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The Social Brain and Connective Intelligence Communication and Decision-making Processes

> Cerebro social e inteligencia conectiva Procesos de comunicación y toma de decisiones





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Comunicar 52



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# Neuroscience for Content Innovation on European Public Service Broadcasters

La Neurociencia para la innovación de contenidos en la televisión pública europea

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#### ABSTRACT

The new media landscape is characterized by the fragmentation and disaffection of the audience towards traditional television. Such a context requires innovative strategies to meet the needs of the public and connect with it. This article analyses the ability of Neuroscience to optimize the production of content adapted to audiences. For this purpose, a review of management and economic reports and corporate websites of the European public broadcasters (n=100) was carried out, as well as the evolution of the audience in the period 2010-15. Also, an exploratory analysis and in-depth interviews with open and closed questionnaires was undertaken. The data collect the opinion of neuroscientific experts, Neuromarketing consultants, academics and professionals in European public television (n=22) on the usefulness and introduction of this science for audience research, its possible application in programming, and the role of Neuroeducation in the design of educational programmes. The findings determine that almost a dozen public service media in Europe are already applying audiovisual Neuromarketing as an incipient and innovative tool to test entertainment programmes, commercial spaces and competitiveness improvement strategies. However, it has not been implemented in educational content, which is a core mission of public broadcasters.

#### RESUMEN

En el nuevo panorama mediático, caracterizado por la fragmentación y desafección de las audiencias hacia la televisión tradicional, urge la incorporación de innovadoras estrategias que atiendan a las demandas de sus públicos y conecten con ellos. El presente artículo analiza la capacidad de la Neurociencia para optimizar la producción de contenidos adaptados a las preferencias de los espectadores y comprueba la introducción de esta metodología en las radiotelevisiones públicas europeas. Para ello se realizó una revisión de los informes de gestión, memorias de cuentas y webs de las radiotelevisiones públicas estatales y regionales de la Unión Europea (n=100) así como de la evolución de sus audiencias de 2010-15. Complementariamente, a partir de un análisis exploratorio y de entrevistas en profundidad con cuestionario abierto y cerrado, se recogió la opinión de expertos neurocientíficos, consultores de Neuromarketing, académicos y profesionales de la televisión pública europea (n=22) sobre la utilidad e introducción de esta ciencia para el estudio de las audiencias y su aplicación en la programación, y el rol de la Neuroeducación en el diseño de programas educativos. Los resultados determinan que cerca de una docena de RTV públicas ya aplican el Neuromarketing Audiovisual como herramienta innovadora para probar y diseñar productos de entretenimiento, bloques comerciales y estrategias de mejora de la competitividad frente a su implementación en la programación educativa, encomienda principal del servicio público.

#### KEYWORDS | PALABRAS CLAVE

Neuroscience, audiovisual Neuromarketing, Neuroeducation, television, audience, public service, educational content, entertainment. Neurociencia, Neuromarketing audiovisual, Neuroeducación, televisión, audiencia, servicio público, contenido educativo, entretenimiento.

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#### 1. Introduction

Interest in new research methods and innovation is part of the concern about how audiences consume and behave towards linear and non-linear television, due to the proliferation of screens (Wilson, 2016), hybrid systems for production and transmedia and interactive dissemination (Perrinet & al., 2011), receiving and access devices and channels, audience fragmentation (Prado, 2012), engagement and social audience (Carpentier, 2014), and decline in the value of traditional measuring systems (Quintas-Froufe & González-Neira, 2016). As regards audience measurements, most countries still include only linear television, 31 deferred TV and 21 VoD. Only 14 countries monitor computer use and 6 the access via tablets and smartphones (Eurodata, 2016). Nevertheless, great effort is made by companies to incorporate new techniques and devices of Television Audience Measurement, Cross Media Audience Measurement, Media Metrix Multiplatform, and Return Path Data.

As regards Public Service Media (PSM), attention is drawn to innovation in methods on new consumption trends and TV use (Patriarche, Bilandzic, Linaa, & Jurisic, 2014). Also, qualitative studies have gained ground (Jensen, 1993; McQuail, 1997) due to the quantitative decline in PSM's traditional audiences and the need to reorient their core values (Moore, 1995), to demonstrate their contribution to society and thus to renew their legitimacy (Suárez, 2015).

Changes in TV access and consumption are significant in young and active audiences. Average audience share in European public service media was 21.7% in 2015, which dropped to 13.5 among youngsters. The average daily consumption was 3 hours and 41 minutes, one minute less than the previous year. Young people consumed, however, 2 hours and 6 minutes on average, six minutes less than 2014 (Eurodata, 2016). Something similar happens with traditional radio (EBU, 2016), where the average PSM market share was 37.7% in 2015, 0.2 points less than the previous year. Among youth, the average radio market share was 21%, 0.3% less than the previous year. As regards radio listening time, European people consumed 2 hours and 29 minutes on average (13 minutes less than 2010) and 1 hour and 30 minutes among young people (14 minutes less than five years ago.)

