The Spatial and Temporal Properties of eLearning: an Exploratory Study Regarding the Students' Perspective

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ABSTRACT

The paper aims to analyze and comment the current eLearning environments considering the space and time characteristics in order to better understanding of certain antecedents' factors for eLearning system acceptance and effective use by students. The current paper illustrated the eLearning platforms – from the differences between online and traditional face to face learning to the spatial thinking and learning process – using as a case study the minds of students from a technical University of Romania.

Keywords: eLearning, traditional learning, students’ perception, spatial thinking, temporal cognition

1. INTRODUCTION: COGNITIVE FACTORS IN ELEARNING VS. TRADITIONAL LEARNING

Recent days, more and more schools promote or have an alternative in hosting online courses. They have become more and more popular due to the flexibility they have – a student is able to consume the content at his/her paper(s), anytime and anywhere, pause, rewind, take notes and review the material however they choose. However, a good part of the populations stays away from this kind of ‘entertainment’, mostly due to misconceptions or incomplete information/documentation beforehand. Due to this rise of eLearning adoption, traditional courses must come up with new ways to keep its students engaged and active in class. So, the viewers interest is retained for the entire duration of the lecture, for instance. Overall, there are two types of persons – the ones more engaged by physical classes and the ones for whose eLearning factors are a game changer. In the following paragraphs we’ll analyze and compare the two techniques.

Online Learning

This type of learning was initially oriented towards professional consumers i.e. those looking to expand their skills, get accreditations or even host online classes, e.g. the modern-day employee – working 9 to 5, five days a week, the only time he’s able to attend classes is late afternoon and even then, it’s not always possible (due to incompatibilities with school schedule or overtime overlaps). In such a case, the solution can be the Online Classes. He can attend those, learn and apply itself from
the comfort of his own couch, during the weekend when he’s relaxed and has a couple of hours to spare. He’s investing these hours into his future, after all (Bylieva, D. et al., 2019).

From the other way around, through online classes, the teacher cannot directly interact with its students. That means that, if someone has a question, it’s harder for him/her to get the answer fast. It might be needed to further search online or contact the Online Course Owner — that takes time. Some courses could offer some sort of live chat or an additional forum, where attendees can engage and help one another. This form of chat-rooms might bring the extra edge that online courses needed.

Staying on the same principle, some people believe that interacting with the trainer is the best way to learn, to confirm their ideas. Spontaneity is key here and for those kinds of people, live or synchronous trainings would be the way to go. They might be a bit more cover some to set up, but the benefits outweigh the disadvantages.

Another form of online knowledge gathering might be considered the old-fashioned web search. This kind of tackling the situation brings both advantages and disadvantages. The advantage might be that we can quickly dismiss articles and topics that are not necessarily related to their point of interests – this mainly relies in the capability to understand how these online search engines work, so people can exploit them to their fullest potential. The main disadvantage is that, after the search, people still left with thousands of articles and news and web results that might be related to what they need. It’s their duty to go through them, validate their accuracy and perspective and only afterwards trust them. This is an extra step to perform that not all students might be willing to take. The majority just blindly believe whatever is written online… All and all, online learning is more suitable to adults or grownups that are familiar with the domain taught and are able to discern between false information and the correct one.

**Traditional Learning**

As stated before, traditional classes are more suitable in teaching young children, adolescents or new entries in the workforce. Periodic and checked attendance in class help them in getting a sense of belonging, being a part in something bigger. Making them feel like they matter helps in creating a sense of security that engages and should make them want to perform better. A competitive nature is sometimes benefic towards the formation of the human character. Also, a strict, predefined schedule, helps form the kids – they end up more responsible, disciplined and improve the mental alertness. The traditional method contributes in helping both pupil and teacher get acquainted in a more in-depth matter. This empowers the professors to know their student on a more granular level, to adjust their assessment methods to a per-person-basis and better apply their experience to the overall classroom needs. Hence, a professor should be a mentor, a guide and an enabler to the student’s future and possibilities.

In a more traditional context, students can directly engage with the conversation, creating a more personal approach to the feedback loop. The entire classroom can immediately participate in the debate, share new ideas, discuss personal or other nonobjective points of view and so on; in the same time, the professor can act like a moderator to the conversation – making sure that the conversation stays productive or even launching new concepts in order to stimulate the overall context. As for the exam documentation, most often than not, the classroom notes and the course books are the best source of preparing for a test. The topics discussed are the most likely to appear in the test (some of this might even be controlled by the professor – he could create both the study-material and the test itself). Understanding Q&A patterns, possible question suggestions, or just going through the topics one more time could give the students just the extra help they needed in order to better comprehend the given topic. Basically, the online resources students might find are in a more generalized form than the direct interactions that can occur in class. Also, open discussions help alleviate the pre-exam fears one might had – this can rarely occur through using online courses.
2. SPATIAL THINKING & SPATIAL LEARNING

