultures prefer long descriptions and expressions of courtesy, while others appreciate communication which is straight to the point. The commanding tone of communication in one culture could seem offensive to somebody from another culture. This should also be considered.

Implementing Moodle As a Solution

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

Moodle (Modular Object-Oriented Dynamic Learning Environment) is a Learning Management System (LMS) used for e-learning projects, mostly in schools, universities, and workplaces. Customizable management features make it a good tool for creating private websites with online courses for educators and trainers. Moodle allows for extending learning environments using community sourced plug-ins. The software also allows instructors to hold live online meetings. Features include a private online Learning Room with document, audio, and video files (Stanley, 2014). Various integrated Moodle tools, such as Forum, Wiki, Glossary and Choice, make collaboration well-organized.

Forum can be used for general announcements but also for discussions and evaluations. It is possible to create many different fora in sections of the course.

Wiki helps in collaborative writing of papers. It registers all the changes made by individual team members. It also saves all the previous versions of a document as a backup, which provides greater control of the writing process.

Using Glossary is an essential part of any interdisciplinary project. Collecting definitions and explanations of the specific terms used prevents misunderstandings and improves communication between the team members.

Choice is a simple decision maker. A simple question can be asked and a few options are provided to choose from. Depending on the activity settings, one or more answers can be chosen. The disclosure of the results can be regulated.

Moodle is a particularly good repository. It also has a reporting system that shows all the activities of each participant.

Case Studies

To check the suitability and correctness of the chosen solution in practice, cooperation with representatives of technical, medical, and business environments has been established and an experimental group of volunteers, including students, teachers and entrepreneurs has been created. The information gathered was used to prove that using Moodle along with clearly specified technical programs makes interdisciplinary work faster and much more efficient.

Engineers, Physicians and Entrepreneurs – Erasmus+

Without doubt, one of the best inducements for universities to collaborate with each other occurs when they receive a grant or become involved in a major project. Some interdisciplinary projects have resulted from inter-academic cooperation between Gdańsk University of Technology (GUT) and Medical University of Gdańsk (MUG) with the support of the SP4CE ERASMUS+ program.

Erasmus+ is a European Union programme for education, training, and sport in Europe. The ERASMUS+ project SP4CE (Strategic Partnership for Creativity and Entrepreneurship) directly addressed the aims and needs of enhanced European cooperation in vocational education and training. SP4CE was a response to needs identified in the "Bruges Communiqué on Enhanced European Cooperation in Vocational Education and Training for the period 2011 – 2020." (Cedefop, 2010). To implement a SP4CE portal, WordPress and Moodle were used. The WordPress page (http://sp4ce.eu/en/) provides information and training materials in five languages: English, Greek, Polish, Slovak and Hungarian. The Moodle platform

(http://sp4ce.moodle.pl/) allows for the collaboration of consultants, teachers and students from different universities using the concept of Learning Rooms.

Learning Rooms are an on-line space on a dedicated Moodle platform created to work on one project. It usually consists of a discussion forum, a set of tools such as built-in links, books and pages working as a materials repository, and also some activities, such as Wiki, assignments, surveys or voting tools. Moodle offers many external plug-ins, like PoodLL, Skype, Facebook or different webinar platforms which can engage the participants and diversify the collaboration. The work can be both synchronous or asynchronous, depending on the conditions, time zone differences and personal preferences.

All the project results and project actions were connected with promoting the adoption of innovative practices in education and training by supporting personalized and collaborative learning approaches, as well as critical thinking, strategic use of Information and Communication Technologies (ICT), Open Educational Resources (OER), virtual mobility and other innovative learning methods (Grabowska, Czaja, Kozłowska, & Pałasz, 2016).

The aim of the SP4CE project was to develop information and organizational solutions which would enable professional training aimed at an effective collaboration between all project target groups during the learning process. The SP4CE project supported collaboration between project partners by exchanging modern educational solutions and developing innovative tools to facilitate communication and collaboration between students, schools, and businesses.

