THE CONE OF EXPERIENCE IN TEACHING MATHEMATICS SYNCHRONOUSLY AND ASYNCHRONOUSLY

Abstract. Teaching online is a new challenge for every single teacher. Mathematics in particular remains the school subject that requires special teaching tools. This article describes Edgar Dale’s «Cone of experience» and Bruner’s learning approaches for synchronous and asynchronous teaching in Mathematics. It also describes the most important tools that can be used for online teaching in a combination of both formats, asynchronous and synchronous. These teaching methods are described not only in terms of digital tools, but also in terms of Jerome Bruner’s theories on information processing.

Keywords: asynchronous, synchronous, blended.

Introduction

Going through a difficult time, having access to a wealth of information on the best methods and techniques of teaching online, it is necessary to find a balance in the teaching process and choose the best strategies in order to achieve the objectives set out in curricula.

Being one of the school subjects that require serious consideration in addressing each topic, Mathematics demands a careful selection of teaching tools so that the basic concepts are understood and practiced by solving different mathematical problems, problems that have more and more points in similarities with real-life problems.

A particular topic in the online teaching-learning-evaluation process is synchronous and asynchronous teaching for all school subjects, both in pre-university and university education. Over the years, there has been some quite discussion about this kind of teaching approach and it has been put into practice in various countries around the world.
This article describes the aspects of synchronous and asynchronous learning in Mathematics not only from the perspective of using platforms for teaching and learning, but also with a view to students’ learning and their information-processing. Through synchronous and asynchronous teaching we understand the entire teaching-learning-evaluation process. Starting from the basic principles of Jerome Bruner’s information-processing methods and applying online tools, we get a clear description of synchronous and asynchronous online learning in Mathematics.

The e-learning process started with the emergence of radio, television and later internet.

Since 2000 many researchers have questioned whether e-learning has the same results as traditional learning, the results have shown that there are no differences. Good results can also be achieved in distance learning by using the blended teaching of e-learning by applying asynchronous and synchronous teaching. Asynchronous and synchronous teaching started using the chat, e-mail, video conferencing and later it led to the development of the Web-2.0, gradually using even social media as an educational resource for teaching-learning-evaluation process.

The first requirements for asynchronous and synchronous teaching appeared among the students who were time-limited because of combining education with family, service and other obligations. However, this led to accepting a more passive learning, but also effective. Classroom teaching is a form of synchronous learning, a classic method of learning.

Learning needs intersect with the ability of each individual to perceive what he or she has learned. The tools we choose to teach synchronously or asynchronously should take into account the subject we select and the individual level of understanding: new concepts or review of what students have learned.

Taking into account that Mathematics in both pre-university and university education shall take into account for both types of online teaching. There are
school subjects that can use more often the asynchronous teaching such as text, books, etc. for History or audio teaching, videos for Music. In Mathematics class or course, teaching concepts using only texts or videos would not help to achieve the proposed objectives.

The general features of asynchronous and synchronous online teaching are the time and space where the activity takes place. Asynchronous teaching can be performed at any time and repeated as often as desired, it is not limited by the space or the devices used - online or offline. For example, the digital materials can be created, viewed and distributed on any kind of digital device; a tutorial can be watched several times, etc.

The synchronous teaching is the delivery that takes place in real time, has a set time and is limited by some time. For instance, a scheduled course or workshop takes as long as planned. Synchronous teaching depends on the speed of the Internet, some technical problems that may arise, the devices available to each student and teacher, modern teaching methods and students’ skills to be open to new information and challenges.

These types of teaching have advantages and disadvantages [1,2].

One advantage of asynchronous teaching is that the learners can organize their learning activity at their own pace. With this teaching approach, the learners have enough time to get informed, to understand and process the information they receive and think more creatively about the problems, to apply the knowledge they gained and develop their imagination as well.

The advantages of synchronous teaching are very much related to human interaction, the question asked by the learner and the immediate answer received from the teacher. Also, the discussions and debates that may occur between students and the educational experience that every person needs are things to consider [3].

The disadvantages of each type of teaching can be seen as the advantages of the other, they are opposite and of course they can be completed by the blend of both formats (fig. 1).
There are online schools in the world that offer both approaches of teaching, but also their combination: Full Sail University, California Southern University Online, University of Illinois in Chicago, etc [4].

As the advantages and disadvantages described above, and taking into account the psychological particularities of a person, the Jerome Bruner’s theories of processing the information (1966) were studied in the context of a successful implementation of asynchronous and synchronous teaching [5,6].

