Augmented Reality technology - a sustainable element for Industry 4.0

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Abstract: *Augmented Reality (AR) is a current, sustainable, efficient, and promising tool that will make an essential contribution to the development of the Industry 4.0 revolution. AR technology fully and effectively responds to the current extended digital age, in the last year and in the field of education, of learning at all levels. The applicability of AR technology is varied and complex: retail interior design, health, industry, logistics, etc. This paper show the applicability of AR technology in the learning process, from the perspective of the Industry 4.0 concept, highlighting the sustainable and efficient aspects on the economic performance and not only of the companies. The main conclusion of this research is that the use of modern digital technology (AR and VR) in learning in various fields, including education, must be based on the principles of ROI (Return on Investments) and SROI (Social Return on Investments).*

Keywords: *Augmented reality, Industry 4.0, Business, Business Education, Virtual Reality*

JEL Classification: O14, Q55

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1. INTRODUCTION

Global/human society is experiencing a great change, which could be described as the fourth industrial revolution. Today, we could say that we live in the digital age, because any information reaches its addressee in just a few seconds; this is because of the technical progress that has gained considerable momentum over the last century, which has developed very intensively, allowing the adaptation of classical actions in virtual space both at individual, consumer level and, above all, at business level in all areas of activity.

Fig.1 The stages of the industrial revolution
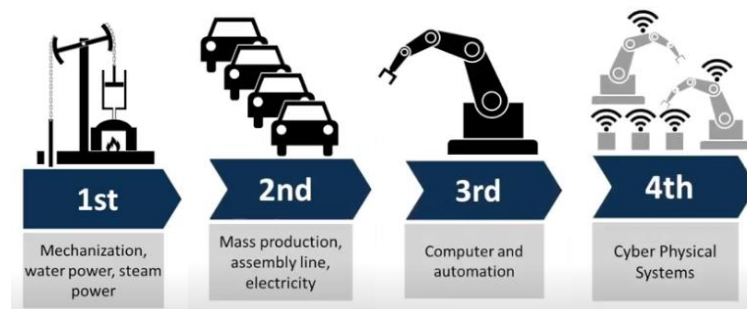
The concept of abstract worlds has existed since the ancient Greek period. In modern times, the first use of the concept of "virtual reality" comes from the area of literature and theater.

Today information technologies have embraces the everyday system of every person, forming the basis of the post-modern business society from various fields to education, being a useful and easy tool, which is proven by the present time of mankind. There are several factors influencing the education system, such as culture, technology, but also some economic aspects. Technology is a tool to transform a person's learning mode. It could contribute to the economic development of a society, introduce new approaches to learning and collaboration, provide access to different information, and also adapt learning experiences to meet people's needs (Birsan, 2020).

Technology has always revolutionized the way we work and live. *The purpose* of this work is to highlight the potential of "AR- augmented reality" in the business process in various fields of activity and in specific mode - through a concrete case study - of basic education or lifelong learning(LLL).

From a technological point of view it AR be at an early stage, so the idea for which this instrument was created is rather uncertain. Technologies help us make life easier, comprehensive or useful, and the AR is the next step on the journey. In recent years, and in a relatively short time, AR it's used to support critical business functions and help people use products and services in more productive ways (Seal, 2020).

2. APPLICABILITY OF THE CONCEPT OF AR: FIELDS OF ACTIVITY AND LEARNING, STATISTICS, DEVELOPMENT

The term of enrichment, according to the index, to add new elements to a good, seems to be linked in this context (AR) to the interaction of physical objects with computers. That is, we are talking about the most advanced technology that produces objects that interact with the real environment(Benko et al., 2012). Retailers give priority to the experience experienced by customers, especially as a result of the increasing use of digital technology in this field. As the physical interaction between the employee and the customer is reduced, the AR will allow the

introduction of new ways of shopping. For example in a clothing store, customers could test the garment without a trial(Fade, 2019) or offer customers the ability to view and customize the products in 3D when buying (Threekit, 2020).

The design and development sector uses AR to make the activity efficient. This efficiency is sought not only in the service sector but also in industry, which is quite broad in scope. Any producer will try to reduce the cost of obtaining products, based on the ratio of supply and demand(I.D.Legman,M.R.Gabor,2020).