The SP4CE project used the experience and results of two lifelong learning projects, OpenInn and HIG. The project consortium consisted of six partners from four EU countries. The project coordinator, PIAP (Poland), is a research institute with long-established cooperation with the industry and educational institutions. PRO-MED (Poland) is a private company which has experience in developing innovative approaches to teaching and learning with e-learning and blended learning methodologies. TUKE (Slovakia) is a technical university fostering links with institutions in the private and public sectors, while ASTRA (Slovakia) is a training company which has significant experience in conducting manager training. TREBAG (Hungary) has rich experience in the development of innovative training materials and methodologies, including e-learning and implementation of technology, and IDEC (Greece) has consulting experience in developing quality management systems (Grabowska, Urbancikova, Słowikowski, & Zieliński, 2015).

SP4CE portal provided the space for:

- problems to be solved, questions to be answered,
- creating teams, which wanted to work towards finding solutions to problems,
- mentoring & coaching,

- presentation of developed solutions,
- publishing of solutions.

It was dedicated to three main target groups:

- coaches from companies who formulated and submitted the problem.
- students from various universities who chose problems, looked for solutions and submitted short proposals.
- teachers who were allocated in accordance with the proposed solution to students in Learning Rooms and assisted in the problem-solving process.

To achieve good online collaboration between all target groups, volunteers from Gdańsk University of Technology and Medical University of Gdańsk have been trained to use the appropriate software.

Participants of the SP4CE project took part in some open Moodle courses, starting from a Massive Open Online Course, Moodle MOOC 7, run by dr. Nellie Deutsch on the Integrating Technology Moodle4Teachers platform (Deutsch, 2015). Experience gathered by both students and teachers during those Moodle MOOCs was implemented in the project. Short training videos relating to Moodle tools and the operation of Learning Rooms were created as part of the training and used for future educational purposes. Numerous Learning Rooms were created for students to be used for university group projects, med-tech consulting, research, paper writing and much more.

Even though during the Moodle MOOCs and individual training numerous different webinar tools were tested (e.g. WizIQ, BigBlueButton, Zoom, ClickMeeting), none of them were selected to be included in the Learning Rooms as recommended.

After the professional training of some of the project leaders, a free two-day workshop for students and teachers from Gdańsk University of Technology and Medical University of Gdańsk was organized as part of SP4CE implementation and Autodesk Fusion 360 Designation world online event. Among the 31 participants who finished the whole course, 10% were students of medical faculties, 13% were PhD students, 16% were academic teachers and the remaining 61% were engineering students of Gdańsk University of Technology faculties of: Electronics, Telecommunications and Informatics; Electrical and Control Engineering; Applied Physics and Mathematics; Mechanical Engineering and Management and Economics. The Moodle platform created for the purpose of the SP4CE project (http://sp4ce.moodle.pl/) allowed participants from different institutions to join a dedicated Learning Room without formal obstacles.

One of the most successful projects, carried out and completed online with the use of a Moodle platform and the new CAD cloud designing program Autodesk Fusion 360, was a collaborative mandible implant design created by two students of mechanical-medical engineering at Gdańsk University of Technology, working

online with a student of dentistry from the Medical University of Gdańsk. As a result, they not only prepared the design and material selection, but also produced a prototype based on an individual computer tomography examination of a real patient after bone resection, and a reconstruction with the usage of CAD programs and 3D printing (Halman & Etmańska, 2017).

Based on this case study, a structural outline consisting of the following steps was prepared for future use:

- diagnosis,
- X-ray and/or Multidetector Computed Tomography (MDCT),
- MDCT evaluation,
- sharing the results on Moodle,
- consultations between physicians in different medical centers,
- more medical tests, if needed,
- final diagnosis,
- planning the surgical treatment based on MDCT,
- consultations between physicians and engineers during the process of CAD designing,
- 3D printing or milling of a prototype,
- evaluation,
- 3D printing or milling of surgical template,
- 3D printing or milling custom implant,
- surgical template and custom implant sterilization,
- surgical procedure,
- postoperative control using MDCT or Magnetic Resonance Imaging (MRI).

For the purpose of visual presentation of the collaboration process, a simplified flow chart (Figure 1) was created as an additional resource, which can be used as an simplified instruction and an explanation of the recommended cooperation contrivance for future collaborative implant designing projects.