The countries of northern Europe, which are financially stable and have solid reputations and are known for their innovation, maintain their leadership in audience daily share, such as Denmark (69.9%), United Kingdom (43.9%), Finland (43%), Norway (40.3%), Germany (43.9%) and the Flemish VRT (39%). Almost all of these public service media organisations have increased their audience by 10% in the period 2010-2015. Quite the opposite happens in public broadcasters from southern Europe. Affected by the crisis, these organizations lost audience share by 53.6% in Greece, 38.9% in Portugal, 35.5% in Slovakia and 33.7% in Spain in the aforementioned five-year period.

To meet these challenges, public service media organizations are facing the technological transition (losidifis, 2011), the 2.0 revolution (Brevini, 2015), the search for new online opportunities (Donders & Raats, 2015), the redefinition of their public service remit across the digital boundary (Trappel, 2016), the preservation of the use of spectrum and universal accessibility in all platforms (Michalis, 2016) through the reinvention of public service media (Moe, 2008) and the transformation of the values that gave rise to the ethos of PSM (Cunningham, 2015); and the strengthening of independence (Karppinen & Moe, 2016), transparency, accountability (Moreira & Rousiley, 2009) and service to civil society (Thomas, 2016).

The most dynamic state and regional television networks are trying to embody innovation as the engine of change of their organizations. This will help PSM to renovate contents, to stimulate creativity (Turner & Lourenço, 2012), to bring back young audiences, to revitalize their brand image, to increase participation, and to improve the communication of their value. The BBC Backstages incorporates innovation through the use of Big Data and other interactions with programmes (Lin, 2015). The Norwegian NRK is experimenting with the successful format of slow television (Puijk, 2015). The Italian RAI is analysing the evolution and changes of narratives in the news (Gavrila & Morcellini, 2015), and the Spanish RTVE is assessing the convergence between innovation, promotion and audience engagement strategies (Franquet & Villa, 2014).

Public corporations like the BBC aim to redefine and redirect their programming offer towards distinctive and distinguishable products from the commercial television, and ruled by their mission to inform, educate, and entertain (DCMS, 2016). This is, however, a critical shift in focus within the competitive audiovisual arena (Harris & Chasin, 2006). The viability and stability of the new model will mainly depend on the audience's support of the new contents and services. Understanding viewers 'behaviour and preferences is key to success.

In recent years, broadcasters have made progress on audience research, encouraged by a more scientific and objective approach in decision-making processes (Napoli, 2011). In this regard, neuroscientific methods have the

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ability to identify cognitive and emotional processing (Bechara & Damasio, 2005; Vecchiato & al. 2011), which are of interest for PSM to substantiate and implement attractive and efficient products in terms of education, information and entertainment that will eventually contribute to PSM social legitimation.

#### 1.1. Neuroeducation and television

The 20th century is characterised by multidisciplinary research. The combination of knowledge like computer science, artificial intelligence and neuroscience has opened up new spaces to understand individual neural processing in relation to the external environment. In recent years, the democratisation of technology has led to the incorporation of neuroscientific methods in the study of emotions and their impact on decision-making processes, which is of great interest for social sciences (Manes & Niro, 2015). As a result, hybrid disciplines such as Neuro-communication (Timoteo-Álvarez, 2007), Neuro-marketing or consumer Neuroscience (Hubert & Kenning, 2008), and Neuroeducation (Mora, 2013)

have emerged to decode cognitive and emotional processing and to propose efficient actions in the respective action fields.

While Neuroeducation is an emerging discipline and rises difficulties when applied in practice (Sharples & Kelley, 2015), the available empiric information is relevant (Gabrieli, 2016), and will achieve its full potential in the future (Devonshire & Dommett, 2010). Meanwhile, investments are carried out to speed up the process. Research projects such as Mind, Brain and Education from Harvard and the Centre for the Future of the Mind from Oxford provide a basis for the convergence between Neuroscience and Education (Ansari, De-Smedt, & Grabner, 2012).

If Neuroscience is called to mold the education in the Understanding a brain's functioning and decoding how knowledge should be implemented in education is a difficult issue to deal with nowadays. However, while convergence between Neuroscience and Education is an emerging trend, there are strong reasons to foresee that this field of knowledge may play an essential role in education and public service media platforms. The qualitative leap forward made by Cognitive Neuroscience over the past decades, due to economic investments, technological advances and multidisciplinary work, has improved the knowledge of brain mechanisms that have an impact on learning processes, memory, attention and emotion.

current century, the audiovisual and technological sectors will become the main platforms to shape education in present and future society (Ferrés-i-Prats, 2014). The Johns Hopkins University Neuro-Education Initiative (NEI), states that art, through audiovisual productions, may be a powerful tool for education (Eilber, 2009). This shows a need to broaden horizons and to use informal teaching platforms like videogames and television (Fischer, Goswami, & Geake, 2010).

Television offers new formulas for the audience to access and participate, and it has the ability to make cognitive changes in our brains. Against this background, the introduction of techniques and knowledge based on Neuroscience could help broadcasters to better design contents and to attract greater attention, emotion and engagement (Steele & al., 2013).

Also, the exploitation of emotions and empathy –essential pillars of education– (Kort, Reilly, & Picard, 2001), makes television an ideal platform to implement fundamental theories in Neuroeducation. The goal of the article is to show how public service media organizations are introducing neuroscience methods to develop and test contents. Given the social commitment of these organizations towards their audience, the research addresses the potential of these techniques on educational contents.

