

Section 1

Chapter 2 - Interactive Environments For Involvement And Motivation For Learning

Theoretical Framework

2.1. Learning and Motivation to Learn

One of the most common problems in our current educational system is student motivation. It is frequently argued that our students are digital natives and the present system cannot adequately teach them. Educational experts, policy makers and stakeholders are worried about this issue, as we can see when we search for the keywords "motivation" and "student". For example, in Scopus, we can find 13,033 documents ranging from 2015 until the present day under the keywords motivation & student. If we search on Google, we can find 390,000,000 results. This is unquestionably impressive. After checking the main results, and by a process of rough estimation, we can observe that some of the main recommendations for teachers are linked to the planning of the teaching methodologies (objectives, timing, methods, and organization of learning activities). However, there are also relevant suggestions concerning interactivity: interaction among students, interactive environments and interactive resources. Thus, interactivity is one of the main aspects to consider in the changing educational system.

We can increase student motivation by using different educational strategies, such as gamification, badges or promoting active participation in the classroom. These strategies are relevant for changing the most typical of classroom situations: very often the main motivation of our students is to pass a subject with good marks, or merely to pass the course with any mark. Therefore, the final assessment is the only reason for many students to study, above all in higher education. But it is not enough for teachers, as they attempt to promote a love for learning in their



students. This aim implies working on both types of motivation (intrinsic and extrinsic) along with the involvement of students in the education process.

One of the most famous researchers on motivation and self-regulated learning is Pintrich. One of his articles (Pintrich, 2003) contains an interesting study of student motivation. The author considers that motivation is an issue that must be focused on both from a psychological and an educational perspective. Both of these contribute to the understanding of student motivation because together they are relevant "to developing deeper scientific understanding as well as practical and useful applications with which to improve education" (p. 669). According to the same author, the specific questions that we must consider in relation to student motivation are: What do students want? What motivates students in classrooms? How do students get what they want? Do students know what they want or what motivates them? How does motivation lead to cognition and cognition to motivation? How does motivation change and develop? What is the role of context and culture?

In our opinion one of the most interesting questions is: "Do students know what they want?" Teachers with real experience in teaching could probably answer this question using their own practical knowledge, and research confirms that students do not always know what they want or what is motivating for them. Very often, this type of knowledge is unconscious and is not part of a self-regulated process.

"In research on cognition, there has been a great deal of research on implicit cognition where cognitive processing occurs outside conscious awareness and control. In a similar manner, the work on implicit motives or unconscious needs suggests that motives or needs may operate to influence cognition and behaviour, but at a level below conscious awareness and control [...], in effect suggesting that individuals do not need to know what they want in order for motives or needs to influence them" (Pintrich, 2003, p. 678).

We have studied the power of interactivity activities in the CARMA project, an Erasmus+ project about non-formal techniques in Secondary education (<http://carma-project.eu>). In this project, we have designed educational activities based on interaction with students and on team work or collaborative work in classrooms. We have studied the level of satisfaction of teachers, students



and parents and all thought that these techniques have been extremely interesting and powerful in promoting learning based on innovative strategies. Moreover, we have tested the level of motivation with an Academic Self-Regulation Questionnaire (SRQ-A) based on the Self-Determination Theory proposed by Deci and Ryan (Ryan & Connel, 1989). These experts in motivational research demonstrate in different publications that improving motivation and involvement requires the improvement of learning regulation (internal and external). We have used this questionnaire in pre-test/post-test research with 72 Spanish students whose ages range from 11 to 16 years old. In general, the results show that the introduction of these interactive techniques has had positive effects on students' motivation and on behavioural regulation. Therefore, it could be extremely interesting to introduce these types of innovative activities into our traditional classes.

2.2. Technologies as Educational Resources

Media are very usual in education. Traditionally teachers have always used different media, including colourful chalks, blackboards, notebooks, films, transparencies and slide projectors, but nowadays they have resources such as computers, tablets, mobile devices, the internet and apps. Although we can use innovative technologies and still maintain the classic classroom structure, it is also true that these new technologies involve methodological changes. We cannot teach in the same way as we did without these technologies.

Why is this? It is because, amongst other factors and probably most importantly, we have new models of interactivity. We are going to focus on this characteristic of digital media and highlight the power of promoting not only changes in education, but also changes in informal education. Nowadays our students not only learn at school, but probably learn more outside school. Because of this, we need to break down the walls and to open up our classrooms, thereby connecting the educational experience within classrooms with the informal experiences of learning outside them. In this way, we will be building real communities of learners and real communities in which to



learn, combining face-to-face with virtual communication. We will be in the real world of the 21st. century.

