



# Developing Teaching Competencies for Implementing Blended Learning in Higher Education: Experiences of Faculty of Science, University of Kragujevac

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**Abstract:** *One of the invariants for the education through the time is the effort for improvement and changes caused by different cultural, economic, and overall civilization circumstances. Nowadays, the huge impact of digital technology on educational systems and everyday practice is evident. The didactic theory still seeks guidelines for adequate use of new information communication technology. Higher education in Serbia also is a part of this process, as activities of ERASMUS+ project TeComp (Strengthening Teaching Competencies in Higher Education in Natural and Mathematical Sciences, 598434-EPP-1-2018-1-RS-EPPKA2-CBHE-JP) testified. In this paper, we present some outcomes and experiences collected during the project with an aim to disseminate results and to contribute broad discussion in the HE community. We give a quick overview of teachers' attitudes about ICT in their teaching practice as well as some important information and conclusions conducted from evaluations of trainings the most visited by teachers from the Faculty of Science, Kragujevac, concerning aspects of incorporating blended learning in HE in fields of natural sciences, mathematics, computer science, and informatics as a way for strengthening teacher competences.*

**Keywords:** *teaching competencies; blended learning; higher education*

## 1. INTRODUCTION

The educational theory and practice have been constantly evolving since the establishment of the first school. Those transformations have been rapidly accelerated in the last several decades, becoming more demanding in the process. This has primarily been caused by the changes in the living conditions of entire societies, in fact, the whole of humanity, setting new educational goals and outcomes. Furthermore, dramatic circumstances connected with the COVID 19 pandemic have shown how important the flexibility of one of the vital systems in any society is, the system which determines the very fate of the society's future – the educational system. All this has additionally motivated but also forced, teachers around the world to integrate technology in their instruction regardless of how willing they were to take such a turn, or how prepared they were to implement new strategies (1).

One of the dominant features of the modern age is the omnipresent influx of technology into our lives (both on the individual level and the level of the entire society), as well as the exponential increase of the available information. This also affects the change in instruction and teaching methods, so that

the education results in what could in brief be called the key competencies of a 21st-century individual. Some of these are for instance problem-solving competence, "learning to learn" competence, and social competence. A question arises about how to accomplish this. One of the answers which the contemporary pedagogic and didactic theory states is the use of teaching strategies that will support active learning, which will put the student into a position of the key participant in the process and the key agent in activities, while the teacher is more likely to play the role of the organizer and coordinator of the learning process. At the same time, it is recommended that the instruction suits the current moment, the environment in which students live today, and their habits, so it is recommended that there is a purposeful and adequate introduction of the technology into education. Actually, what is intended is to find a way to maximize the use of the good sides of face-to-face traditional teaching combined with the new potentials of providing information and cooperation by using modern technologies, or more precisely to form a synergy between traditional and online classes. Briefly put, it is an idea from which a new model of education has emerged, a new strategy of

teaching and learning, the so-called *blended learning*.

Following modern trends and the increasing influence of technology in everyday life, especially in the last decade, higher education in Serbia introduced and planned the accelerated development of appropriate models of mixed learning, which primarily related to the introduction of information and communication technologies in the educational process. Thus, one of the main goals of the ERASMUS+ project TeComp (Strengthening Teaching Competencies in Higher Education in Natural and Mathematical Sciences, 598434-EPP-1-2018-1-RS-EPPKA2-CBHE-JP) is the improvement of teacher competencies by introducing innovations in teaching supported by modern digital resources and ICT tools. This goal was imposed primarily because the general observation was that there is a great potential for ICT in education, even in higher education, but there is a lack of clear guidelines and a systematic approach in the application, which in the previous period was more often the exception than the rule. However, something that was planned as a gradual introduction, due to the pandemic, has become a necessity in the past two years. This dramatic turn certainly required a quick adjustment and from the initial coping, it is now taking on formal outlines. The work on the TeComp project, which began in 2019 with an analysis of the current state and good practices of universities from the EU, faster than planned, during the pandemic focused on the application of what was seen and the design of training for the improvement of teaching practice, while learning was immediately put into practice and tested.