#### 2. Materials and methods

Recent studies point out the direct impact of emotions on learning processes and the capacity of Neuroscience to innovate in education (Immordino-Yang & Damasio, 2007). Information and Communication Technologies (ICT) provide original formulas to connect emotionally with audiences, encouraging new theoretical and methodological approaches (Serrano-Puche, 2015) and their effective inclusion in learning processes (Wellings & Levine, 2009).

Fostering Neuroscience in education is relatively new and uncommon (Graphic 1). For as long as the records have existed, the Scopus database has identified 52 articles on "Neuroeducation" while the Web of Science has listed 46. Both databases include three references on "audiovisual neuro-marketing", while none of them refers to television as a platform for Neuroeducation. Nevertheless, interest in Neuroscience is present in many of PSM's annual reports.

The aim of this research is to offer the state of the art on the introduction of neuroscientific methods in audiences and television contents research by European PSM. Likewise, taking into account the PSM's refrain from



educating, special attention is paid to the role of Neuroscience in learning processes (Neuroeducation) and educational programmes for television.

Qualitative methods have been used to carry out this work. First, a documentary analysis was conducted on innovation, taking as source annual reports and corporate websites of the EU-28 regional and state public broadcasters (n=100). Also, an exploratory analysis and interviews to a panel of experts on

Graphic 1. Evolution of publications on "Neuroeducation".

public television, neuro-marketing specialists and neuroscientists (n=22) has been undertaken (Table 1). Contacts concluded when they found saturation on answers. The questionnaires had both closed and open-ended questions with a scale from 0 to 10. The design of the questionnaires for each group of the contacted panellists was based

on previous experience regarding Neuroscience techniques in the Spanish audiovisual sector.

The contact of experts was developed in three stages. The first stage consisted in requesting the collaboration of academic experts and professionals in PSM belonging to the PSM Global Experts Network (https://globalpsmexperts.net/), with the aim of getting a preliminary diagnosis of the state and the main challenges of PSM in Europe. The second stage addressed the state of the art with the collaboration of international consultants, who are

| Table 1. Panel of experts               |  |  |  |  |  |
|---|--|--|--|--|--|
| Expert                                  | Institution  | Specialisation   |  |  |  |
| Dr Susana Martínez-Conde                | Suny Donwstate Medical Center,<br>University of New York | Neuroscientist specialised in visual<br>perception                 |  |  |  |
| Dr Luis Martínez-Otero                  | Neuroscience Institute, Alicante                         | Neuroscientist specialised in visual system                        |  |  |  |
| Dr Fernando del Valle-Inclán Alsina     | University of A Coruña                                   | Expert in experimental psychology, attention and short-term memory |  |  |  |
| Dr Roberto C. Agís-Balboa               | Hospital Álvaro Cunqueiro                                | Neuroscientist specialised in epigenetic                           |  |  |  |
| Dr Cristina de Balanzó                  | Walnut Unlimited (United Kingdom)                        |  |  |  |  |
| Mév Bertrand                            | Neuro-Insight (United Kingdom)                           |  |  |  |  |
| Duncan Smith                            | MindLab (United Kingdom)                                 |  |  |  |  |
| Arnaud Petre                            | Brain Impact (Belgium)                                   |  |  |  |  |
| Dr Thomas Zoëga Ramsøy                  | Neurons Inc. (Denmark)                                   |  |  |  |  |
| Philipp Reiter                          | Eye Square FmbH (Germany)                                | Neuro-marketing Consultant   |  |  |  |
| Jarkki Kotola                           | Exakti Intelligence Oy (Finland)                         |  |  |  |  |
|   | Incore GmbH (Germany)                                    | 1  |  |  |  |
| Unknown representative                  | Ottosunove (Italy)                                       |  |  |  |  |
|   | German Consultant  |  |  |  |  |
|   | French Consultant  |  |  |  |  |
| Expert Global-PSM-Experts-<br>Network 1 | University researcher                                    | PSM Spain  |  |  |  |
| Expert Global-PSM-Experts-<br>Network 2 |  | PSM Poland   |  |  |  |
| Expert Global-PSM-Experts-<br>Network 3 | Media professional                                       | PSM Europe   |  |  |  |
| Expert Global-PSM-Experts-<br>Network 4 |  | PSM United Kingdom   |  |  |  |
| Expert Global-PSM-Experts-<br>Network 5 | University researcher                                    | PSM Spain  |  |  |  |
| Expert Global-PSM-Experts-<br>Network 6 |  | PSM Europe   |  |  |  |
| Expert Global-PSM-Experts-<br>Network 7 |  | PSM Spain (Catalonia)  |  |  |  |



members of the Neuro-marketing Science & Business Association (NMSBA). This group revealed the Neuro-marketing research practices used by public broadcasters (method, objectives and object of study), and assessed its future viability in the media arena.

