

9. Tools or materials we can use in Outdoor education.

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Introduction

The use of tools or materials in order to interact with the physical world around us is something common in education outside of the classroom. Habitually tools are used in order to obtain information about the environment around us or ourselves in relation to the environment such as maps, compasses, GPS devices, cameras, heart rate monitors, etc. Notwithstanding, we can also use tools like ropes, harnesses, helmets, saws and other objects to carry out different concrete activities making good use of the resources that our natural or social environment has to offer. Although studies give value to adventure activities and making specific types of activities contributes to the learning process, we are going to focus on the activities that have evolved most and which also have great educative value, the tools necessary to obtain information about the world around us.

These tools allow us to acquire information about various topics very different in nature. Through this information we are able to make conclusions and create new knowledge and we are also able to derive other facts and information without the use of any tool except our own mind.

Tools have evolved throughout the entire existence of human beings on Earth, from the most rudimentary to the most technological. Most of these tools were not created with an educative aim but with a specific purpose, however this does not mean that their use can't be valuable to learning. To begin with they are educative tools because they teach us to use objects in a purposeful way, and if this purpose is related to the subject matter from a course, its use is more than advisable.

Using tools is a motivating factor for students, they are often very enthusiastic about learning to use something new and putting it to practice to check its effectiveness.

Moreover, the newer the tools are, the more motivated they are by being able to use them. This is a problem since most modern of tools are often expensive although we can find some exceptions, as discussed below, and even build our own tools.

Another function of tools that we must keep in mind is the ability to use the information being offered to us in the same place where the experience is produced. For example, before the existence of the internet a photograph of a bird could have helped us to have physical evidence that we had seen that bird in a specific place. But, if we didn't know which bird was in the picture, we wouldn't be able to use that information until we had a bird-watching book in hand, in which case the photo would help us to remember details about the animal and to be able to use this information in the classroom, and share it only with the people around us. Later we will see how communication systems have changed and how they can help us in the use of information and the importance of this technology.

From the past to the Present. Evolution of tools.

Tools, whether they are educative or not, have evolved in the same way that human beings evolved and learned new things. In recent years we have been able to observe how knowledge and technology have evolved at a much faster rate than in previous centuries. Many more new tools have appeared which can be used in the learning process, the majority of them related to information technology.

The fact that the majority of tools created today are technological in nature can limit us because using electronic devices outside of the classroom on a rainy day could be a problem. Even though technology itself will ultimately solve this problem, at the moment we can make use of more basic (non-computerized) devices. We mustn't forget about the older devices which have helped us to arrive where we are today.

Indoors, we can see how we have gone from the horn-books (1650), wooden paddles with printed lessons, to the computers in the 1980s and internet in the mid 90s. During more than 300 years we have seen how we have gone from having the lesson printed on wood, to having it printed on paper, to being able to show it on a blackboard, pencils and pens were created, etc. In the last 30 years the progress in the field of computers and its different applications has been greater than it was in the previous 300 years and it's expected that

there'll be even greater progress in the coming years. Therefore we can say that there's a before and an after, in our point of view, of the computer age.

Outdoors we have seen how computers arrived to replace tools and methods which had and have been used during the years both in and out of schools. For example, we used to orient ourselves in space utilizing the map and the compass, now we have GPS devices; pulse rates used to be calculated manually and now we have heart rate monitors; to know the temperature of something we used to use a mercury thermometer and now we have digital thermometers, etc.

We are going to talk about all these tools and devices which, from our point of view, are closely related with outdoor education.

The camera: During the last 40 years we have gone from cameras with film rolls able to take photos to digital cameras which, in addition to taking photos, are able to take videos with audio. Now, you can see the photo you have already taken and delete it just after taking it without the need to print it. Cameras also have facial recognition systems which help them to take better photos. The camera's evolution is not just about going from analogue to digital, now most people can take their snapshots and record memories at any moment. Before, only people who were planning to take photos or record videos brought their cameras with them, today most people have a smartphone with a digital camera. Therefore, smartphones allow us to share the information in real time thanks to the internet.