2.2.1. Interactivity with digital technologies

Educational resources are changing from printed to digital at every level of the educational system, but especially in universities. More and more, our students are able to study with digital and interactive media, and screens are the replacement for the printed page. Why are these media suitable? Most of all, because they can be interactive. Interactivity is the bonus of digital resources, because they allow students to have control and make decisions about their own processes of work and learning. It is a relative control, because in our formal educational system the teachers continue to have the leading role in the planning of teaching. However, it is clear that students currently access interactive information by themselves, and in this way the classroom is open to the outside world, even if the teacher does not desire it.

The most intelligent position would be to recognize that technologies can help us to build an innovative teaching and learning process, and we can insert these technologies into our instructional designs and take advantage of their benefits instead of fighting them.

But what does interactivity mean? It is necessary to clarify what is meant by interactivity in the field of technology enhanced learning. In a previous work (Prendes, 2004) we presented a model with which to understand interactivity and the uses of different technologies. We used two dimensions of interactivity in our model: **cognitive** and **instrumental** interactivity. We can communicate with other people using technologies but, in another sense, we can communicate with the technologies themselves. Both models of interaction can occur in different situations, or can occur simultaneously. We can explain these ideas by using some simple examples. I can search for information on the web using my computer, a navigator and a search engine. In this case, I am interacting with my machine and with the programs, so this is a good example of instrumental interactivity. In another scenario, I can use videoconferencing to talk to other people, so I need instrumental interactivity (with my computer and the videoconference program) but also cognitive interactivity with my colleague at their place of work.

Interactivity based on these types of communication -with machines and/or with people- is a concept that must be combined with the dimension of **time** to obtain a complete view of interactivity in technological communication. Regarding time, communication can be synchronous or asynchronous. For instance, there is cognitive and synchronous interaction when we use videoconferencing, chat, and play on-line team videogames or make a simple phone call. On the other hand, there is cognitive asynchronous interactivity when we use a forum, share documents with other people using the cloud, send an email, collaborate in editing a wiki page or play with others but not simultaneously (for example, a quiz or a chess game where the other player does not respond immediately).

The third factor is physical **space**, the place where we are and the place where others are. Others can be people or can be technologies, if we consider artificial intelligence to be cognitive interaction, because advances in artificial intelligence demonstrate that we are able to talk to machines, and machines are able to learn with this interaction. Therefore, in relation to space, communication can be with recipients in the same location or recipients far away. Cognitive interaction can be seen when people edit a document using Google Drive (a collaborative edition in the cloud); all of them in the same room but using their own computers. This is an example of interaction in the same place. On the contrary, if these people are in separate locations, this is an example of interaction in different places. A simple example of cognitive interaction in different places is a videoconference or messenger programs. Instrumental interaction (people with machines) is usually in the same place, but what happens if I am controlling my home thermostat using my mobile phone? There is instrumental interaction with my mobile phone (same place) while at the same time I am giving orders to my thermostat (different place). There are some examples which combining these three factors (interactivity type, time and space) in the following table.

Table 1: Examples of types of Interactivity in Relation to Time and Space.

	Cognitive Interaction (with people)		Instrumental Interaction (with machines)	
Same Time	A team working in the same office with an on-line shared document	People talking by videoconference or chat	Using a search engine	Playing with friends using an on-line game
Diff Time	Using the same computer to finish a task by different people	Sharing a document in a virtual folder	Using a computer to work out a large calculation	Playing chess with a friend who can answer later
	Same Space	Diff Space	Same Space	Diff Space

It is important to understand that when we use technologies, we are always interacting with devices, so we always have instrumental interactivity. But we do not always have cognitive interactivity, because on the other side of the screen people are not always necessary. Video gaming is an interesting example with which to explain these ideas because we can play alone, using only the device or we can play with another player on line. In the latter situation, there are videogames for playing with others at the same time (multiplayer on-line games) or, videogames where we can wait for the answer and continue playing later, such as quiz games or chess.

We refer to instrumental interactivity when we apply the concept to resources such as multimedia, educational activities or environments. We can understand that digital tools or materials can have different levels of interactivity. We talk about a high level of interactivity when the user can assume control of the itinerary and control the resource itself. For example, the web is a digital resource with a high level of interactivity because you can freely navigate, upload or download files, and use links to share information. A video has lower level of interactivity than the web, because it is usually designed as a linear message with a beginning and an end. You can only stop and you can rewind, so the level of interactivity is not as high as that with the web. At a lower level of interactivity, there is the book. This is linear. Books - printed or digital - are written to be

read as ordered speech. Therefore books are a good example of artefacts with a low level of interactivity.