The study is complemented by in-depth interviews with Neuroscience experts, focused on the ability and suitability of Neuroscience to design educational TV

| Table 2. Main challenges of European Public Service Media |        |                    |  |
|---|--------|--------------------|--|
|   | Mean   | Standard deviation |  |
| Audience fragmentation                                    | 8.2857 | 2.21467            |  |
| Improvement of quality content                            | 5.8571 | 3.33809            |  |
| Content adapted to audience                               | 6.0000 | 1.41421            |  |
| Attracting young audiences                                | 8.1429 | 2.47848            |  |
| Attracting global audiences                               | 4.1429 | 2.60951            |  |
| Attracting investment                                     | 6.0000 | 3.16228            |  |
| Improving the efficiency of ad spaces                     | 1.8571 | 2.26779            |  |
| Legitimating the public service                           | 8.8571 | 1.67616            |  |
| Producing public service competitive content              | 8.0000 | 2.51661            |  |
| Producing contents distinguishable from                   | 7 5714 | 3 04725            |  |
| competence  | 7.5714 | 5.04725            |  |
| Producing entertainment of better quality                 | 6.2857 | 3.72891            |  |
| Becoming a news benchmark                                 | 8.7143 | 2.36039            |  |

contents that are effective for learning processes, the potential of transmedia and social television to improve learning processes, brain plasticity and the attention deficit, and the required protocols to develop this symbiosis.

#### 3. Analysis and results

Public service broadcasters in Europe are in the midst of a transition crisis, due to digitisation (losifidis, 2011; Cunningham, 2015; Brevini, 2015; Trappel, 2016) and the weakening of their legitimacy (Camacho, 2005). PSM experts consulted (n=7) stated that the main challenges are the need to renew and recover lost and not-reached audiences and to produce public service contents to renew PSM's legitimacy and their leading position (Table 2).

The future of PSM depends on their ability to adapt themselves to the new media and social context. Becoming an information referent is the solution that reached the greater consensus among the consulted experts (Table 3). While entertainment has a strong acceptance among users, the production of more efficient and attractive educational contents is a competitive advantage, plus it is a way to strengthen public legitimacy.

As it is considered that most of the problems faced by PSM depend on their engagement with users of interactive services, questions have aroused concerning the utility of audience research as a tool to produce contents able to satisfy their needs. While there is consensus on the utility of PSM, results show that these organizations have a general lack of knowledge about Neuroscience methods. Among the main reasons are the existence of many others quantitative research methods such as Big Data, the lack of knowledge about the benefits of Neuroscience methods, the belief that Neuro-marketing does not generate enough value for money, and the assumption that traditional techniques are already appropriate. There is an estimation, however, that this methodology will experience a medium-term increase among PSM, mainly due to its wider dissemination and the price reduction.

#### 3.1. Neuroscience in European Public Service Media

In order to determine the reach of Neuroscience methodology among European PSM, Neuro-marketing consultants (n=11) have participated in the study. Each company has estimated the level of integration of this type of research in their respective countries. Findings show that Neuroscience techniques in PSM from Finland, France and Belgium have little or no presence. However, countries such as Denmark, United Kingdom, Italy and Germany use these techniques at a middle level. The future implementation of these studies is positive for all analysed countries. It is expected that Belgium and France are the most developed countries in this regard within a 5-year period because of its poor implementation today. Finland and Germany will slightly increase its use, while the United Kingdom and Denmark, where Neuroscience methods have a lot of presence, will remain at the same level. In Italy, its use will decrease slightly. The reasoning behind this positive trend is, according to consultants, as follows:

Questions have been raised regarding the introduction of Neuromarketing in Europe. Accordingly, it is considered that its use by European public service media is medium. It should be noted that representatives from Finland, Belgium, Italy and France estimate a greater presence in Europe than in their countries. The trend is reversed in the United Kingdom and part of the German panel, while in Denmark and the rest of the German panel there is a link between Europe and their countries. In general, this methodology is expected to grow in Europe in the next five

| Table 3. Contents to overcome the legitimacy crisis |        |                    |  |  |
|---|--------|--------------------|--|--|
| Contents  | Mean   | Standard deviation |  |  |
| Educational   | 5.7143 | 1.25357            |  |  |
| Entertainment                                       | 6.2857 | 3.72891            |  |  |
| Informational                                       | 8.7143 | 2.36039            |  |  |

years. Interviewed Neuromarketing consultants meet the following profile. At least three out of eleven companies have public service media organizations and public-service commercial broadcasters as customers. All of them serve national public service media or public-service commercial broadcasters (100%). Most of these clients are concentrated in one consultant. The workload represents between 1%-10% for 75% of consultants, while the remaining spend between 20% and 25% of their time. These services have been outsourced in the BBC (British

| Table 4. Reasons to use or not to use Neuromarketing                                      |            |  |
|---|------------|--|
|   | Percentage |  |
| Getting better known  | 70.00      |  |
| Proving its efficiency to produce educational, informational and entertainment<br>content | 70.00      |  |
| Competitors will use it and promote its use among PSM organizations                       | 60.00      |  |
| Their techniques and data interpretation will improve                                     | 50.00      |  |
| Neuromarketing will be needed to show the efficiency of advertising spaces                | 40.00      |  |
| Price reduction   | 30.00      |  |
| General lack of knowledge   | 20.00      |  |
| It will be expensive  | 10.00      |  |
| PSM will use it due to its innovative nature  | 10.00      |  |

Broadcaster Corporation); DR (Danmarks Radio); NRK (Norwegian Broadcast Company); ARD (Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland); ZDF (Zweites Deutsches Fernsehen); and Channel 4 and TV2 Denmark, British and Danish public channels with a commercial purpose.