The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites. This technology is replacing the map and the compass, among other things, as a tool to calculate position and direction. GPS devices make easier the interpretation of information about position on a map and the creation of a route from point "a" to point "b". GPS devices are a great motivation tool for the participation of the pupils in outdoor activities, as much for orienteering as for investigating the natural environment. Today this device is also found in smartphones and its computer programming is very easy, even a child can use it.

Digital weather stations are small monitoring devices put in place to collect real-time weather data. They can be installed near home, school or in nearby parks, enabling

students to add weather conditions to their study of the local environment. Today, smartphones are connected to a huge net of weather stations and they can obtain this data without any installation.

Heart rate monitors are devices that allow us to obtain information about the heart rate in real time and they also work as a digital clock. This way we can monitor effort during an activity. The heart rate monitor replaces the traditional way to calculate heart rate, manually, without the need to stop the exercise in order to receive this information. There are sensors in some smartphones and apps that allow us access to this information which, together with the information of GPS devices, give us very useful information about the effort and the data that this involves (maximum speed, average speed, calories burned, dehydration, etc.). All this information is going to count for something when somebody needs to make a training programme or a training session.

As we reviewed in these examples, computer technology allows us to have many devices, or at least the functions of many devices, inside one single device. Comfort and ergonomics are appreciated in today's world and smartphones and tablets, with their devices and apps, seem to be the best candidates to incorporate all these functions by incorporating techniques found from information tools in the past. If we add the possibility of sharing information thanks to the internet, utilities increase greatly and overall improvement with respect to traditional tools is more than evident.

We don't have too many references about the use of tools outdoors and their evolution during the years. We are still in the beginning of the computer age and we're still discovering their possibilities for different areas in education. Much like Gardner's Eight Intelligences, stimuluses capable to be perceived and calculated by a computer are varied and seem to be in constant evolution. Today a machine that fits in in your pocket can be your phone, your clock, your thermometer and weather predictor, your map and GPS device, your radio, your little computer, your music player and your voice recorder, your notebook and your calculator, etc. Possibilities that computer programming provides seem to have no limit, just the imagination. It's like talking about infinity, you can progress but there's no end to the road.

Smartphones and Tablets. Present and future of outdoor education.

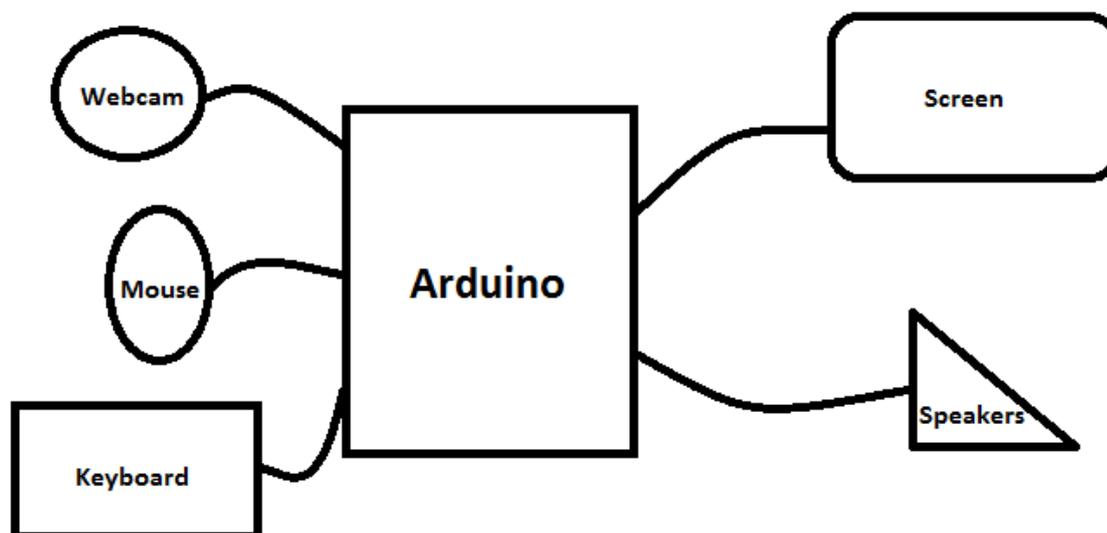
As we have seen, it looks like mobile devices are the present and future of outdoor tools for obtaining information outdoors. That's the result of the number of functions that they're able to bring together in a unique device. We'd like to distinguish between two types of functions:

1. *Hardware*. These are the components of the smartphone's physical structure (camera, GPS, radio, etc.). All of these devices have to be part of the smartphone and they are the support of the apps and programmes installed in the phone.
2. *Software*. These are the computer's programmes that make possible the fulfilment of specific tasks inside the computer or mobile device. They are capable of using the received information from the hardware and giving it a purpose or utility.

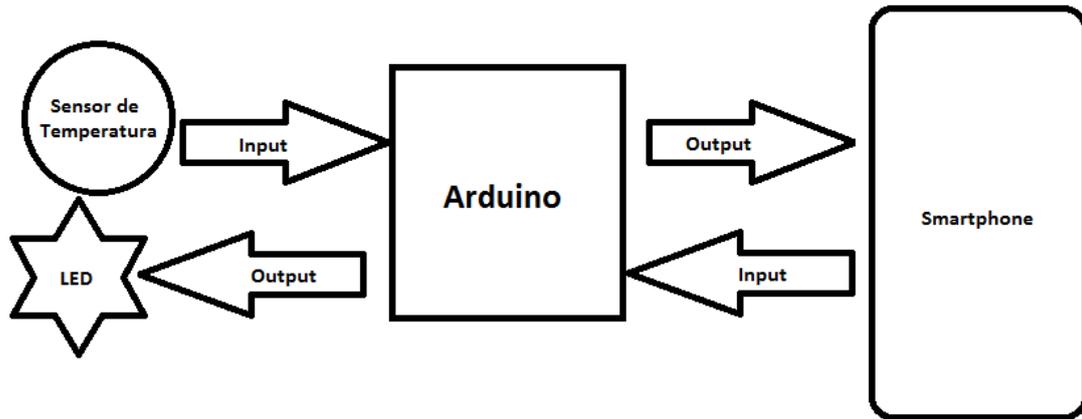
For example, the *Google Maps* app (software) allows us to orientate ourselves and draw up routes to go from one point to another, but if there's not a GPS unit installed as part of the smartphone or tablet the programme won't have a physical support where it can be installed. There are a few apps (software), for example, the radio, which can be installed "in some way" without the need of hardware in the device but these apps require the use of the internet because we have to access this information through the net and not through our smartphone or tablet.

Development of hardware technology is not as active as software development. It seems like software technology provides more possibilities than hardware, but we can mention an easy to use device that allows us to realize different functions and it can be connected with our mobile devices, we're talking about Arduino.

Arduino is a free hardware platform designed to make easier the use of electronics in multidisciplinary projects. The ease to programme it and its low cost make Arduino appealing to everyone and provides its users with a lot of possibilities. Another way to explain it is that Arduino is like a microprocessor where you can connect inputs and outputs. Arduino works similarly to the way a computer works, you can connect sensors and devices as inputs (mouse, keyboard, webcam, etc.), Arduino process the incoming information from them and generates the outputs to other devices (screen, speakers, etc.)



