Inovace a technologie ve vzdělávání
1/2019

ΤΟ ΄ΙΝΤΕΡΝΤ ΤΩΝ ΠΡΑΓΜΆΤΩΝ ΣΤΗΝ ΕΚΠΑΊΔΕΥΣΗ ΣΤΗΝ ΕΛΛΆΔΑ ΚΑΙ ΚΡΑΤΙΚΉ ΥΠΟΣΤΉΡΙΞΗ ΜΈΣΩ ΤΗΣ ΕΕΤΤ

IOT IN EDUCATION IN GREECE AND STATE SUPPORT THROUGH EETT

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Internet of Things refers to connecting people, data and objects/things to each other via the Internet. Its nature is such, that it can provide an interactive learning process where students, and even those with learning disabilities, learn to seek and acquire knowledge in a pleasant way that raises their imagination and mobility. All of the above, of course, must be done under the supervision and coordination of the teacher in an appropriate and safe environment.

The Hellenic Telecommunications and Post Commission (EETT) is an Independent Administrative Authority. It acts as the National Regulator that monitors, regulates and supervises: (a) the electronic communications market, within which fixed and mobile telephony, wireless communications and Internet access providers operate and (b) the postal services market, within which postal and courier service providers operate.In addition to that, EETT's role is to support those programs and actions that focus on the development of new technologies in scientific fields such, as electronic applications, new e-services like the Internet of Things, Machine to Machine, etc., in broadband networks regardless of transmission technologies (wired or wireless).

This project aims to highlight the continuous procedure of upgrading communications in Greece, so that our country and its citizens are able to participate in the Knowledge Society of the future and enjoy the benefits of modernized education.

Keywords: internet of things (IoT), modern learning, smart classroom, EETT

1 THE PURPOSE

Technology and the Internet are nowadays an integral part of our everyday life. Their rapid evolution and utilization in various sectors have led to a globalized market. The education sector has been influenced and it is called upon to adapt to the modern era we live in, that is characterized by a wealth of information, a rapid dissemination of knowledge and a variety of technological means. These facilitate the existence of the knowledge society and the lifelong learning by improving its methods and teaching tools.

Today's students are significantly familiar with the new technologies, social networks, the Internet, and of course the diverse interconnected electronic devices. They are used to interact by utilizing the aforementioned means and therefore it is easier for them to learn through teaching methods and activities that involve them (Kennedy, Judd, 2008). Meanwhile classrooms tend to become more open and "smart" by utilizing interconnected electronic devices, specialized software, video, written word, teleconference, allowing for distance monitoring and enabling students to attend lectures without being physically present (Chang, Chen, 2015). Thus, the education sector must be aligned with the emerging world of Internet of Things (Internet of Things - IoT), the world of the electronically interconnected people, processes, data and objects.

This essay, which is a bibliographic research, will showcase that the Internet of things is already being used in various countries, among them ours too, as a means of modernizing the teaching process. We will also present a series of IoT applications capable of supporting learning processes and improving the way students perceive and acquire learning and knowledge.

2 INTERNET OF THINGS

Internet of things, as a term was invented in the late 1990s by businessman Kevin Ashton, is the communication network for home appliances, cars and any object incorporating electronic means, software, sensors and network connectivity to allow connection and data exchange (Madakam, Ramaswamy, 2015). According to recent estimates by a global research firm in a year from now, IoT will have 31 billion devices interconnected (Sharma, Shamkuwar, & Singh, 2019).

This global phenomenon already provides smart solutions to various day-to-day issues such as safe and fast transport with the modernization of the city infrastructure and the so-called "smart cities", home security where we can remotely control locks and thermostats and ultimately create an appropriate climate for our premises according to our preferences. All of the above can be applied in the field of education, by making pupils' transport to school safer, as well as their clasrooms more equipped and in many ways more suitable for creative teaching.

3 THE CONTRIBUTION OF THE GREEK STATE

In order to define a strategy for the digital single market in Europe and the proper implementation of the Electronic Communications Code, responsible public authorities are primarily the respective Ministries and Regulatory Authorities of the Member States. On behalf of the Greek State, the National Telecommunications and Post Commission (EETT) must ensure through its responsibilities the compliance of broadband providers regardless of technology with the requirements of this Code.

3.1 WHAT IS EETT?

The Hellenic Telecommunications and Post Commission (EETT), is an independent administrative authority. It acts as the national regulator that monitors, regulates and supervises: (a) the electronic communications market, in which fixed and mobile telephony, wireless communications and Internet access providers operate and (b) the postal services market, in which postal and courier service providers operate. Moreover, EETT is entrusted with the competences to act as the competition authority in the aforementioned markets (EETT, 2019a).