Contents tested for these broadcasters are: the efficiency of advertising spaces (3 consultants); national TV series (2); entertainment programmes (2); contests and game shows (2); casting (2); foreign TV series (1); documentaries (1), and films (1). The employed techniques were: electroencephalography (EEG) (3 consultants); eyetracking (2); galvanic skin response (2); heart rate (2); implicit association test (1); steady state topography (1); and functional magnetic resonance imaging (1). The application of behavioural economics (1) and social media psychology studies (1) are complementary studies carried out for public service media's contents.

The state of the art was complemented with a comprehensive documentary analysis, which allowed to determine the most important strategic issues for broadcasters' sustainability. These elements are essentially two: 1) the test of entertainment contents to adapt them to audience's preferences; and 2) the demonstration of the effectiveness of advertising spaces to maintain the public system.

The secondary research, which consisted in a documentary analysis of the conglomerate of European organizations, shows that public broadcasters have started to experiment with techniques linked to Neuroscience with the aim of increasing competitiveness of key contents in domestic and foreign markets. According to the BBC Trust (2015), the future requires the opening up of innovative channels to meet an audience's needs and connect with it. Carrying on its tradition in experimenting with new methods of market research, the BBC introduced the first tests with neuroscience techniques. The broadcaster invested in software development in its quest to find formulas for tracking audience's reactions and emotions to successful contents, such as the TV show "Sherlock" and the programme "Top Gear" (BBC Media Centre, 2014). The British Corporation has worked with companies engaged in technological solutions as Lightspeed GMI, that belongs to Kantar Group (MRS, 2015), Neuromarketing consultants as Neurosense (Probst, Frideres, Demetri, & Vomhof, 2014), and Synetiq, for assessing people's emotional and cognitive response to the media (Dalesio, 2015).

In 2014, the BBC Worldwide, together with Lightspeed GMI, carried out a pilot study on the emotional responses to their products in the Australian market. Supported by psychological knowledge and by the platform Crowd-Emotion in the monitorization of micro-facial expressions, emotions were analysed and quantified in 22 BBC shows on a sample of 4,657 people. The Experience, already integrated in Anglophone markets as the United States, United Kingdom and Australia, is expected to be more widely used since it provides objective and quantifiable data, information segmented by regions and reliable information for managers and investors, and helpful development models for content creation (Market Research Society, 2015).

Thanks to technological start-ups, other benchmark public organizations have also incorporated innovative formulas in consumers' studies. France Télévisions, together with Mensia Technologies, is entering into the monitorization of brain electrical signals to suggest and implement contents from audience's emotional state in the platform Pluzz (Fontaine, 2014). The Danish DR has experimented -in partnership with Synetiq-, with biometric techniques in TV shows, in order to adapt its offer to the preferences of that audience that contribute financially to the broadcaster's sustainability (Dalesio, 2015). The Flemish VRT monitorized electrodermal response and introduced EEG techniques to test fiction TV shows (Deproeftuin, 2015), as well as the Spanish RTVE (Crespo-Pereira, Martínez-Fernández, García-Soidán, 2016). Neuroscientific methods are also used to test the efficiency of advertising spaces in broadcasters funded by this source. The Irish RTE, together with TNS, implemented semiometrics to register sub-conscious responses (RTE Media Sales, 2014). The technique aims at establishing asso-

ciations between words and programmes to determinate the best psychological consistency between them and advertising campaigns (RTÉ & TNS, 2004). Another case is Channel 4 that, using eye-tracking and electrodermal response, assessed the efficiency of commercial spaces in its VoD platforms against amateur content aggregators (Ellis & Greenbank, 2015).

#### 3.2. Neuroeducation and educational television

Consulted neuroscientists (n=4) define Neuroeducation as the application of knowledge about brain functions to design efficient programmes. The visual pleasure allowed by television and the basis on which stories are created (sequence, attention, emotion and memory) make this medium an interesting platform to implement Neuro-education theoretical approaches. Should a will to bring back educational television exist, Neuroscience could open up new possibilities towards the creation of efficient educational contents (Bavelier, Green & Dye, 2010). This science, in its different areas of knowledge, would permit the research on cognitive and emotional consequences underlying the viewing (Anderson, 2007). Neuroscience could be also incorporated in early stages of production, particularly in attractive programme design and in the optimization of their presentation. To achieve this, it is essential to invest in a basic and practical research, to encourage the transfer university-enterprise and to have human teams that firmly direct and implement neuroscience and education knowledge to audiovisual production. In this regard, multidisciplinary teams and psychology will play a key role (Horvath & Donoghue, 2016).