As it is presented (Al-Busaidi, K. 2012), the concept of "spatial thinking" is relatively new in the literature. Some of the authors associated it with spatial intelligence, that intelligence of "pictures and images" that implies the ability to correctly perceive the surrounding world by visual, as well as the ability to recreate their own visual experiences. People with increased spatial intelligence have the ability to perceive with extreme sharpness the colors, lines, shapes, space, can perceive the relationships between these elements. They also can visualize, can graphically represent images in space, can understand their own position in a matrix space. They transfer mental images to an object they are create or improve it. Visual perception is combined with a set of previous knowledge, emotional reactions, preexisting images to create a new vision offered to others as an experience.

In another approach, spatial thinking is the ability to identify, analyze, and understand position, location, scale, patterns, distances, spatial relationships and time between objects, phenomena, to interpret data related to them.

Spatial thinking is an important factor in the learning process because students use certain spatial analogies to learn new things. The spatial thinking, according to cognitive psychology (Dawson, G. and Fernald, M., 1987), has two components: thinking about space and using space to think. Moreover, the component thinking about space may be seen from two different perspectives, respectively the scale of environments and the scale of objects.

Spatial learning is an effective learning method that is based on spatial thinking. Students who use spatial learning prefer to use images, colors, maps / schemes, video demonstrations, to organize their information and communicate better with others. They also have a good spatial sense, which gives them a good sense of directions in space. They can easily navigate to new places using maps and are rarely lost. For these students e-learning is much more suitable than traditional learning to learn quickly. Students who study engineering, architecture, and medicine have especially much more developed spatial thinking and they can learn spatial easily.

The fundamental concepts with which spatial thinking operates are found, in all activity domains, in all spheres of social and private life. The main aspects of life, how systems work, how and why there are certain relationships, how to address and solve certain problems can be analyzed in terms of "Spatial thinking".

A perspective approach

As it is presented (Bueti, D., Bahrami, B., and Walsh, V. 2008) the perspective approach refers to the ability to see and understand a visual object or scene from different points of view; it involves the ability to imagine them - in your mind - from a different perspective than yours. It may also involve physically looking from another point of view at a visual object or scene. Perspective approach has long been an area of interest for psychologists who have studied its various aspects (Moss, J., et all., 2016), especially visual, cognitive and affective (such as empathy). Until recently, however, educational research in the field of mathematics has given relatively limited attention to the spatial approach in perspective, or the ability to imagine us elsewhere or to physically change the place to see from a different angle.

Essentially, the perspective approach is a cognitive ability that we use daily in our lives to give meaning to the physical world. Recent studies also show that the skills developed in the perspective approach are significantly linked to the general mathematical skills.

There are two main ways of approaching perspective. One involves the movement of the body or an object to experience a different view; it is sometimes called "embodied perspective taking" - the embedded perspective approach. Meantime, information distributed through a 3-dimensional representation lies at the core of any efficient learning technique. This sort of learning pattern can apply to any kind of data – from mathematical formulas and the way one can influence another, to the way IT engineers’ sort and access information regarding a software infrastructure. This kind of learning is scalable and puts each piece of information in a specific place, individually distinct from
any other piece of information. This kind of special skills are important for a student. It allows him to memorize large amounts of information in a reliable way. In the current academical environment, students are required to understand information in a spatial way. This is usually achieved through abstract visualizations or presentations. Initially, this kind of thought process may come as a barrier, but overtime, through exercise, things will get better. Every individual uses spatial thinking to an extent as he / she interacts with the world around them. One of the first steps to develop such a way of thinking comes through ones youth. Quality resources and examples will assist with the learning process. The more “at the core” the learning material is, the better. The instinct is to use fun but superficial software or games, but that’s not the recommended way. The kind of resources refers to the mapping of concepts and abilities needed in an interesting and captivating way.

3. TIME MODELS & LEARNING PROCESS

The sense of time is an essential capacity of humans, with a major role in many of the cognitive processes expressed in our daily lives. Perception of time is among the first abilities that have evolved in biological systems and thus, have affected the subsequent evolution of almost all cognitive modalities (Hinton S. C., Meck W. H., 2004).

The meaning of time and temporal knowledge is largely absent from robotic systems, and this has a clear negative impact on integrating autonomous artificial agents into human environments. This is because the basic idea of the human-robot symbiotic interaction involves the close, synchronized and temporal coupling between people and machines. It is important to focus on efforts considering how time perception can be used with other rational or behavioral abilities (Maniadakis, M. and Trahanias, P., 2014).