EETT's vision is to operate, while maintaining best relations with all interested parties, as a **state agency** and as a factor of effective and flexible **market regulation**, in a market that

offers to the **consumers**, to the **state** and to **businesses, quality telecommunication and postal services**, in **affordable prices**, thus contributing to (a) the **growth** of national economy, to the benefit of Greece's **residents** and **visitors** and (b) to the elimination of all forms of **digital gap.**

The commission participates in the formation and implementation of the national digital strategy through its experience, funding actions and know-how, which are always available to the state. Its main objective is the constant upgrading of communications in Greece so that the country and its residents can participate in the Knowledge Society and enjoy the goods it offers. Towards this direction, EETT has developed a multi-level activity, which confirms the authority's key role in the digital development of the country. With its high-level staff, which has specialized know-how and significant experience, performs important actions and interventions at regulatory and supervisory level. In order to achieve the above objective, this regulatory authority should ensure through its responsibilities the compliance of broadband providers regardless of technology with the requirements of the Code, as set out in Directive 2018/1972 of the European Parliament (Directive of the European Parliament and of the Council (EU) 2018/1972, 2018). This will ensure that every European citizen, regardless of how close or far s/he lives or works from urban areas, enjoys the following minimum set of digital telecommunication services:

1. E-mail
2. Search engines enabling search and finding of all type of information
3. Basic training and education online tools
4. Online newspapers or news
5. Buying or ordering goods or services online
6. Job searching and job searching tools
7. Professional networking
8. Internet banking
9. E-Government service use
10. Social media and instant messaging
11. Calls and video calls (standard quality)

Moreover, EETT supports, through its role, programs and actions for the development of new technologies in scientific fields such as electronic applications, new electronic services, Internet of Things, Machine to Machine, etc. in broadband networks regardless of transmission technologies (wired or wireless) (EETT, 2019b). More specifically it ensures, through its regulatory competencies that the assigned spectrum is properly allocated for the harmonious operation of all the above services. At the same time, it takes care, through its supervisory responsibilities, for the uninterrupted use of this, by protecting against any interference. Harmonization in the set technical terms will greatly help to smooth the introduction of IoT wireless technologies in the areas already used by mobile providers and will help them further expand into new applications and services. For mobile communications providers, the availability of existing spectrum resources for the Internet of Things is the key to the success of the new venture. At the same time, upcoming 5G technology is expected to become an

important aid to the pillar of connectivity, hence leading to the take-off of the Internet applications of things.

According to EETT's latest official data, in the first half of 2018 there were more than 350 thousand Machine to Machine (M2M) connections in Greece. That is twice as much as in 2015. At the same time, studies are talking about 20 billion devices worldwide connected to the Internet of Things by the end of 2023, of which 3.5 billion will go through mobile networks. Also, according to the GSMAssociation (*Global System for Mobile Communications)*, by 2025 IoT connections used for voice transmission will exceed 11 million in our country (EETT, 2019a).

4 INTEGRATION OF IOT IN EDUCATION

4.1 MASSIVE OPEN ONLINE COURSES

The Internet of Things (IoT) has a great influence on education. It makes several new ways of studying, such as online seminars and virtual classes, possible and overall plays an essential role in the general educational technology. Such practices, have already found their place in our country's higher education, paving the way for a possible larger implementation of distance learning in the future. For instance, the decision of the Hellenic Open University to host several of its courses online over the years, has influenced the many of the the other institutions in Greece to take notice and slowly start to provide the same capabilities to their students (Kappas, Tsolis, 2018).

These modern educational practices could be addresses as Massive Open Online Courses (MOOC), a term that is used to refer to as series of structured open access academic material offered on the internet (McAuley, Stewart, Siemens and Cormier, 2010). That includes traditional lectures, videos, and problem-solving assignments, among other features. MOOCs are built upon interaction as their main pillar of focus, allowing the academic community to get involved into discussions in order to figure out solutions and gain access to a vast array of knowledge (Gnostopoulou et. al., 2019).

Distance learning is being satisfied by the MOOCs i.e. the "Online Courses, that aim at mass (Massive) participation and open (Open) access to knowledge via the Internet". MOOCs are provided through online training platforms such as Udemy, Pluralsight, LinkedIn Learning, Coursera and Udacity. In fact, edX, Coursera and Udacity were pioneering, created in 2012. They offered a series of interactive video tutorials that concerned several sectors of higher education (Kappas, Tsolis, 2018). The University of Miami launches the same year the first MOOC related to the secondary education that consisted of video tutorials for a biology course (Gore, 2014). Students, via platforms that host MOOCs for both higher and secondary education, may register and attend any course they choose either for free or for payment. They need only a computer and an Internet connection. As an educational model, MOOCs simulate the real classroom feeling since they have a starting date, lectures, assignments, discussions and evaluation. MOOCs are conducted with video lectures, questionnaires, online tests and homework. The learners may also adjust the course follow-up according to their schedule, while, at the same time, they have the opportunity to interact with classmates and teachers, as well as obtain a certificate of completion (Kappas, Tsolis, 2018).