In this case, we're talking about mobile devices, it would interest us to use sensors out of our smartphones or tablets as inputs. Outputs would be a connection with the device in question (wireless is the most popular). Similarly, we can establish a connection in the opposite direction, an input in the smartphone with an output to another mechanism to control it with the phone. This mechanism seems to provide us endless possibilities because every physics variable (speed, acceleration, temperature, inclination, pressure, etc.), we can transform these variables into electric signals that Arduino can calculate for the development of different projects. For example, once we have designed the mechanism and the devices are programmed with Arduino, we can create an application to calculate the temperature and read it on the phone or we can create an application to control the brightness of a light. Educational possibilities are evident, in addition to the education that brings the design and creation of a system like this.



As we said previously, software development is much more important than hardware development in our day. App creation is at the forefront of technology and that generates a great number of offers for the same purpose. Educational environment is not unaware of all of this and there are a lot of apps that can help us and our students during the learning process. In the same way, as we'll see from this point forward, the possibility of sharing information in real time and with documented evidences like photos, users have a greater capability for collaborating with different studies.

Talking about education and applications, the most attractive idea for pupils is to learn playing games, smartphones have to move from being toys to being tools. Traditional education views (notes, tests, etc.) isn't attractive for the students, while technology (apps, trends, etc.) gets their attention and motivates them. It's necessary to use new technologies, within our possibilities, in order to energize the learning process and to promote an active participation of the pupils. If we look at how fast everything is progressing, using mobile devices is not going to be enough in a couple of years, old applications can lose their effect as motivation factors. For this reason, teachers have to pay attention and be informed about new trends and technologies and use them to catch their students's attention. Now, we're going to talk about a series of applications which can be interesting for the education programme and a few ideas about how to work with them.

Quick Response(QR) codes were invented in 1994 and today we can use them in several different ways. A QR code is an information storage module, the information is in a matrix

barcode. The operation of this technology is quite simple, we need an imaging device (camera, scanner, etc.) to read the barcode and a software which can process the image and get the information encrypted in the barcode. We can do this with our smartphones and an application to read QR codes, we have to start the app and focus the image until the information inside the image is open (HTML links, files, v-Cards, locations, etc.). With these possibilities teachers can



QR Code

design activities or games with QR codes, but they're going to need to generate the codes and encrypt the information inside of them. This step is very easy, there are many websites to create QR codes with the information we want. This way, we can coordinate our work with other apps like *Google Maps* and create a route with different locations in the outdoor environment.

We can place a QR code in every location with information about that place or with a problem to solve. We can use texts, music, videos, games, etc in order to involve the pupils in the learning process, but all this work needs to have educational goals. Using different stimuluses is going to be positive to work with different type of skills or “intelligences” (Gardner 1993). Besides, this educational route could be used by people external to the school center, this way they would interact and learn information about the environment around him/her. We can even do classwork with another group of pupils who have experienced a similar activity, making them responsible for the design and the making of the route. This way they'll learn much more than technological information.

Another software that can help us during the educational process is the **augmented reality**. Augmented reality (AR) is a technology that allows us to add virtual elements to real world elements perceived through a technological device. Virtual elements go together with elements from the physical environment in real time, constructing a mixed reality that is able to interact with it (zoom, spin, etc.). This mix of real images and virtual images is very attractive for most students, it is used to motivate them to experience this technology and it catches their attention. The need to produce a programme with augmented reality and the design of the activities is quite similar to the QR code programmes. We need a smartphone or tablet with a camera, screen and the reading software, to reproduce the 3D images on the

smartphone screen it is necessary to have the app on and focus the camera on the image. Another option is to change the image for a location, this way the image will appear when the device is on the exact coordinates. The main difference with QR codes is the interactivity with 3D images, even when we can make activities with QR codes, 3D images can give us a view about how a building looked in the past when we're seeing it. Both apps are acceptable and allow the students to have close experiences with both natural and cultural environment, which is very good news for the learning process.

