

The Role of Blended Learning in Preparing Digitally Competent Educators

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Abstract. *This article explores the integration of blended learning models in the education of future teachers within higher pedagogical institutions. Given the rapid advancement of information and communication technologies, modernizing teaching approaches is essential to enhance professional competencies and independent learning skills among students. The study reviews key blended learning models, including Rotation, Flex, A La Carte, and Enriched Virtual, highlighting their practical applications and benefits in fostering student motivation, engagement, and academic success. Challenges in implementation, such as the effective use of Learning Management Systems and the incorporation of collaborative elements, are also discussed. The findings underscore the significant role of blended learning in preparing educators capable of utilizing digital technologies and innovative instructional methods to meet the demands of contemporary education and the labor market.*

Key words: *blended learning, information and communication technologies (ICT), pedagogical innovations, professional competencies, digital education, Rotation Model, Flipped Classroom, Flex Model, A La Carte Model, educational technology, Learning Management System (LMS).*

INTRODUCTION

The rapid development of information and communication technologies (ICT), as well as the innovative progress of the education system, necessitate the modernization of the educational process in higher pedagogical institutions. In particular, it is of great importance for future computer science teachers to deeply explore and master new technologies and integrate them into the teaching process. In the context of constantly evolving digital technologies, falling behind may negatively affect the efficiency of future pedagogical activity. Therefore, educating students in mathematics and computer science based on modern educational technologies, developing their professional competencies, and enhancing their ability to work independently are among the urgent tasks of today.

METHODS

Various teaching technologies are being implemented in the educational process to develop students' professional competencies. One of the most effective among them is blended learning technology. Blended learning is an instructional model that combines traditional face-to-face teaching with online learning, allowing students to choose the pace, time, place, and method of learning that suits their individual needs.

The Clayton Christensen Institute has conducted over a decade of research on blended learning, identifying more than 40 instructional models. Based on the work of M.B. Horn and other researchers, the following key models of blended learning are widely recognized:

1. Rotation Model, which includes: Station Rotation; Lab Rotation; Individual Rotation; Flipped Classroom.
2. Flex Model
3. A La Carte Model
4. Enriched Virtual Model

1. Rotation Model

The Rotation Model refers to a course or subject in which students rotate between different learning modalities, one of which must be online learning. The rotation can occur according to a fixed schedule or at the teacher's discretion. Other modalities may include face-to-face instruction in small groups or whole-class settings, group projects, or individual learning tasks. Students primarily study at the educational institution and complete assignments at home.

1.1. Station Rotation

The Station Rotation model involves students rotating between online and traditional (offline) learning stations in a sequential manner. In this model, the teacher works with small groups of students individually, while the rest continue their learning independently at other stations, at their own pace and direction. One of the stations is an online learning station where students complete tasks using computers or tablets.

Dividing students into groups based on stations allows the formation of smaller learning communities within a large classroom. As a result, this facilitates more effective classroom management, strengthens individualized instruction, enables the adaptation of learning models, and provides differentiated support. It also helps in gradually deepening theoretical knowledge and applying it in practice with increasing complexity.

The most commonly used format of Station Rotation involves dividing students into three groups based on the type of learning activity. Each group works in a specific area (station) of the classroom:

- ✓ Teacher-led instruction station
- ✓ Online learning station
- ✓ Project-based work station

During the lesson, the groups rotate among the stations so that each group engages in every type of activity. The composition of the groups may change from lesson to lesson depending on pedagogical objectives.

Using the Station Rotation model can address several pedagogical challenges, including:

- Increasing student motivation
- Improving learning outcomes
- Supporting struggling learners
- Developing high-achieving students (e.g., preparing for academic competitions and expanding subject-specific knowledge)
- Students can be grouped according to various criteria, such as:
 - Preparedness for the lesson determined by a diagnostic quiz or pre-class online survey
 - Performance on homework or prior tests
 - Identified gaps in understanding of previous topics
 - Interest in the lesson topic (measured through surveys)

1.2. Lab Rotation

The Lab Rotation model is a form of instruction based on the rotation model, in which students rotate between different locations within an educational institution according to a predetermined schedule or at the discretion of the instructor, all within the context of a specific course or subject.