MOOCs have a set of advantages. Firstly, they provide free or low cost, high level lessons available for everyone. Therefore, they are considered fair since trainees from almost

every corner of the world may exploit these learning opportunities together, overcoming educational, social and cultural differences, as well as the inequalities that exist in the world population (Kallogianakis, Papadakis 2014). They also favor teachers by giving them the ability to evaluate students' reviews, identify their positive and negative parts and improve themselves. The MOOC platforms are a kind of e-business that needs personnel and hence new job opportunities are given to teachers.

4.2 APPLICATIONS IN THE LEARNING PROCESS

As it has been already mentioned, the term "things" in IoT addresses to devices able to connect to the Internet. Many of them have embedded sensors which are used to receive data and acquire knowledge through processes of information collection, providing more empirical knowledge to help make better decisions. The use of IoT devices with sensors can improve the teaching process, removing it from the sterile stellar quote of concepts and helping children learn in a more experiential, more fun and therefore more interesting way (Marquez, Villanueva 2016). An example of that approach could be displaying the concept of speed in a primary school through an integrated sensor on a toy car. Below is a series of IoT devices that are either designed to be used in the educational process or their features allow them to be used in safe and proper education.

Interactive whiteboard: This is an "object" that can be described as the heart of a dynamic new teaching reality. This is a digital touchscreen device that connects to a computer and a projector. The optical output signal of the computer is displayed on the panel surface by the projector and the user can control the computer by touching the table or using a special stylus. The most advanced models offer a surface without any reflections, real-time response, accompanying programs (software) and can connect to external audio and video devices such as optical disk drives, digital cameras, etc. (Huang, Su, & Pao, 2019).

E-Books: *The* electronic *books* or e-*Books*, as their name implies, are electronic forms of previously printed in paper books or textbooks. E-books require the use of either a computer or a specific device (e-readers) such as the Amazon Kindle or Apple iPads to be read. E-Book is still considered to be an innovation in education, as it has recently found its way into the educational and learning environment in different countries. Many studies have dealt with the effectiveness of digital books in enhancing the learning process. One of the success stories of the e-book movement is reflected on the Clearwater Lyceum e-Book project, which selectively replaced the typical manuals in a number of schools with the Kindle e-book reader in a promotional partnership with the creator company Amazon (Brown, 2012).

Undoubtedly, the e-books have specific characteristics and criteria which facilitate and improve the learning process by providing clear advantages. As for learning, students using e-books can find the reading process more fun thanks to the various attractive features of digital books, such as the user-friendly features, the graphics, the ability to vary the text size as desired or the possibility of audible reporting that some publications offer. Such features can result in a more creative and autonomous learning procedure (Embong, Noor, 2012).

Mobile devices: These devices, such as mobile phones (smartphones), tables and others, equipped with software that allows connection to Internet and connection to other devices. They have sufficient size screens, variety of applications, audio recording software and video, sometimes even a series of sensors for various measurements, high processing

power and battery life. These devices not only are able to replace the digital readers mentioned earlier, effectively reducing the cost of integrating digital books into education, but they also provide a host of other benefits. By using such devices, the teaching and learning relationship in the classroom changes and becomes more targeted, focused on students and friendly towards them, allowing for more creativity (West, 2013). For students, mobile devices are easy to use and, at the same time, they find them attractive. The numerous applications available, allow them to work independently, in groups and as part of the whole class, developing a range of knowledge and skills. Evidence suggests actually that there's a wide range of already developend applications out there, able to support the learning process (Dias, Victor, 2017). These devices allow students to control their individual learning, while giving them the feeling that they have ownership of their learning process in a much more attractive way than traditional teaching methods (West, 2013). Last but not least, it reduces the teachings consisting of lectures and presentations and increases and enhances the learning activities through practical work (Dias, Victor, 2017).

Sensors - Heating, Ventilation and Air Conditioning systems (HVAC systems): Within the context of creating an appropriate climate in the classrooms, intelligent HVAC systems are included (Heating, Ventilation, and Air-Conditioning). The main purpose of such systems is to provide thermal comfort and maintaining good indoor air quality through proper ventilation and filtration. An intelligent air conditioning system is equipped with the ability to make decisions towards a establishing a proper indoor climate. It can help a school achieve energy and cost savings by operating only when required. Temperature detection conditions of the classroom are determined with the use of sensors. One of the best known examples of sensor application and IoT in a classroom comes from Bosch's IoT lab, which has installed, through the "Quantify Art" Project, various pieces of artwork containing smart sensors in many schools. These sensors monitor the level of carbon dioxide (CO2), room temperature, pressure and humidity that trigger color changes on each painting, in real time, eventually warning the students about possible flancuations in their environment (Rigger, Wortmann, 2015).