The concept of interaction is very common in educational technology because we talk about interactive resources, interactive environments, interactive multimedia, or interactive videogames, and the meaning is always the same: giving control to the users. The user has the ability to take decisions regarding the technology which they are using, and decisions can be influenced by the manner in which the technology is used, the type of information being processed, or even the design of the screen.

From an educational point of view, a high level of interactivity is not always advantageous for a digital resource. For example, if we are working with children, perhaps some limitations on interaction would be desirable. If we work with adults with a low level of self-regulated learning competence, it could probably be better to have an organized environment with limited options. Students with special needs should also be considered, because a high level of interactivity could be disadvantageous. Technologies must help education, but must not cause problems. Thus, the level of interactivity must be adequate for the potential users and especially if we talk about educational resources.

After examining these concepts, we can better understand the idea of interactive virtual environments as digital and online telematic tools where we are able to communicate with others and interact with the platform.

As time goes on and artificial intelligence advances, we can find that interaction with telematic tools is sometimes very similar to interactions with people. Science-fiction is becoming reality. We can talk to devices and receive a coherent answer, as with Siri for example. Thus, the possibilities for interacting with machines are increasing as fast as the technology develops. Although we cannot definitely predict the future, we can be sure that technologies like artificial intelligence, the semantic web or blockchain will surprise us over the next few years.

2.2.2. Interactive digital technologies

To conclude this section of the chapter, it is important to mention some tools and technologies which have a high level of interactivity in both the instrumental and cognitive sense. On the one hand, there are virtual worlds and videogames where we interact with the machine, but there have recently been many well-known virtual worlds and videogames which involve on-line interaction in real time, so we will need to have the skills to use the technological device (instrumental skills) but also interact with other players (cognitive interaction). These environments use our real world rules as a simulation of reality, the best known example of a virtual world being Second Life (<https://secondlife.com>).

On the other hand, there are many examples of virtual reality (VR) or augmented reality (AR), applications which can be understood under the umbrella concept of extended reality (XR) introduced by Milgram and Kishino, and well explained by Simpson (2018). All these technologies combine the real world and the virtual world, but the level of integration is different. When we use augmented reality (AR) we are in the physical world, but using technologies to heighten our real experience. On the other hand, mixed reality (MR) implies experiencing the virtual world as the main aspect of the experience. However, we use real elements inside the virtual world. Virtual reality (VR) is the complete experience generated by technologies. Probably the best example of an interactive environment is virtual reality (VR) and the combination of augmented reality (AR) and virtual reality (VR) in extended reality (ER), as you can see in next Figure 3.

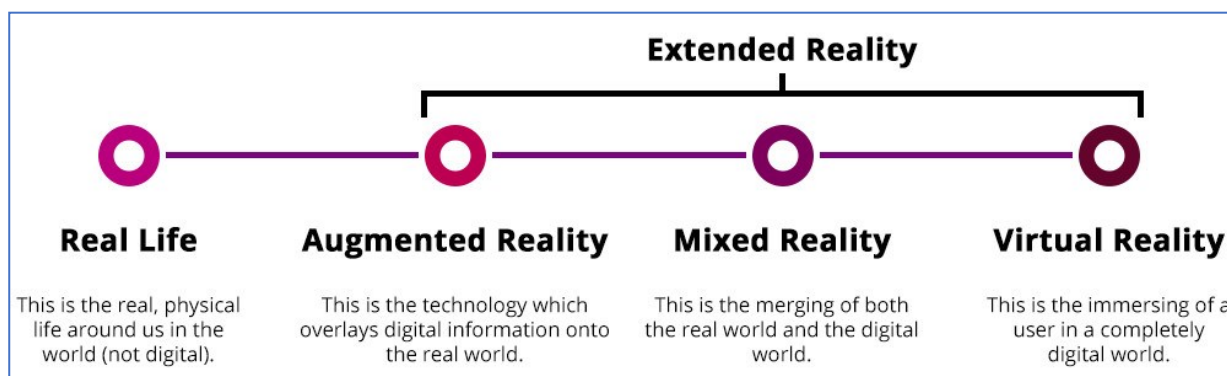


Figure 3: Extended Reality by Simpson (2018)