AR differs from virtual reality, AR is closer to reality, while VR is closer to the virtual environment. The combination AR – VR produces mixed reality.

Figure 2 – VR And AR Important Elements Of Mixed Reality
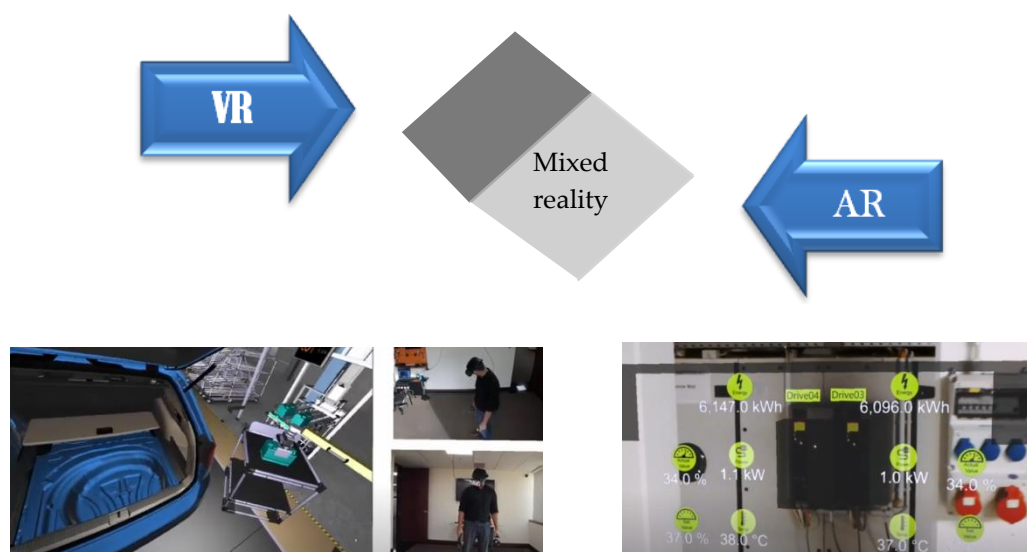
It would allow us to add digital elements to the physical world around us. In VR the entire activity is performed in the virtual environment. This tool allows employers to use a variety of ways to represent knowledge and to build understanding of mental mechanisms, related conceptual schemes, reflecting employee-level knowledge.

Employers are facing new dilemmas, the workforce must assimilate new skills, with digital skills increasing in importance, also due to the current global environment and the pandemic. An effective solution from this perspective is the AR, known as effective for more difficult tasks to demonstrate, such as a flight simulator. Thus, many employees need to become familiar with leadership skills, change management, digitization, VR and AR, etc. (PWC, 2020). AR has a special place in Industry 4.0.

Between February and October 2019 the PwC emerging Technology Group (2020), in collaboration with Oculus for Business, conducted a 12-site study on how employees are trained in three different learning environments: Classroom, online learning and virtual learning. This study revealed several elements related to increasing the efficiency of the employee training system. The time a person assimilates new knowledge in the classic system is about two hours, is reduced to only 30 minutes in the AR learning system, i.e. 400% efficiency.

Trust plays an important role during learning. When performing a training, it is preferable that the environment is safe. It is also essential that the stress level is low, especially in learning situations. According to the same study, the trainees trained with VR were up to 275% more confident in implementing what they learned. Their confidence was 35% higher than those who

prepared online and 40% higher than those who were prepared in the classical system. In the field of health this technology not only can help doctors and surgeons in complex operations, but it is also a useful tool for training medicine students before actually working with patients (Seal, 2020; Young, 2019). This helps to speed up the learning process and reduces the risk of mistake during patient interventions (Pegus, 2019).

**Figure 3 – Place of AR in Industry 4.0**

The AR can be a useful tool in designing and building modern facilities. Using virtual maps and improving real-world environments can save time, increase architectural accuracy, explore the most effective equipment placement options.

Projector-based AR platforms, such as light Guide systems (Rzynar, 2018), provide team members step-by-step guidance by projecting visual indices on the part or work surface to help them in their correct selection, packaging, inspection, assembly or training, Proving that technology would be an instrument of Lean manufacturing.