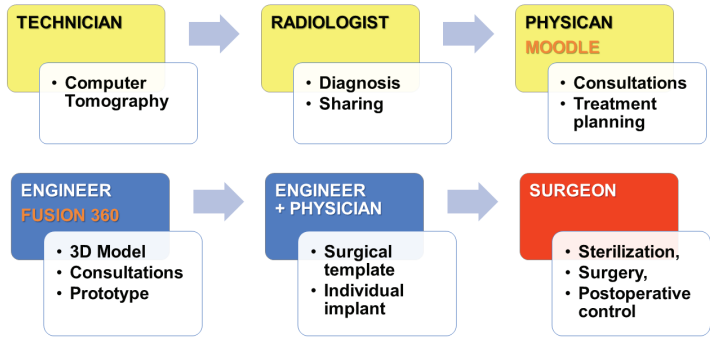

Figure 1. Engineer-Physician collaborative e-designing contrivance.

Thanks to the new technology, all the collaborative designing process was conducted strictly online (Grabowska et al., 2016).

By the end of the project, there were over 500 registered users working in 124 Learning Rooms. These users were from Austria, Belgium, Brazil, Bulgaria, Croatia, France, Germany, Greece, Hungary, Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Spain, Sweden, and the UK.

Although the SP4CE project is officially finished, many Learning Rooms are still being used and more are being created after the acceptance of the final report by the European Union Commission, which is the evidence of the project's sustainability.

Interdisciplinary PhD Dissertation – on Moodle?

Collaboration appears to be complicated even for colleagues specializing in different aspects of the same profession. An ongoing interdepartmental PhD research project can be given as an example. The subject matter, connected with heat transfer, 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 Gdańsk University of Technology, Faculty of Mechanical Engineering. Because of some prosaic inconveniences, the work had been going slowly, mostly because of the lack of proper information exchange.

The main problem was an inconsistent application of communication tools. Email exchanges were mixed with phone calls which were usually impossible to record and hard to remember. Moreover, teachers from both departments used to contact only the PhD student and ask what the other scientists had decided or hurried them up without talking to each other. Meetings at the university were repeatedly postponed because of poor time management or conflicting schedules. It all resulted in almost a year of planning without undertaking any action.

After the great success of many interdisciplinary engineer-physician projects carried out as a part of the SP4CE program and a Moodle-conducted master's thesis, it was decided to continue PhD research and consultations on Moodle. Once the research had moved to a Moodle working area (Figure 2), communication rapidly improved, which resulted in a better understanding of the subject and, therefore, an increase in research efficiency.

However, after a few weeks, work slowed down again. The main PhD supervisor took the position of an observer and, therefore, left others confused about who was taking on the leadership position. It is a cultural custom that in some countries, university social status makes interpersonal relations more distanced. In other words, if a student took control over the project and started issuing commands, it could be considered rude. As long as it is done in a polite way, with respect and

clear explanation, it is acceptable to have one rule bent or even broken for the purpose of general improvement.

In this case, it was the PhD student who had to take over and put some pressure on other team members, otherwise, the research and experiment would have gotten stuck at a dead end due to procrastination.

It also turned out that some of the university teachers, mostly elderly ones, would never admit that they did not feel comfortable enough in the online col-