In this paper, we will present the experiences of the Faculty of Science in introducing and fostering blended learning technology implementation, which resulted from the TeComp project activities. Major conclusions derived from results and evaluations of conducted activities will be presented along with the direction of future activities.

## 2. BLENDED LEARNING

Blended learning is a teaching model that relies on the strategies and systematic approach of combining time and types of learning, so that the best aspects of traditional face-to-face teaching, i.e., the teaching in a real classroom, and online interactive teaching, using suitable digital and communication technologies, are combined (1).

The genealogy of blended learning can be found in distance learning through correspondence courses. For example, the children of lighthouse keepers in Canada were educated in this way as early as 1919 (2). The objective of overcoming the spatial distance remains one of the major motives for the use of blended learning. An additional incentive for the development of such a type of teaching

happened at the end of the previous century when the availability of personal computers and the emergence of the Internet and social networks made the development of new teaching models and learning at the various educational levels possible. The new technology had the potential not only to cross the space but also to cross the time (by recording) and to individualize learning (students have the control to choose their path through the curriculum and to choose their learning pace).

Most broadly understood, and most probably the most profound and useful interpretation of blended learning is the one where it needs to include a combination of various teaching theories in educational practice in a way that most adequately suits the given situation. Essentially, this approach involves the blending (combining) of:

- face-to-face learning activities with online activities and formats,
- traditional teaching schedule with some other types, such as working at weekends, intensive work, supplementary work,
- conventional technologies, such as note-taking, combined with social networks and modern technologies,
- simulations, group activities, learning by using sites, practical exercises.

What needs to be kept in mind is that learning theories are not like a religion, one does not exclude the other, and the aim is to have a proper theory for a proper situation (3). The choice in a specific situation depends on the characteristics of the students, educational field, and concrete teaching content, as well as the nature of the knowledge and skills that the students need to acquire and the context in which these are meant to be applied.

Five key factors can be distinguished as the important elements of the contemporary implementation of blended learning (4):

1. live events, which are synchronous learning events headed by the teacher, where the students participate synchronously in a real or virtual classroom;
2. self-paced learning, i.e., learning where the student is autonomous, learning at his or her own pace at the time which is the most suitable for him or her;
3. cooperation, students communicate among themselves in an appropriate format and environment, e.g. by email, as a part of a forum or on social networks;
4. grading/assessment, the evaluation of students' knowledge, which can precede the live events and self-paced learning, so in these instances they aim at reinforcing the previous knowledge on which the new knowledge builds, while subsequent instances of testing the knowledge are obligatory in order to determine

the accomplished level of knowledge and measure the achieved knowledge transfer;

5. performance support materials, which can be diverse: printed, electronic, linear, non-linear, interactive, or not.

In [5] authors performed thorough analyses of different designs of blended learning applied to higher education courses. Here we will give final conclusions in brief. Authors emphasized that there is no generally accepted definition of the model, so different course designs, resulting from various blended learning concept interpretations, were developed by the teachers.

The main challenge for numerous teachers who have only started to adopt the idea of blended learning is the appropriate choice of the course designing approach. Investigating different processes of designing blended learning courses, the authors distinguished three different design approaches (5):

- 1) low-impact of blended learning, which includes adding supplementary activities to the existing course,
- 2) medium-impact of blended learning, which includes substituting activities in the existing course,
- 3) high-impact of blended learning, which assumes building the course from scratch based on the strategy which relies on the blended learning model.

The classification of these approaches has been made in accordance with the potential changes in the existing curriculums and students' learning experiences.