In the field of *logistics*, large companies like DHL and Amazon take advantage of this AR technology to train employees to find the best materials storage solutions, find the most efficient ways to ship cargo.

**Fig 4 Influence of AR on some economic indicators**
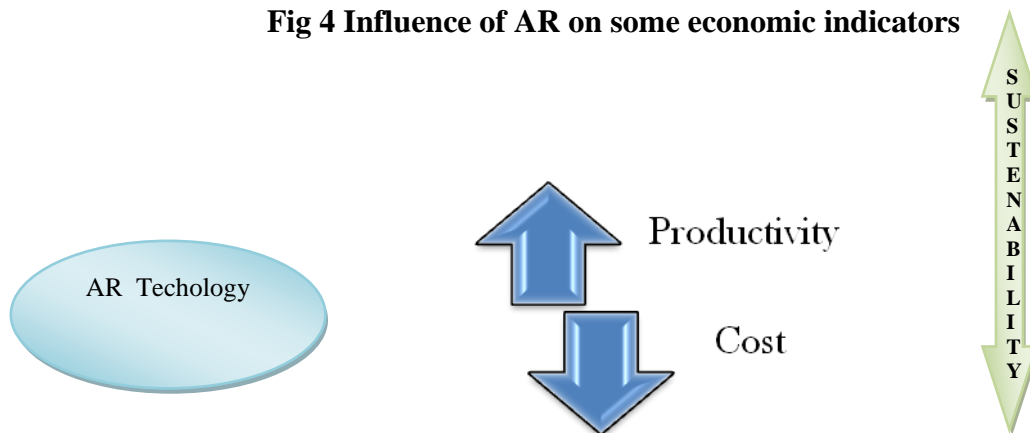
The use of these technologies not only increases productivity, but also increases employee satisfaction. As the firm progresses to higher levels of sustainability maturity, its influence becomes more visible compared to other industry firms. From training to development, assembly, quality control (Segovia et al, 2015), maintenance all these areas of the company benefit from the implementation of AR due to increased productivity and reduced costs.

If we customize in logistics, such as warehouse organization, employees must perform multiple tasks to manage orders and tasks. In the case of technologies, the same employees can enter a connected system that tells them exactly where products and goods are, allowing them to work at a much faster and more unifying pace. DHL reports that, thanks to AR solutions, employees can simultaneously scan items and record processes, which allows the real-time inventory update (Downing, 2019), Such systems reduce the time needed to train new employees, as well as overcome language barriers for non-domestic employees.

Figure 5 shows that applications can be created to be used as technical support in the industry to facilitate maintenance processes or assembly procedures in order to reduce uptime and training costs.

Figure 5 – Augmented Reality mind map of its principal functionalities
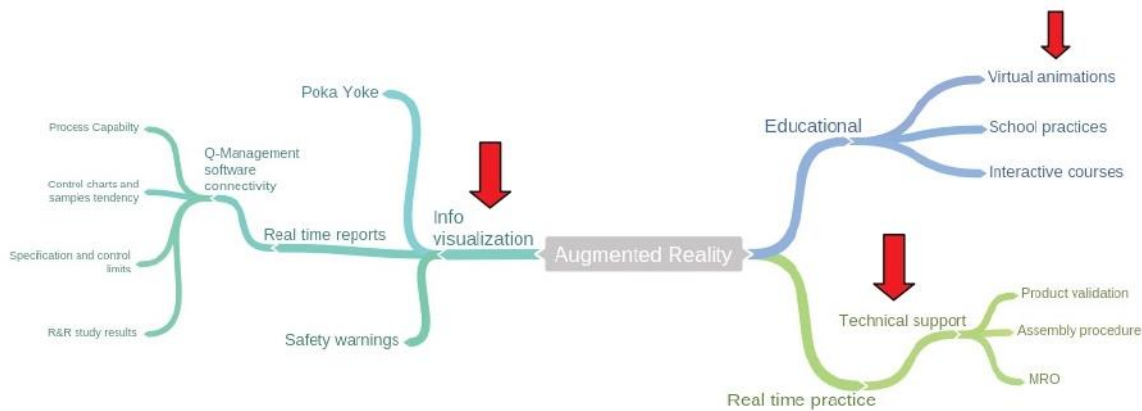
Source: Segovia et al.(2015)

The fields of use are among the most diverse (Seal, 2020): The automotive industry (Huds, smart city technologies), the tourism industry (quiq scan of the area, etc.), the field of services (AR smart glasses, etc.)