Time processing mechanisms in the brain

Over the past decade, a number of different brain areas have been implicated as key parts of a neural time-keeping mechanism in the milliseconds-to-a-few-seconds time range and discussed together with assumed functional properties: notably, event timing in the cerebellum, generalized magnitude processing for time, space and number in the right posterior parietal cortex, working memory related integration in the right prefrontal cortex (Hegarty, M. and Tarampi, M.R., 2015), coincidence detection mechanisms using oscillatory signals in front-striatal circuits etc.

It is important to focus on efforts considering how the perception of time can be used in conjunction with other cognitive or behavioral skills (Ivry R, Spencer R. 2004). The participation of many areas of the brain in the processing of temporal information proves the key role of time in several aspects of reasoning, such as decision-making, memory storage / recall or action planning.

4. A STUDENT’S PERSPECTIVE TO ENHANCE THE ACQUISITION OF SKILLS THROUGH eLEARNING

To check the opinions of the students regarding the spatial and temporal properties of eLearning, a case study about the student’s perspective to enhance the acquisition of skills has been implemented. The case study comes under the form of a questionnaire in which 93 students were asked 27 questions. Those questions were classified in 5 categories, each category representing a point of view of the learning aspects and those are:

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✓ Curricular area
✓ Spatial analysis of the courses
✓ Evaluation and corrections
✓ Temporal analysis of courses
✓ Social Opportunities

Also, each answer of the questions represents a number from a response scale with values between 0 to 5, each number representing: 0 = not important; 1 = very low importance; 2 = low importance; 3 = medium importance; 4 = high importance; 5 = very high importance

Firstly, we will check the total number of the answers in the questionnaire, grouped by their value (from 0 to 5) and represented in percentages, to have an overview of the results, given in Figure 1:

![Figure 1 - Answers of the questionnaire, grouped by their value (from 0 to 5), in %](image)

As it can be seen from the Figure 1, the biggest percentage of answers are of value 4 (30%), followed by number of answers of 3 (28%) and then by 5 (23%). But even if we have these percentages, we can’t say that the questionnaire result is that eLearning is better, because not all the questions or their context refer to that.

Further, we will take each category and discuss its percentages of answers, and what each question refers to. For the category, referring to Curricular area, the percentage (%) of the question answers are represented in the Figure 2. This refers to how the learned lessons domain, homework’s, projects and teaching methods are corresponding with what the students were expecting from an eLearning course.

![Figure 2 Curriculum area](image)

As we can see from the Figure 2, most of the students are at least satisfied with the learned curriculum area, most of the answers being of medium (3) and high (4) importance.

Meantime, for the spatial analysis of the courses (presented in Figure 3), the questions refer to spatial
learning, the visual elements from the courses, the way in which online learning use spatial analysis in the presented courses, and if this is helpful for the students.

![Space analysis](image)

**Figure 3 Spatial analysis**

In the same way, the next categories are represented. Those categories refer to ways of evaluation like tests and quizzes and if those evaluation methods present the information’s in a clear way, if the structure of exercise is conforming the course, if the evaluation is verifying the capacity of the student to solve problems, not only memorize information, the answers being seen in Figure 4.

![Assessment](image)

**Figure 4 Assessment of the course**

In the temporal analysis of courses category, the answers are also pretty good, online study having more advantages in this area than the classic learning methods and this can be seen in the answers from Figure 5. High (4) and very high (5) importance are mainly reported.

![Time analysis](image)

**Figure 5 Temporal analysis**
Also, in the Figure 6, even if the last category is referring to social opportunities and one might think that there are not so many ways to socialize, one may be wrong; in online learning you can interact with at least the same number of students, even if not more than in the classic learning methods, and that is seen very well in Figure 6, where most of the answers are above average about this subject.

![Social opportunities chart]

**Figure 6 Social opportunities**

### 5. CONCLUSIONS

Hence, it can be concluded that not all students are agreeing perfectly with all the aspects of modern ways of learning, but even so, the most answers are above the average level of importance and that means that most of the students already take into consideration the modern learning methods, and even if there are also some negative answers, maybe in the future this will change and online learning will be seen better by more and more students.

In order to sum things up, the current paper illustrated the eLearning platforms – from the differences between online and traditional face to face learning with both its’ respective advantages and disadvantages; to the spatial thinking and learning process – using as a case study the minds of students from a technical University of Romania. Regarding the spatial area of cognition, it is necessary to maintain a close relationship between human space concepts and spatial concepts which is used for artificial agents / distance learning. As follows, the development of spatial’ component of an eLearning system must be reinforced, in order to complement rather than replace human cognitive abilities.

On the other hand, time is ubiquitous in the functioning and knowledge of the brain. The present study reveals that time management is a strong reason for those that choose online learning. Most of the students consider the flexibility of online learning as a positive thing.

Finally, the teacher is no longer the one who verbalizes with the students, but rather is a guide in the learning activity everyone wants to follow. Teaching is done using active and participatory methods that ask for students’ interest, creativity, imagination, involvement and participation to acquire knowledge to use them.

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