2.2.3. Collaboration on the net

Interaction between individuals is one of the most important effects of digital technologies. We talk about ICT, so the keys to these technologies are both information and communication. In the field of education, we have changed the models of communication using technologies (virtual communication and also face to face communication, using digital technologies such as interactive whiteboards or interactive multimedia). In this section we will focus on collaboration between people as one of the most powerful challenges, both in education and in general. Perhaps the most common examples of informal collaboration on the net are Wikipedia (<https://www.wikipedia.org>) or Citizendum (<http://en.citizendum.org>). Both demonstrate the relevance of the internet in promoting the involvement of and collaboration between internet users with no reward other than the collaboration itself. These are examples of informal collaboration (Prendes & Castañeda, 2006).

Furthermore, teachers are used to working autonomously in their classrooms, but technologies open the classroom not only for students, but also for teachers. Teachers must collaborate in order to design resources and instructional activities and strategies. We have already seen many examples of this collaborative way of understanding education. A well-known example of initiatives promoting collaboration is the OER movement. The aim of this initiative is defined by UNESCO (2012):

"Open Educational Resources (OER) are teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions".

Linked to this OER movement is the *Open Course Ware* experience in higher education, an example that demonstrates the importance of sharing resources in order to promote not only the collaboration and reusability of resources, but also improvement of the educational system. Another well-known example is the *Khan Academy*. If we can find good quality educational resources better than ours, why not use them? In the same way we can give our resources to other people if these materials are useful or interesting for them. To guarantee legality, we have

specific licenses for digital resources (copyleft), and the most common one is "Creative Commons".

Besides shared educational resources we should also be speaking about the virtual communities around an educational proposal. The main characteristic of this collaboration is its voluntary nature. It is an open experience and the reward is the feeling that we are participating in the building of a community, in the improvement of education in the virtual world. One example in Spain is the *Internet en el Aula* (<http://internetaula.ning.com>), developed using Ning. This community shares all types of educational resources but also hosts discussions in forums and works with peers to form work groups. Another example of informal communities collaborating on the net is *Wiki Education* (<https://wikiedu.org>).

2.2.4. Education and games

Student motivation has been an ongoing concern throughout the history of education and has been one of the most common research topics for psychologists and educationalists. While psychological approaches focus on the type of motivation (intrinsic or extrinsic), the cognitive connections of motivation and the effects on behaviour, in pedagogy our interest shifted to instructional designs tailored for the students and/or for the contexts. At the same time we studied methodologies based on increasing students' levels of motivation.

We can find many examples of this research, but before collecting some examples of good practices or real scenarios, we are going to focus on three connected but different concepts: games, gamification and serious games. At first, we can think that all of these concepts are the same, but this is not so. We will explain these concepts and highlight the differences amongst them.

Games are activities in which we play according to rules, and our aim is enjoyment. Games can be collaborative or competitive. There are many examples of competitive games (chess or monopoly, among others) and fewer examples of collaborative games (guessing the title of a film in teams) or games that use both strategies (two teams letting go of rope and only one team wins).

When we use game strategies in formal education, we talk about **gamification**, so we design educational activities or tasks based on the same rules and the same strategies which we know, so the game must always be linked to contents or educational aims. Thus, gamification implies that teachers try to combine the process of teaching with the fun of a game. In the end, we will have an educational strategy based on game strategies. Examples of strategies based on gamification are the *Treasure Hunt* or the *Webquest*. Both are strategies based on gamification with the main aim being educational. Students must search for information on Internet and use digital resources to finish the webquest or to find the treasure.

And finally, we will explain what **serious games** are. These are obviously games, but a specific type of game with an aim. In this case the objective of the game is a serious one. While gamification entails the relevance of a strategy, the serious game is the tool itself. Moreover, we can learn with normal games, but serious games have been designed specifically to teach. There is the same difference between books and textbooks: we can learn by reading a book, but textbooks are specifically for learning. Interesting examples of serious games have been compiled by Del Moral and Villaoustre (2018). They argue that serious games promote a multisensorial environment with proved effects on motivation, learning, behaviour change, competence training, promotion of positive attitudes and developing multiple intelligences. In their work, these authors recommend 10 serious games with which to prevent bullying.

The playful nature of these simulations makes them good scenarios for promoting positive social learning (Breuer & Bente, 2010), while also promoting reflection on ethical issues, such as the impact of aggressions on victims of harassment, in order to modify undesirable behaviours and to activate social-emotional intelligence (Graesser, Chipman, Leeming & Biedenbach, 2009).