Some of the advantages businesses would benefit from implementing technologies AR:
- more active brand interaction due to the high level of interactivity and engagement,
- the ability to increase the degree of customization compared to traditional systems,
- increasing the efficiency of companies in terms of both employee training and logistics
- using AR, retailers have a new way to compete with a completely new customer experience that leads to higher sales and greater customer satisfaction (Threekit, 2020).

Because the technology is considered to be a new one, customers will certainly be surprised, allowing attention to be drawn to the company that implements these technologies.

3.   WORLDWIDE BENCHMARKS IN EDUCATION

The size and awareness of the AR market will continue to increase as they are also adapted for educational uses (Seal, 2020)

None of the generations had so many gadgets available and the trend is steadily increasing. We will need to prepare young people to adapt to a virtual hybrid environment, we will need to help adults adapt to changes in perception, all of this in view of growth, development and efficiency.

AR can be used as a model for different situations in everyday life, with which learners can face as society evolves. This element can offer profound educational experiences, which go beyond traditional vocational education and training scenarios, provided that there is an appropriate pedagogical basis for implementation. The focus must be on providing an experience that enriching their knowledge and understanding.

Several studies have been carried out at international level for and against the use of these innovative learning methods. A study from Taiwan by the Ministry of Science and Technology reveals that AR is an emerging trend toward improving learning outcomes (News RX, 2018). This study investigated the effects of learning activities as a result of using AR technology. The study was carried out on 104 students in the IX-class The results of this study showed that students who used this technology have better understood the teaching material and achieved better results from the summary evaluations. This technology would offer the possibility of having an image from different angles (S.W. Chung, 2018).

Moreover, interest has been raised for students who had until then had results below the middle level.

Figure 6 – Students taking part in the AR application in the classroom

Source:www.onlinelibrary.wiley.com

The work of students who participated in the application of these technologies has gone beyond meeting the tasks that have been classic. In addition to the professional training the participating students understood that the experience was a pleasant one, which increased the level of involvement. Overall, the project has had a positive impact on trust, even leading to the resolution of complex tasks (Linda, 2020).

This transcending of space and time, together with the hybridization of our communication paradigms, involves significant changes in our perception. We cannot yet measure the full impact of these changes, but certainly tends to be abstract. The educated student/student will interact with a digital entity.

In order to be able to implement such a technology at a lesson, we need to take a new attitude toward the teaching-learning-evaluation process. For the lesson to be successful, we must first create active learning. In ICT discipline viewing computer parts from multiple angles can be a real challenge.

Elements of the real world can be incorporated with elements from AR, creating a strong mixed reality that provides a rich environment in possibilities to explore teaching-learning processes. This creates a situation that could distort the learner's perception and mask the goal. In conducting a lesson the teacher/trainer can use this technology at any time of the lesson. It would

be appropriate to limit the period of use, precisely in order not to inhibit basic educational activity.

So if we want to improve the learning/education/training process through these approaches, we need to understand how we will guide students through this sensitive process. Studies have shown that this hybrid reality affects the human brain with the same intensity as sensory experience and can activate neurotransmitters that produce feelings and emotions in the real world. In other words, learning experiences in a virtual world can produce the same effects as counterparts in the real world (Riva, 2007).

Figure 6 – Adaptation of technology in education
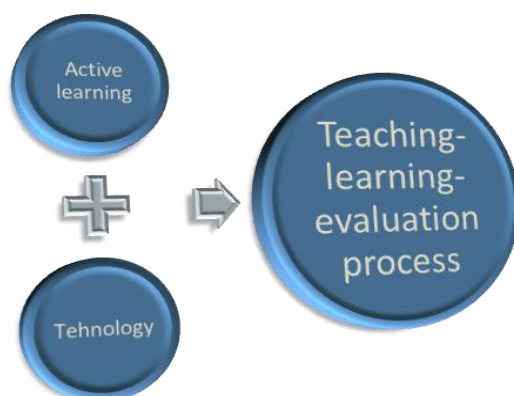
Source: Own sources

The teacher/trainer shall be appropriately trained for such a lesson, in particular to avoid experiences that could cause confusion or negative emotions (VR school, 2018). This technology is not common, so there is the possibility that students may be distracted by different aspects, lose focus. It is important to stress that this technology should be used as a support element of the learning process and not as a tool for transmitting a large amount of information. Yes, the motivation is indeed stimulated, but the purpose of using this technology cannot be lost. The target objectives must be carefully pursued regardless of the technology used.