The study explores the neural consequences of technological impact on brain plasticity (Mathiasen & Schrum, 2010) and attention deficit (Small & Vorgan, 2009). Interviewed experts refer to a theoretical approach, arguing that the more enriched and volatile is the medium, the more brain connections are created and, thus, the more the plasticity is able to be flexible and trained. In such a context, ICT introduce great possibilities. Combining traditional television with other platforms can be of great help to generate proactive behaviours that encourage learning. Interactivity, customized content, research on users 'feedback and transmedia strategies -which promotes redundancy and thus learning- could lead the way towards a more efficient public broadcaster in terms of education.

If the audience is actively questioned, ICT would have the ability to improve issues such as visual attention and response times. Videogames have been already tested in this regard (Green & Bavelier, 2003). So, if used properly, television and digital platforms could improve some attention deficits. At present, there is also uncertainty about the implementation of knowledge on formative learning.

Be that as it may, there is consensus on the potential of theory to be incorporated in education and television, in the long term. The creation of efficient contents based on Neuroscience will be possible if progress is made in the functioning of brain mechanisms associated to emotion and stories as learning drivers (McNett, 2016) and in the implementation of knowledge.

#### 4. Discussion and conclusions

Understanding a brain's functioning and decoding how knowledge should be implemented in education is a difficult issue to deal with nowadays (Kopton & Kenning, 2014). However, while convergence between Neuroscience and Education is an emerging trend, there are strong reasons to foresee that this field of knowledge may play an essential role in education and public service media platforms (Linebarger & Walker, 2005). The qualitative leap forward made by Cognitive Neuroscience over the past decades, due to economic investments, technological advances and multidisciplinary work (Martín-Rodríguez, Cardoso-Pereira, Bonifácio, & Barroso, & Martín, 2004), has improved the knowledge of brain mechanisms that have an impact on learning processes, memory, attention and emotion. Results show the benefits of using neuroscientific techniques in the design and test of audio-visual contents, and the potential of ICT in learning processes in stimulating touch-sensitive, kinesics (Pérez, 2008), customized and interactive experiences (Pérez, 2008). The study has not found an educational project in European television that has used neuroscientific methods. This is a notable finding, as it could be an ideal tool to renew public service media 's legitimacy through the production of contents oriented to entertain, inform and educate.

The trend of PSM to compete under the principles of commercial television and to give priority to entertainment over public service contents is reflected in research based on neuroscience methods. Almost a dozen European public service media organizations have introduced this methodology in entertainment (TV programmes and shows) and advertising spaces with the aim of enhancing competitiveness in key markets. This also indicates the significance given to these products and ad spaces -at the expense of educational contents- for the viability of public broadcasters in the current media arena. The expected increase of this type of audience research points, in the medium and long term, to the standardization of Neuroscience knowledge for the optimization of public and commercial broadcasters ' management. Over the next years, demand will determine the viability of this methodology in testing and designing products and the strategic value of tested contents. Future work should establish a comparative framework between public and commercial television and assess the usefulness of Neuromarketing techniques in broadcasting.

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# Evaluation of Emotional Responses to Television Advertising through Neuromarketing



Evaluación de las respuestas emocionales a la publicidad televisiva desde el Neuromarketing

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#### ABSTRACT

Since the last century, we have witnessed a steady evolution of advertising techniques in an effort to adapt to the new social context in the market. As a strategic resource, Neuroscience brings a new perspective by allowing you to explore those difficult or verbally unconscious motives behind consumer behaviours. The present work aims to discover the relationship between the emotions induced in audiovisual advertising messages and their impact on the memory of the subjects. To achieve this goal, an experiment was carried out with eight audiovisual advertising messages (six representatives of the basic emotions: joy, surprise, anger, disgust, fear and sadness, and two rational ones that show the technical specifications of the product). Neuromarketing techniques such as the electrical activity of the heart (ECG) and the electrodermal activity (EDA) of the subjects are used, on one hand; and, on the other, a conventional research technique, a questionnaire applied to the subjects that participated in the research. The results show variations in the measures performed in the commercials corresponding to joy, surprise and anger, while for both, remembrance of the message transmitted and activity of the advertiser, the commercial with the best results has been the one regarding sadness, advertisement that has also been considered the most attractive for participating subjects.

#### RESUMEN

Desde el siglo pasado hemos presenciado una evolución constante de las técnicas de comunicación publicitarias en un intento de adaptación a las nuevas realidades sociales del mercado. Como recurso estratégico, la Neurociencia aporta una nueva perspectiva al permitir explorar aquellos motivos difíciles de verbalizar o inconscientes que hay detrás de los comportamientos de los consumidores. El presente trabajo tiene como objetivo descubrir la relación entre las emociones inducidas en los mensajes publicitarios audiovisuales y su impacto en el recuerdo de los sujetos. Para alcanzar este objetivo se ha realizado un experimento con ocho mensajes publicitarios audiovisuales (seis representativos de seis emociones básicas: alegría, sorpresa, ira, asco, miedo y tristeza; y dos racionales) en el que se han utilizado, por un lado, técnicas de Neuromarketing como son la actividad eléctrica cardíaca (ECG) y la actividad eléctrica de la dermis (AED) de los sujetos; y, por otro, una técnica de investigación convencional, un cuestionario aplicado a los sujetos que han participado en la investigación. Los resultados ponen de manifiesto variaciones en las medidas realizadas en los mensajes correspondientes a la alegría, la sorpresa y la ira, mientras que, tanto para el recuerdo sugerido del mensaje trasmitido como para la actividad del anunciante, el anuncio con mejores resultados ha sido el de la tristeza, anuncio que también ha sido considerado el más atractivo para los sujetos participantes.