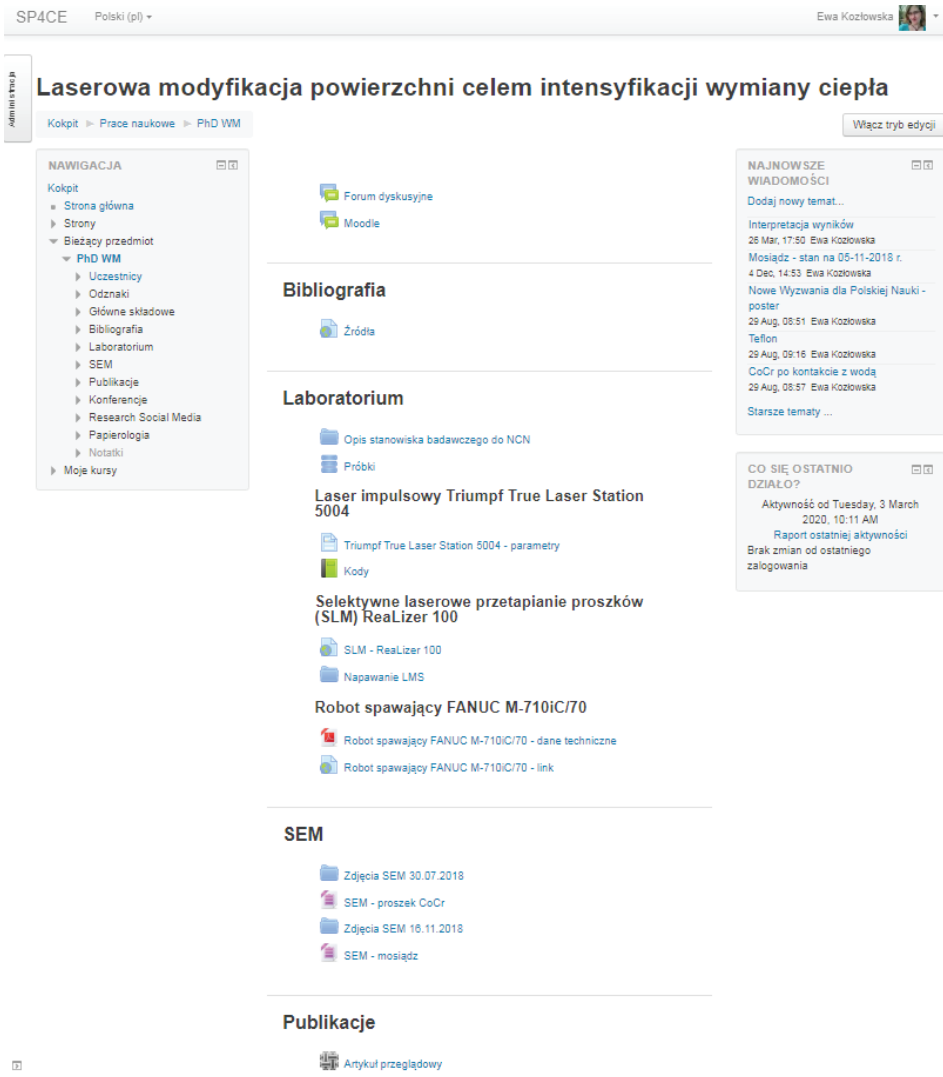

Figure 2. Moodle working area created to carry out a PhD research (in Polish)

laboration environment. Although their lack of some basic digital skills excluded them from proper participation in the project, it was too embarrassing for them to ask for help. It could have been the differences between the former and modern deportment that adversely affected the integral endeavor.

The solution was to implement personalized training for teachers, which was carried out in a way that their authority remained intact. Human habits, attitude, abilities, and willingness should always be taken into consideration as an important factor determining the success or failure of a proposed solution.

Conclusions

Constant communication between professionals specialized in different disciplines has a positive effect on the whole designing process. Interdisciplinary cooperation between all the multidisciplinary team members reveals the possibilities and limitations of each medical and technical solution from both points of view. It makes the results more credible. Jointly developed solutions are more sustainable and much safer. Using the right e-collaboration tool makes interdisciplinary work faster, safer, and more efficient.

Transferring the collaboration contrivance to the universities' Moodle platforms causes many concerns over some formal obstacles such as scientists, project participants and researchers from outside the university logging into the university platform. Gdańsk University of Technology has its own Moodle platform – eNauczanie (https://enauczanie.pg.edu.pl/moodle/), which is integrated with the general university portal MojaPG (https://moja.pg.edu.pl/). The system allows people from outside of the university to access the Moodle platform after going through a registration and verification process.

LMS Moodle supports online collaboration in multiple ways. The variety of available tools allows for many adaptations of the working area to meet the needs of different projects in diverse disciplines. Working online with Moodle saves time, money and saves participants from unnecessary frustration.