The authors summarized factors influencing the choice of approach in the course design in the following way (5):

1. Low-impact blend
  - Teacher has no experience in designing and developing for blended learning.
  - Teacher has no prior experience in teaching the traditional course.
  - Teacher has some knowledge in integrating technology.
  - Teacher has no confidence in integrating technology.
  - No institutional support is provided.
2. Medium-impact blend
  - Teacher has designed and developed a blended learning course.
  - Teacher has thought the traditional course.
  - Teacher has good knowledge in integrating technology.
  - Teacher has some confidence in integrating technology.
  - Institutional support is provided.
3. High-impact blend

- Teacher has several years of experience in designing and developing for blended learning.
- Teacher has made several iterations of teaching the traditional course.
- Teacher has strong knowledge in integrating technology.
- Teacher has high confidence in integrating technology.
- High institutional support is provided.

It can be concluded that implementing blended learning demands multiple competencies and experienced teachers, where ICT competencies play a very important role.

### **3. BUILDING COMPETENCIES FOR SUCCESSFUL BLENDED LEARNING IMPLEMENTATION**

Due to constant technological, scientific, and social development, knowledge and skills that should be acquainted through institutional and informal education, as well as the technology of their delivery are constantly adapting and changing. Consequently, universities must follow trends and demands and must support the continuous development of teaching competencies of their staff. Support for continuous education and development of teaching skills should be well planned and efficient. If an institution plan to promote and implement, or broaden the implementation of some educational technology, such as blended learning methodology, to teaching practice in a systematic way, it must be aware of the current teaching practices of its staff, their attitudes, skills, capabilities, and their preparedness for new practices. Preparing supporting materials, training, workshops, and similar, for educating educators must be planned accordingly. Delivery methods must be suitable and effective. One of the key factors influencing the success rate of blended learning implementation are teaching and educational technology competencies of teachers. Teacher training courses are indispensable and very important part of such support. Such courses must be designed to help teachers reach the necessary skill level in an efficient way and be conducted in a way that they can fit into tight university teacher schedules, also. Fulfilling those demands is not a trivial task, so finding, studying, and applying good practices from referent institutions with rich experience in the field can reduce development and experimentation during training design.

In this section we will present experiences of the Faculty of Science in introducing and fostering blended learning technology implementation, which resulted from the TeComp project activities. In the first phase of the project, in early 2019., an analysis of current teaching practices and teacher competencies was conducted. Results and

conclusions were used for defining plans for collecting good practices in teachers' training courses. During the period from late 2019 until early 2022, the Faculty of Science project team members, along with colleges from other partner universities, attended 11 trainings related to contemporary pedagogical approaches, methodologies, and educational technologies. Nine of them were conducted by teachers from European universities (University of Gent, University of Oviedo, University of Granada, University of Ostrava, University of Metej Bel in Banska Bistrica), experienced in teaching methodologies and contemporary teaching practices.

To present the successful concept of training aiming at leveraging teaching skills in the usage of educational technologies, we will describe, in brief, a professional development course in "Educational interaction and communication" held by the University of Gent, highly rated for its usefulness and organization by all participants.

Due to Covid pandemics, the course in "Educational interaction and communication" was held in an online form. The course was designed as a hands-on course where participants were challenged to implement contemporary information and communication technologies to create various teaching materials. The themes covered during the course (Knowledge clips, Video feedback, Posters, Discussion and collaboration in higher education, Animations as an interaction and communication strategy, and Asking questions) were based on approaches commonly found in higher education and applicable in all knowledge domains. The course run in six cycles of two weeks. One cycle per theme and one task for each theme. Participants received materials and information about theories and research that supported design guidelines for completing each task.

Participants were working in small groups (usually three members). Each task elaboration of each participant was the subject of peer review of group members on the base of a feedback cycle, meaning that the participant gives feedback on the feedback received. Upon course completion, participants evaluated course organization, and usefulness and gave their own impressions, by filling out a survey.

Experiences collected from described and all other trainings resulted in developing training material (1,6) and conducting the professional seminar "University Teaching - Can It Be More Efficient?", designed for a broader audience of teachers and young teaching associates employed at the Faculty of Science. The aim of the seminar was to present practices in blended learning implementation on higher education courses, along with supporting software tools, to raise teachers' awareness of blended learning possibilities and to motivate them to familiarize themselves with the available tools.