At least one of these locations is a computer lab designed for online learning, while the remaining settings may include traditional classroom instruction, group work, or other forms of learning activities.

The Lab Rotation model differs from the Station Rotation model in that students do not remain in a single classroom. Instead, they move between multiple spaces across the campus.

This model can be implemented either for a single subject or simultaneously across multiple subjects. To enable this, the schedules of different groups and their access to the computer lab must be coordinated. Multiple teachers can organize their instruction using the Lab Rotation model in parallel by:

Designing or selecting online learning materials,

Creating a unified digital learning space,

Reaching an agreement with school administrators to conduct every third or fourth lesson for their subject in the computer lab.

For example, if two teachers who each teach a group with seven weekly lessons agree, they could allocate two of those lessons to be held in the computer lab. These sessions may take place on different days and focus on increasing learning effectiveness. Each lesson would include student access to a topic-specific learning guide. One of the teachers may accompany the group during these sessions to provide support.

The Lab Rotation model can also be implemented within a single subject where students use the computer lab once a week to deepen or reinforce their knowledge. The key distinction between this model and Station Rotation is that students in Lab Rotation engage with digital tools only once a week.

The Lab Rotation model helps address several pedagogical objectives, such as: increasing student motivation, enhancing learning outcomes, supporting students with lower academic performance, developing high-performing students (e.g., through preparation for academic competitions and broadening subject knowledge).

In the computer lab, students may engage in various types of activities, such as: quick diagnostic assessments, quizzes and independent tasks, reviewing previously covered material (through videos, quizzes, or interactive exercises), practicing skills (via interactive tasks), learning new content (using videos or short assessments with interactive exercises), preparing for academic competitions.

1.3. Individual Rotation Model

The Individual Rotation model is a type of blended learning in which students rotate between different learning modalities—at least one of which must be online—according to a fixed schedule set by the teacher or a software system.

The main distinction between this model and other rotation models is that students are not required to rotate through all available stations or learning methods. Instead, their learning path is personalized and aligned with their individual academic needs and learning plans. Each student's schedule is adapted daily based on previous learning outcomes, often informed by data collected from online learning platforms.

This model offers several advantages, including:

- Personalized instruction tailored to individual student needs,
- Increased motivation and self-regulation skills,

- Adaptive learning paths that evolve based on performance,
- Effective integration of educational technologies into instruction.

1.4. Flipped Classroom Model

In the Flipped Classroom model, students engage with learning materials online at home, using internet-connected digital devices. They learn new content or reinforce previously covered material before coming to class. During class sessions, students deepen their understanding and apply knowledge through discussions, workshops, role-plays, project-based learning, and other interactive activities.

This model shifts away from traditional whole-class instruction and instead supports active learning environments where classroom time is used for practice, collaboration, and problem-solving.

While a simplified definition of the flipped classroom is "homework at school and schoolwork at home", in reality, it is a comprehensive instructional strategy that allows teachers to incorporate a wide range of educational technologies and pedagogical techniques.

Flipped Learning is a pedagogical approach in which direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment. In this space, the teacher guides students as they apply concepts and engage creatively with the subject matter.

The flipped classroom is considered one of the easiest blended learning models to implement. However, it may not always meet high-quality standards of blended learning, particularly if teachers are not fully prepared to facilitate interactive, hands-on group activities during class time.

Key benefits of the flipped classroom model include:

- Allowing teachers to focus on interactive learning activities during class,
- Eliminating the need for whole-class direct instruction of new content,
- Enabling lesson planning based on students' prior preparation, particularly when integrated with Learning Management Systems (LMS).

2. Flex Model

The Flex model of blended learning is implemented depending on the physical layout and infrastructure of the educational institution. Typically, there is a central, large learning space equipped with individual student workstations or mini-offices. Each student has access to a computer or tablet and engages in learning primarily through an online platform.