Figure 7 – The AR method part of the education process
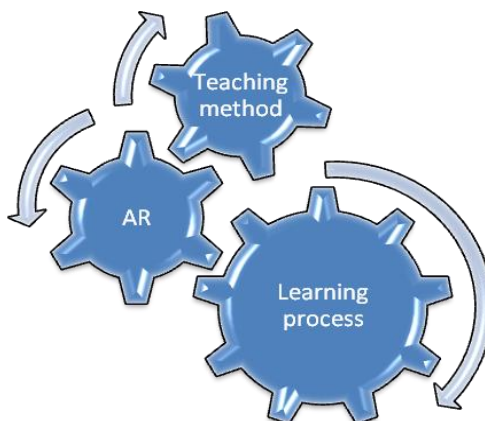
Source: Own sources

Space, time and contextualized understanding become part of a non-transferable learning experience. As Gisbert, Esteve and Camacho pointed out (2011), the benefits of using 3D AR/worlds as a teaching tool are multiple (Gisbert, Esteve and Camacho, 2011). They provide a unique learning and knowledge sharing environment, provide opportunities for group interactions in the learning process. In addition, it improves communication skills so that students can more easily transfer knowledge from the classroom that applies in real life. AR provide support for creativity, exploration and development of identity. The combination of role playing strategies and virtual worlds is becoming an enormous potential for creating scenarios in which students can take on different tasks without consequences in the real world. The classroom space must be adapted to the function of the education process and the technology is selected as a function of these needs. A consequence of this approach is that as technologically equipped learning spaces become more complex, Learning activities need to be increasingly tailored to provide advanced learning strategies and procedures that promote autonomous learning processes (Heo, H., & Joung , 2004).

Learning tasks would move us away from traditional learning. The virtual world offers students the ability to disconnect from their physical environment and practice with digital objects that respond to eye movements, gestures and even voice. Young people will grow up in these environments, use them for learning, many of them are likely to work or even use them in their daily activities. The human capacity to perceive information is related not only to senses, but also to cultural prejudices (Zeki, S., & Bartels, A , 2006).

4.   CONCLUSIONS

Finding new ways to learn and implement innovative tools is more difficult than ever today, especially when technology has taken such a momentum. This technology AR it is a very effective tool that can be applied in many different fields, from education to business. The skills developed through the use of the AR are essential, they are intended to address the challenges in a knowledge society.

At international level there are many discussions about the effectiveness of implementing such technologies in both educational programs and in the business environment. For example, at 2020 level, according to Threekit (2020) 52% of retailers think that for implementation A good partner would be needed to have a successful ROI (return on investment) after the adoption of AR. The main criteria for assessing such technologies should be the effectiveness and functionality and according to the same sources (Threekit, 2020) 71 % of consumers say they would buy much more often if they used the AR because they increase consumer confidence (40 %) that they are willing to pay more for a product that uses customizing in AR. All these figures are imprecise and not negligible in all areas where introduction and use of the AR is possible, with a direct impact on efficiency and productivity in a market estimated at $50 billion in 2024 (Alsop, 2020).

Although VR can accumulate larger titles and keep imagination stronger, AR it prove to be a much more practical and realistic means of presenting the digital world. (Seal, 2020) AR is now one of the fastest growing industries in the world, because it proves to be an extremely efficient business tool (Reydar, 2020).

The application of such technologies should not only be mental but also physical. These technologies can be used efficiently in particular for the group learning process. With the help of technology, businesses have the opportunity to increase their economic efficiency in different areas of activity.

The conclusions must include the main aspects related to the topic addressed. The results of the research should be briefly presented. The limits of research and future directions of research should be found in the conclusions section.

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