#### KEYWORDS | PALABRAS CLAVE

Neuromarketing, marketing, market research, efficiency, advertising, commercial, memory, emotion. Neuromarketing, marketing, investigación de mercado, eficacia, publicidad, anuncio, memoria, emoción.

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#### 1. Introduction and the current situation

The loss of efficiency in advertising has forced marketing leaders to search for new tools to help them obtain a better knowledge of how information is processed and consumer behaviour; in that context, Neuroscience brings a new perspective by analysing the processes related to the decision-making which we normally carry out unconsciously (Norton, Frost, & Ariely, 2007; Moorman & Zaltman, 1985).

The needs of the persuasive communication sector to adapt to the changes in the social environment, have triggered a process of constant searching for efficiency. In the current state of advertising research, however, we can identify, among others, two challenges in which traditional techniques, created by the advertising environment with a marked rationalist bias, have not carried out any in-depth research:

a) Emotion-based advertising. In recent years brands have tried to create "emotional bonds with consumers and, to do so, they go beyond rational arguments or those based on the benfits of the product" (Roberts, 2005: 105). The study of emotions has been influenced by an evolutionist and neuroscientific school of thought which considers them innate and universal; it is a new, positive vision of emotions: reasoning and emotion go hand in hand when decisions are being made. Daniel Kahneman uses two systems acting in parallel to explain it: rapid, "effortless" thought –therefore using up little energy– and slow, deliberate and costly thought. For this author, the weight of emotions is greater than it used to be when it comes to decision-making. System 2 is too slow and inefficient to constitute a permament substitute for System 1, designed by evolution, to carry out a continuous resolution of the main problems which an organism must solve in order to survive (Kahneman, 2012: 123); as a consequence, System 1 is the most-commonly used for everyday purchasing decisions.

b) Unconscious decisions. The fundamental principle of market research is that it is possible to ask people questions and their response will be true. The restrictions of verbal statements and ignorance of what we really feel makes it difficult at times to understand our own emotions. Consumer behaviour is a reflection of complex mental processes which motivate all human action and therefore "social psychologists are always studying the ways in which we are unaware of what really makes up our behaviour, and to what extent this contradicts the image we have of ourselves" (Graves, 2011: 41). Advertisers are more and more aware that most human decisions are taken intuitively, automatically and, very often, with no conscious control. (Matukin, Ohme, & Boshoff, 2016).

The boom in neuro-science being applied to the study of the consumer as a discipline is making it possible to deepen the understanding of current consumption needs, given that, within the motives which govern purchasing there are factors such as feelings, emotions and subconcious desires which motivate the decisions we take on a daily basis. (Lindstrom, 2008). Currently, researchers join the two main types of mental processes in their studies: conscious and unconscious, the latter are involuntary, taken without effort, very quick and they can be repeated at any time (Barghand & Chartrand, 1999).

The field of Neuroscience is an alternative, or can be complementary to, conventional research techniques (Vecchiato & al., 2014), as it facilitates the study of that motivation which is difficult to verbalise or is unconscious and which lies behind buying behaviour (Li, Wang, & Wang, 2016). In that context, the emotions make up the raw material of the audiovisual sector (Crespo-Pereira, Martínez-Fernández, & García-Soidán, 2015). Our current reality reveals the habitual use of emotions as the fundamental tools for creating positive advertising messages and transferring those feelings to brands (Shen & Morris, 2016). The revolution of emotions is measurable thanks to Neuromarketing (Alonso, 2015). Knowing some of the emotional levers which are activated in the consumer facilitates the identification of those that generate a greater somatic marker as a positive marker (Damásio, 2005) in the positioning and memory of a brand, given that it has been demonstrated that the greater the intensity of an emotion, the greater the advertising impact and memory that can be achieved.

From the field of Neuromarketing, the methods of Neuroscience are applied in order to analyse and understand human behaviour relative to markets and the marketing of goods and services (Babiloni, 2012; Vecchiato & al., 2011). As such, Neuromarketing analyses consumer behaviour from the perspective of the brain (Morin, 2011). It appeared after the combination of concepts which are applicable in the field of Neural Science, Psychology, Human Neurophysiology and even Neurochemistry (Kumar & Singh, 2015). As regards its relationship to advertising research, biometric techniques are used in the search for a detailed analysis of preferences, needs, experiences, emotions, memories, attention and perception in consumers, using the modern techniques and methodolgies such as electroencephalography (EEG), biometric techniques (galvanic or heart measurement, etc) and eye tracking. Thanks to these techniques which are based on clinical Neuroscience, it has been shown how a screening of the activity of the brain makes it possible to research the emotional reaction to the viewing of an advertisement. In

addition, conclusions can be reached from these real-time brain reactions (Ariely & Berns, 2010) which are more accurate in terms of the communication of the product than those obtained by traditional qualitative and quantitative studies which are sometimes less reliable (Wood, 2012; Klaric, 2011). Therefore, "the mental processes of attention and emotion registered by commercials would appear to be a more reliable indicator of success, all the more so bearing in mind the importance of the two mental processes in the generation of remembrance of the commercial in the target public" (Tapia-Frade, Martín-Guerra, & Puente, 2016: 75).