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Ewa Kozłowska

Moodle jako rozwiązanie problemów interdyscyplinarnej e-współpracy

S t r e s z c z e n i e

Szybki rozwój technologiczny w ostatnich latach przyczynił się do licznych zmian w rozmaitych dziedzinach życia, w tym w edukacji i komunikacji. Nawiązanie współpracy interdyscyplinarnej przynosi wiele korzyści, jednak często wiąże się z różnymi problemami i niedogodnościami, a także potrzebą ciągłego doskonalenia, uczenia się przez całe życie, rozwoju zawodowego (CPD) i znalezienia skutecznego sposobu przekazywania informacji. Życie w ciągłym pośpiechu sprawia, że czas staje się kluczowym aspektem, ponieważ coraz więcej operacji jest wykonywanych prawie wyłącznie przy użyciu różnorodnych narzędzi online. Mimo że w wielu przypadkach współpraca bywa skomplikowana nawet dla osób specjalizujących się w różnych aspektach tego samego zawodu, nawiązanie współpracy między konkretnymi grupami interdyscyplinarnych specjalistów, takimi jak inżynierowie i lekarze, ma znaczący wpływ na nowoczesną diagnostykę i rozwój leczenia. Na podstawie wybranych studiów przypadków zbadanych na Politechnice Gdańskiej i Gdańskim Uniwersytecie Medycznym, popartych przeglądem dostępnych e-narzędzi wspierających edukację i współpracę, zaproponowano rozwiązanie oparte na platformie LMS Moodle, które następnie wdrożono i przeanalizowano.

S ł o w a k l u c z o w e: Moodle, współpraca interdyscyplinarna, e-współpraca, inżynieria medyczna

Using Moodle as a Solution to Interdisciplinary E-collaboration Issues

Ewa Kozłowska

Moodle – решением проблем междисциплинарного электронного сотрудничества

Аннотация

Быстрое технологическое развитие в последние годы способствовало многочисленным изменениям в различных сферах жизни, включая образование и комуникацию. Установление междисциплинарного сотрудничества приносит много преимуществ, но часто связано с различными проблемами и неудобствами, а также с необходимостью постоянного совершенствования, обучения в течении всей жизни, профессионального развития (НПР) и поиска эффективных способов передачи информации. Жизнь в постоянной спешке делает время важным аспектом, поскольку все больше и больше операций выполняется почти исключительно с использованием различных онлайн-инструментов. Несмотря на то, что во многих случаях сотрудничество иногда затруднено даже для людей, специализирующихся в разных аспектах одной и той же профессии, установление сотрудничества между определенными группами междисциплинарных специалистов, такими как инженеры и врачи, оказывает значительное влияние на развитие современной диагностики и лечения. На основе избранных тематических исследований, изученных в Гданьском технологическом университете и Гданьском медицинском университете, а также на основе обзора доступных электронных инструментов, поддерживающих образование и сотрудничество, было предложено решение на базе платформы LMS Moodle, которое затем было реализовано и проанализировано.

Ключевые слова: Moodle, междисциплинарное сотрудничество, электронное сотрудничество, медицинская инженерия

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Usando Moodle como solución de e-colaboración de materias interdisciplinarias

Resumen

El rápido desarrollo tecnológico de los últimos años ha contribuido a numerosos cambios en muchas áreas de la vida, incluidas la educación y la comunicación. Establecer una colaboración interdisciplinaria trae muchos beneficios, sin embargo, a menudo se asocia con numerosos problemas e inconvenientes, así como con la necesidad de mejora constante, aprendizaje permanente, desarrollo profesional (DPC) y encontrar una forma efectiva de transferencia de información. Vivir con prisa constante hace que el orden lógico de la transferencia de información se convierta en un aspecto clave, ya que cada vez se realizan más operaciones de forma caótica utilizando múltiples herramientas en línea. Aunque la colaboración resulta complicada incluso para los colegas que se especializan en diferentes aspectos de la misma profesión, el establecimiento de la cooperación entre grupos específicos de especialistas interdisciplinarios, como ingenieros y médicos, tiene un impacto

significativo en el diagnóstico moderno y el desarrollo de tratamientos médicos. Sobre la base de algunos estudios de casos seleccionados investigados en la Universidad Tecnológica de Gdańsk y la Universidad Médica de Gdańsk, respaldados por una descripción general de las herramientas de educación y colaboración disponibles, se ha propuesto, implementado y analizado una solución basada en la plataforma Moodle LMS.

P a l a b r a s c l a v e: Moodle, colaboración interdisciplinaria, e-colaboración, medicina