Speaking of augmented reality, we should discuss another class of reality which is usually confused with it, **virtual reality**. Virtual reality is an immersive multimedia or computer-simulated life. It replicates an environment that simulates physical presence in places in the real world or imagined worlds and lets the user interact in that world. Virtual reality artificially creates sensory experiences, which can include sight, hearing, touch, smell, taste, and more. That environment is contemplated by the user through a device usually known as virtual reality glasses or a virtual reality helmet. These may be accompanied by other devices, such as gloves or special suits that allow greater interaction with the environment and the perception of different stimuluses that enhance the sense of reality. This technology would allow us, in a few years, to be in very distant places or in places at another time. These places are unreachable for us and thanks to virtual reality we can know them. This isn't really outdoor education, but it could be called virtual outdoor education. Like Edison said "books will soon be obsolete in schools. Scholars will soon be instructed through the eye".

Other technologies that are about to come are **biometrics** or **multi-touch surfaces**. Biometrics is a technology that recognizes people based on certain physical or behavioral characteristics. Science is used to recognize the physical and emotional readiness of students in the classroom, altering the course material to adapt to the needs of each individual based on biometric signals. Multi-touch surfaces are virtual images projected on a surface with which you can interact. Usually, they're used like a tool to control functions on the screen of our devices, similar to the function of a keyboard or a mouse but using only hands and virtual images.

We can think of many ideas, and every school and every teacher has to reflect about the best option for the pupils to learn through direct contact with the environment in outdoor activities, if new technologies can help programmes teachers should use it. The best way to

succeed in an educational programme is to choose QUALITY activities, whether we choose to use new technology or not.

Contribution of outdoor education with technology.

In the section related to software we talked about the possibility of using tools as a way to obtain information, but also it's possible to use them to share that information in the creation of something useful for the world around us. If we look for the utility of new technologies in outdoor education we would find many studies where professionals are asking for users help in obtaining information about a specific topic. For example, there's a programme related to knowing the kinds of berries that birds in California eat. Users, thanks to a multitask devices such as their smartphones, can take photos of the birds that are eating berries or just photos of birds on the trees with berries. Then, they can share these pictures with the study for a faster and more effective investigation, the more eyes that you have looking for something the faster you will find it.

Like this study, there are thousands more of different natures and most of them can exist thanks to a tool that can collect environmental data and share it with those who are interested through channels created specifically for that purpose. These programmes are very good and can be very useful but they won't be useful if people don't know about them, that's why education has an important role to make them known and to work directly with them as a tool for the learning process of the pupils. It's a symbiotic relationship: both sides are benefited in the achievement of their objectives. If a natural science teacher shows the pupils this study about birds and he/she shows them where they can find more studies to collaborate with, maybe some students who love nature would have a new hobby, a hobby that is helping others. The most important thing is to give students tools to learn outside school hours, because school is one of many ways in which communication reaches students.

Similarly, there are studies that may be more relevant such as the calculation of water level in a stream to prevent the potentially dangerous water level that will exist further down the river. If different people cooperate by providing information from the different streams

people would predict the approximate level of water passing through a town and people could be advised to leave their houses before the situation becomes more difficult.

Conclusions.

- The use of tools in outdoor education is something necessary to obtain information about the environment and to help us to interact with it.
- New technologies are evolving very fast thanks to computer technology and its many uses. Most tools used for environmental information have been computerized or digitalized.
- Society is looking for a “comfortable” tool, easy to carry and able to do several functions at once. Smartphones and tablets seem to be the most appropriate instruments to fulfill this need.
- Smartphones and tablets are the present and the immediate future for using tools outdoors.
- Students can create their own devices with hardware like Arduino or with software like apps with QR codes, using augmented reality to obtain the information from the environment.
- Technology continues to evolve and soon we’ll have new resources at our disposal. Teachers should keep informed about these new advances to make the experience the most attractive and useful as they possibly can.
- With all these resources the teacher must design an educational programme in which the student is the main actor managing information.
- The information obtained from mobile devices contributes to student learning processes, but can also help different studies and programmes to collect useful information which can expand our knowledge of the world and help us take action toward helping to make it a better place.

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