Within this central space, there are multiple small-group collaboration areas for discussions and brainstorming sessions, scientific laboratories for hands-on activities, and social zones furnished with couches and chairs where students can continue studying in a more relaxed environment. The core principle of the Flex model is that students are free to move around and form groups according to their academic needs and preferences.

Unlike the Rotation models, where students follow a fixed schedule of moving between different learning modalities, the Flex model allows students to determine the amount of time they spend on each learning activity. Each learner follows a flexible and adaptive schedule, which can change based on their progress and individual learning requirements.

This model is considered to be one of the most challenging to implement, but also one of the most promising in terms of educational outcomes. It demands that students develop strong self-regulation and self-management skills, which is why the Flex model is most commonly applied at the higher education level, where learners are expected to take greater responsibility for their own learning.

3. A La Carte Model

The A La Carte model (formerly known as the Self-Blend model) is a blended learning approach in which students choose to take one or more courses entirely online, while continuing to take other

courses in a traditional face-to-face setting with a teacher. This allows learners to combine the experiences of in-person and online education according to their interests and academic goals.

In this model, students have the flexibility to supplement their conventional learning with additional online coursework, often outside regular school hours or institutional settings. The A La Carte model is particularly common in higher education and extracurricular learning environments, where students seek to expand their knowledge beyond the standard curriculum.

Key Features and Opportunities of the A La Carte Model:

- Instructor-led components serve as a fundamental part of the learning process.
- Includes additional internet-based training through microlearning formats such as videos, infographics, and interactive e-textbooks.
- Provides online learning opportunities for both academic courses and extracurricular activities.
- Enhances the learning experience by integrating online formats to reinforce key concepts.
- Gives students access to a wide range of online resources for supplementary learning and research.

This model supports personalized learning paths, empowers students to take greater ownership of their education, and bridges the gap between formal and informal learning environments.

4. Enriched Virtual Model

The Enriched Virtual model is an alternative form of online learning that allows students to complete a major portion of their coursework remotely, typically from home or outside the educational institution, while still providing periodic opportunities for face-to-face instruction with a teacher.

Unlike the Flipped Classroom model, which usually requires daily physical attendance, the Enriched Virtual model does not require students to be on campus every day. Instead, programs designed under this model may require students to attend in-person sessions once or twice a week, depending on the instructional design and course requirements.

This model aims to combine the flexibility and personalization of online learning with the benefits of direct teacher support, making it particularly suitable for students who are capable of managing their time effectively and working independently.

These models have been practically tested and implemented in various schools and universities worldwide. Each model aims to increase student engagement, motivation, and independent learning skills.

RESULT AND DISCUSSION

The implementation of blended learning in the educational process yields the following results:

- Students develop independent learning skills.
- Interest and motivation towards learning are enhanced.
- Students' critical thinking, problem-solving, and teamwork skills are significantly improved.
- Teachers gain flexibility in organizing their lessons effectively.
- Educational quality improves through the use of digital resources.

For instance, the Station Rotation model involves dividing students into small groups, enhancing individual attention and classroom management. The Flipped Classroom model enables students to study materials independently at home, using class time for discussions and practical activities. The Lab Rotation model involves utilizing computer labs for scheduled online learning activities, improving access to digital content.

Blended learning has shown higher effectiveness compared to traditional methods. This model not only prepares students to actively use digital tools but also aligns their skills with the demands of the modern labor market. The Chinese scholar Jia Zhang defines blended learning as a descriptive method

used to outline and analyze each learning process, and suggests several learning systems under this approach.

However, certain challenges exist in implementing blended learning models. Teachers unfamiliar with Learning Management Systems (LMS) may face difficulties integrating them effectively. Furthermore, the lack of collaborative or project-based components in some models may limit their pedagogical impact. These issues can be addressed through professional development programs and training in the use of modern educational platforms.

CONCLUSION

Blended learning is becoming an integral part of modern education. It not only equips students with knowledge but also helps them build essential professional competencies. For students majoring in mathematics and computer science, this model offers an effective strategy for both academic success and continuous professional development. When implemented in higher education institutions, it fosters the training of educators who are proficient in digital technologies and capable of applying innovative teaching methods.

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