The seminar was conducted over a period of four weeks, where each week assumed one term for a meeting. The first meeting was dedicated to presenting and informing participants on methods and tools of interest. Since participants had expertise in different knowledge domains (physics, mathematics, biology, chemistry, computer science) and different teaching and learning context to fit in accordingly, presentations were divided into two parts:

1. Common themes session covering the following themes: Blended learning - potential for applications in higher education, Flipped classroom - how and why?, Visualization in teaching and its effects - presentation of empirical data, Tools for creating educational video content, Interactive video - a way to increase students' motivation and attention.
2. Parallel sessions dedicated to teaching methods and educational technologies practices in different scientific fields of education. Each section covered several themes. Section for biology and ecology covered: Application of selected IT tools and web resources in teaching biology, The use of an EPSON camera as a tool for improving the teaching of botany. Section for physics and chemistry covered: Remote - online laboratories in teaching, Application of virtual laboratories in the teaching of chemistry, Vision of the use of experiments in physics teaching in 2050. Section for mathematics and informatics covered: Possibilities of applying the dynamic software GeoGebra in teaching in higher education, Improving teaching using Wolfram Mathematica software.

Since it was the first seminar concerning new educational technologies from the period before Covid pandemics and teaching practice during pandemics changed point of view and tackled teachers' awareness of ICT usage and distant learning practices, one section of the seminar was dedicated to discussion about the benefits and issues of distant education during pandemics. Its aim was to enable the exchange of experiences and attitudes, estimation of willingness for adapting teaching practices to new contexts, and demands, recognition of limitations and possibilities for the adoption.

At the end of the first term of the seminar, participants were encouraged to transfer some of the presented practices to their actual course setting. Support for this task was provided within two terms for discussion meetings. The fourth and final term was dedicated to presentations and discussion on materials participants delivered as final. All meetings were held online. Upon completion, participants were asked to give feedback on seminar content, organization, and usefulness and to consider their interest in further activities aimed toward building their own teaching competencies and improvement of teaching practice.

#### 4. RESULTS AND ANALYSIS OF ACTIVITIES

Before any concrete activity aiming at building teaching competencies, we have conducted screening of teaching practices and self-evaluation of teaching competencies among the Faculty of Science teaching staff, including teachers and teaching associates (7). 47 lecturers have participated. Lecturers from five areas were present in the sample in the following way: mathematics - 8, computer science - 4, physics - 10, chemistry - 13, and biology - 11. The average number of years of teaching experience is 15.69 years (the standard deviation is 11.33 years). 42,55% were younger lecturers (up to 12 years of experience) and 57,45% were older lecturers (more than 12 years of teaching experience). The shortest teaching experience in the sample is 1 year, while the longest teaching experience is 40 years.

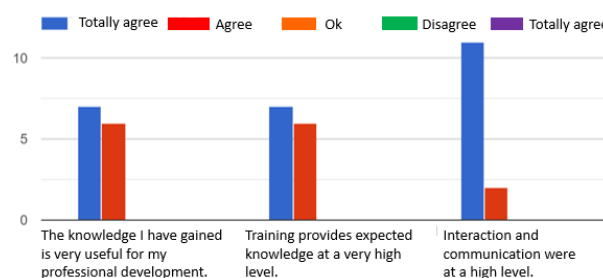
Previous education on courses concerning teaching methodologies and educational tools differed between younger and older lecturers. 31,82% of younger lecturers and 8% of older lecturers did have some courses concerning electronic educational technologies, while 59,09% of younger and 68% of older lecturers attended teaching methodology courses during their education.

Work at the university allows for a significant individual distribution of time. For these reasons, teachers/associates filled out how many hours of work were active during the week and how it was arranged. Average respondents said they spend 43.72 hours of work on different activities (with a standard deviation of 17.45). Participants estimated time spent on teaching activities, preparations, and communication with students against the total working hours participants, which resulted in a relative average of 35%.