3D Printers: By using these printers someone can print a model in all three dimensions. Such a tool may prove to be an excellent way for learning in a more experiential and tactful way. To truly serve an educational purpose, students have to design their own designs – files, which can be later sent out for printing. This enables them to learn design, problem solving, as well as develop the skills required for creating prototypes. Students focus their attention and feel excited about the fact that they can see concepts from various fields, such as geography, history, physics, etc, coming "alive". Unfortunately, studies have shown that 3D printers are still underutilized in learning, and that is even in schools that are actually equipped with them. (David, 2017).

Student Attendance Management System: Managing the presence or the absence of children in the classroom is a procedure that can be automized by using IoT technologies. That is achieved by using wearable devices, such as SmartBands or a Smart Id Card. Those have an embedded chip or sensors that utilize its radio frequency identification technology or some other pattern, like ECG. Apart from the presence, these devices are able to use their array of sensors to measure the brain activity of students during the course. Thus, teachers have a sincere picture of the ongoing activity within the classroom that even gives them the

ability to attract a student's attention by sending him/her a message via tactile vibrations (Rohini T., Mohanish G., Siddhesh, 2016).

5 DIFFICULTIES ON INTEGRATING IOT INTO CLASSROOM

To successfully integrate IoT devices into the classroom, there are certain amenities that should be provided such as a reliable WI-Fi connection and a strong broadband network that will be maintained often. Teachers must be adequately trained in technology and the necessary equipment and devices have to be provided to the students (Dias, Victor, 2017). As these devices can collect data from students' actions, they put security and personal data at risk while maximizing exposure of sensitive information in a network, consisting of Internet-connected devices and cellphones, prone to cyber-attacks (Knowles, Finney, 2018). Apart from being prone to security issues, an IoT structure may be particularly expensive and difficult to manage. In addition to that, there is the possibility of students getting distracted by using said devices. This can also, create discrimination between students that do and do not own such a device, if said devices are not provide to everyone equally by the state (West, 2013).

6 CONCLUSION

Technology and the Internet nowadays have invaded many areas of everyday life by changing it on a significant level. We have reached a point where all of us have one or more devices permanently connected to that Internet and that can receive and send data through it. Internet of Things (IoT) is built exactly on the basis of this philosophy, by making possible for a set of connected devices, applications and people to facilitate everyday life.

One area that the IoT could bring major changes to is that of education. The learning process can substantially improve by using IoT to motivate students to be more active. The classrooms of the future can offer students a more personal, dynamic, effective and perpetual experience, in a way that captures their interest and excites their imagination. IoT also opens a window to educational equality, with the inclusion of children facing learning difficulties. It makes searching, finding and sharing knowledge easier than ever. At the same time it gives teachers a range of possibilities for better transmission of knowledge and rapid monitoring of the educational process. The most fascinating aspect of bringing IoT in education is that it transforms the entire procedure into an interactive knowledge game. Beyond knowledge, IoT also applies in the field of school security and helps control the maintenance of a healthy climatic classroom environment

Internet of Things in recent years has attracted the interest of the country's public and private sector, both offering a plurality of important applications. IoT services have become a key pillar of development for telecommunications providers. It is the future and the natural evolution of services in our era, aiming to make it so the interconnection of people is followed by that of the machines. In order to achieve that purpose in Greece, a commission of public authorities, stemming from the respective Ministries and Regulatory Authorities, was appointed on the matter. EETT's purpose is to ensure compliance of broadband providers, regardless of technology, with the requirements of the relevant regulation. It has become clear to all scientific communities that the Internet of Things is more than just a luxury targeted towards citizens, consumers, students, teachers, researchers and entrepreneurs, as it is able to provide new sources of information, as well as new business and educational models that will boost productivity in all sectors of the economy in the years to come. Of course, IoT is followed by several doubts concerning its potential use and suffers from a wide range of technical

difficulties and limitations when it comes to its actual implementation. The safety of student data, due to their constant exposure to the internet, and the overall cost of equipment and installations are some of the problems that were brought up in this study. Technology will always be hiding risks, the benefits though that IoT brings to the table can actually lead to many improvements in education. The Internet of Things is bound to arrive and make an impact in the coming decade, by radically transforming society, the economy, education and even the way we work, entertain ourselves and interact with our environment. It's a living structure that will constantly keep evolving, in order to be in a position to respond to every new human need and desire that may arise, by offering a plethora of services.

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