Fig. 1. Advantages, disadvantages in learning synchronous and asynchronous

It is well-known the Edgar Dale’s «Cone of experience» (1968) which systematizes Bruner’s three ways of learning: Active (learning by doing), iconic (learning by observation) and symbolic experience (learning by abstraction) [7,8,9].

Analysing the three methods of information processing, we could describe asynchronous and synchronous online teaching in Mathematics, i.e. the experience that students acquire through synchronous and asynchronous learning in
Mathematics can be organized in Edgar Dale’s «Cone of experience», which brings a new contour of the cone in the experience assimilation in Mathematics.

The three ways of learning can be classified as follows:

1. **Learning through abstractions or Symbolic experience method.**

   The symbolic way of asynchronous teaching that stands out for a symbolic explanation of concepts and expressions, the execution of algorithms and methods of resolution: a geometry problem can be described in words and represented in expressions and notations, an exercise can be described by applying a solving algorithm, etc.

   So we can actually see here the symbolic experience which is based on what we hear, see and the symbolic acquisition of the things that have been studied.

2. **Learning through observation or Iconic experience method.**

   The iconic teaching mode is emphasized during the blended, involves in fact blended learning and teaching, it is based on visual aspect, those images: formulas, mathematical expressions, geometric figures, geometric bodies, etc. necessary to know where they can be applied.

   The Iconic experience method can also be used for doing homework, working individual or group projects, watching tutorials and using knowledge through practice.

3. **Active learning – synchronous learning or Active method**

   The active- synchronous method is learning during the teaching of new concepts. It is the process in which we use actively specific mathematical strategies to develop certain skills and habits, to discover new methods and problem-solving techniques. This is about the exploration-based learning and discovery learning method, the exercise and algorithm method. This type of learning requires the teacher to direct the student’s work.

   In the case of active learning we mention that it is specific to synchronous teaching, it is based on the sound ways, on speaking using mathematical concepts/terms, to formulate definitions and theorems, to demonstrate formulas and theorems, to describe the steps in represent geometric figures, etc.
In order to use the methods described above in online teaching, we can use tools that can be applied to teaching Mathematics.

Some tools that cover all three information-processing methods and asynchronous and synchronous teaching are: LarningApps, Symbolab, IXL, GeoGebra, Matrix, WolframAlpha, Idroo interactive whiteboards, AWboard, etc.

They can also be personalized by the platforms used with the above applications (fig.3):

– Asynchronous teaching: Classroom, Moodle, Microsoft Teams, Simblola, IXL, etc. platforms.
– Synchronous teaching: Hangouts, BigBlueButton, Teams Meet, etc.

Fig. 2. Cone of Experience» of learning synchronous and asynchronous in mathematics

Fig. 3. Web tools for Maths learning and teaching
After applying asynchronous, synchronous and blended teaching methods in Mathematics course a survey was undertaken among students in order to find out what they know about these approaches of teaching. 113 students participated in the survey, which had several questions about asynchronous and synchronous teaching. 63 students knew about these types of teaching, but 50 did not know about such forms. It was requested to select one type of teaching: Asynchronous, synchronous and blended, the results were: 16,8% chose only synchronous teaching 16,8 asynchronous teaching and 66,4 blended teaching (fig.4).

Fig. 4. The diagram of answers about blended, asynchronous and synchronous learning

Thus, we can observe that students demand the blended form of teaching between asynchronous and synchronous.

Students were asked to write the advantages and disadvantages for each form of teaching. The advantages and disadvantages they wrote related to individual needs, to learn and receive that information from the teacher that would meet their individual needs to know and study [10]. Their written ideas fully meet the definitions of these teaching methods. An important question in the survey was also related to the ability of each of them to perceive the information or how they think they can study more easily: visually, auditory or blended. The results are recorded in fig. 5.
The results of the survey were as expected; they are sincere and clear opinions on how students want to be taught Mathematics. Applying the blended method to teaching Mathematics: synchronous and asynchronous teaching, using digital resources appropriate only to Mathematics course, this is the way the proposed objectives can be achieved. However, it remains to be seen if these teaching methods will be effective for a longer term as well.

The above may be generalized or extended to other school subjects, too.

**Conclusion**

The research concluded that blended online teaching is the most accurate form of teaching Mathematics. But Bruner also emphasized the social aspect of learning, which indicated a mutual relationship concept arising from the human need to work together and express their opinions in order to achieve a common objective. Thus, this mutual relationship is an incentive for learning. When people who form a group have the same common purpose, the relationship of mutual collaboration to achieve a result appears; processes that stimulate individual learning occur. This is what we are now aiming to provide effective learning methods so that we can collaborate and pass on the information that any student needs to become a professional.

**Reference:**