Participants did a self-estimation of the quality of teaching and gave opinions on the importance of using modern educational technologies by answering a series of questions. Here, we will only the most interesting findings. Teachers' responses indicated that they have a positive attitude towards the use of ICT in teaching. They are open for improving their ICT skills (the average for p4 is the highest, 3.844), and at the same time, they consider ICT to be very important for the quality of teaching (the average for question p1 is 3.787). The same stands both for younger and older teachers. Among all available software packages usable in the context of teaching and creating teaching materials, teachers have the lowest confidence in their skills related to web conference, video editing, and LMS systems (the average mark was below 3 on a scale from 1 to 5), which indicated that there is a significant space for improvement. More than 90% of teachers noticed the benefits of using ICT in teaching and learning while increasing student interest in the subject matter was

considered the most important advantage (70.21%). As the most important barrier to applying modern teaching technologies 46.81% of teachers stated a lack of teacher competencies, while 34.04% stated a lack of time, which highly relates to competencies and inability to improve skills in a short time.

The course held by the University of Gent was attended and finished by 14 staff members from the Faculty of Science (3 professors and 11 assistants), 1 biologist, 2 physicists, 2 computer science researchers, and 9 mathematicians. 13 of them participated in a survey on course quality and their own previous competences. 84,6% of participants stated that they did not previously attend any training on the improvement of teacher competencies. The course was highly rated with an average mark of 4,85, on a scale from 1 to 5. 69,2% stated declared as very satisfied with the training organization and structure. 30,8% said that they plan to participate in similar training in the future, while 69,2% stated that they will probably participate. Participants' attitudes on fulfilling expectations, the usability of course, and quality of communication during the course are summarized in Figure 1.



**Figure 1.** Attitudes on University of Gent course quality and applicability

Overall impressions were highly affirmative. Participants were willing to write a comment, such as "The impressions are phenomenal, the tasks were creative and purposeful. I will try to include as many learned things as possible in my future pedagogical work" and "I think that the training is extremely useful having in mind the current situation of teaching because it provides an opportunity to immediately adopt the acquired knowledge and skills in the teaching process".

A professional seminar held for the Faculty of Science staff was promoted and offered to all staff members included in teaching as an elective activity. Among 121 teachers and associates who did not attend courses held by foreign universities within TeComp activities, 23 participated in all seminar activities and gave their feedback. This means that 20,66% of all staff members were interested and willing to participate actively. 60,9% of participants did not previously attend any training on methods of teaching university courses. The course was rated with an average mark of

4,47, on a scale from 1 to 5. 73,9% said that they plan to participate in similar training in the future, while 21,7% stated that they will probably participate. Overall impressions were positive. Some of them gave suggestions for future seminars concerning its structure, like "to organize more seminars with a smaller number of topics (lecturers), to show/try some ICT tools in more detail", frequency, like "I would like the realization of such training to be more frequent, perhaps to organize a similar meeting every two or three years" or significance of new teaching methods acceptance by a broader audience, like "I think that the entire training is very useful and that as many teachers as possible should join". Additionally, some of the participants have implemented some of the presented practices and used demonstrated tools in their courses immediately after training completion, which presents real proof of training concept value.

## 5. CONCLUSION

In this paper we presented experiences in planning and conducting activities aiming to strengthen university teachers' competencies for implementing blended learning methodology in their teaching practice. The aim of the conducted trainings was to achieve compatible compositions of traditional and ICT-supported teaching technics to gain an efficient and effective learning process. Presented activities were organized within TeComp project. Analysis of training results and surveys shows that there is a positive attitude and willingness of teachers to introduce new methods and teaching practices, which is a prerequisite for anything further. The first trainings were successfully implemented, but surveys and discussions revealed a need for more systematic support for teachers through organizing activities and trainings on a more regular basis. Therefore, a further step would be defining a strategy for continuous development of teaching competencies that will ensure constant improvement and sustainability of achieved results.

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