It is becoming more and more common for advertisers to use experiential emotionality in the advertising messages of their products, in order to activate, to a greater or lesser degree, certain areas of the brain and identify the interest or feelings which are wakened and possible motivation for purchase. The advertising messages which reach the brain of subjects are transformed by the emotions using an unconscious process which gives the messages a personal significance, influenced

by previous experiences and the knowledge of each individual (McClure & al., 2004). Therefore, the level of attraction to advertising stimuli would appear to be related to the response of the brain through the emotions of individuals. In different research a key pattern in the brain has been identified which becomes apparent when the brain perceives something new which catches its attention (Squires, Squires, & Hillyard, 1975). Likewise, the rest of the body undergoes a change which

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may be measured using biometric techniques to gauge the level of pleasure or rejection of the individual. (Jain, Flynn, & Ros, 2008).

Following on from these presuppostions, abundant research has been designed in an attempt to measure the emotional impact of advertising. By way of illustration we will mention some examples: the levels of attention and emotion have been analysed, in correlation with the impact and effectiveness of the advertisements which received prizes at the Cannes International Advertising Festival (Tapia-Frade, Martín-Guerra, & Puente, 2016); the effect of advertisements warning against tobacco consumption and the emotional response of subjects to the same have been assessed (Kim & Niederdeppe, 2014); the significant differences in the emotional variables when viewing messages which were devised for different cultures (Vecchiato & al. 2012) and for different genders (Vecchiato & al., 2014) have been checked; the relationship between long-term memory and the success of the advertisement has been shown (Young, 2009); the emotional differences depending on the advertising preferences of the individuals has been shown (Nomura & Mitsukura, 2015). These cases are only a small sample given the considerable increase in the number of scientific and popular articles on Neuromarketing in recent years, particularly in the United States (Victoria, Arjona, & Repiso, 2015).

#### 2. Material and methods

#### 2.1. Aims and objectives

The general aim of the research is to discover the relation between induced emotions in audiovisual advertising messages and their impact on the individual's memory.

The method for achieving that aim is to:

• Study how the different types of emotions used in audiovisual advertising messages influence the cardiac electrical activity and the electrical activity of the dermis of subjects.

• To find out the differences shown by both the cardiac electrical activity and the electrical activity of the dermis of subjects when exposed to emotional and rational messages.

• To ascertain what relationship exists between the cardiac electrical activity and the electrical activity of the dermis of subjects and the recall of brands and the messages they transmit.

#### 2.2. The design of the experiment

Although is it true that in the field of Neuromarketing there is a "lack of work published by multi-disciplinary teams" (Victoria & al., 2015: 37), for a study of these characteristics, we consider the work of multi-disciplinary teams to be of vital importance. There should be not only researchers from the area of communication but also experts in Neuroscience and professionals from the area of psychology in order to analyse the phenomenon from all of those angles.

The emotional reaction and recall of a series of subjects has been analysed on viewing eight advertising

With this research it has been shown that the cost of measuring the electrical activity of the heart (ECG) and the electrodermal activity (EDA), when a group of subjects is exposed to advertising stimuli, is slightly superior to that which means turning to more conventional research techniques, for example, the focus group. It is important to bear this factor in mind as, a Graves states, "we are at an exciting moment for understanding consumers. The breakthroughs in social psychology, research on the brain and in different technologies which trace the movements of buyers offer new information about what people do and why". messages of which six were representative of basic emotions and two had a specifically rational content based on the technical specifications of the products.

During the course of the experiment, the cardiac electrical activity and the electrical activity of the dermis of subjects was measured while they viewed eight uninterrupted messages all the time trying to simulate the features of an advertising spot on television; the position of the messages was established randomly to minimise the primacy (first) and recency (last) effect, of a serial position derived from the place where each brand appeared which can generate greater recall in the study population (Glanzer & Cunitz, 1966).

Before beginning the session, the subjects signed a consent form and, once in the room, each individual sat in front of a computer screen where the experimental stimulus appeared. They viewed it only once after a few minutes of neutral content to take the base rate of each of the participants. A few minutes after the data gathering process had finished, the participants answered a questionnaire to measure both spontaneous recall and that which is suggested by the brands, the messages, the situations, etc. In this way, we can see the relation between the emotion which each message transmits, the physiological reaction which it provokes in the individual and the efficiency measured in terms of recall.

#### 2.3. Choice of sample subjects and stimuli

The advertising messages had to meet a series of characteristics: a duration of between 30 and 45 seconds to avoid this variable affecting the memory, brands which were not well-known to the participants and which had not been shown in our country to avoid the recall being triggered by the accumulation of impacts in the individual as a result of varying levels of subject exposure to the message.

All advertisements have been selected by a group of eight (four academics and four publicists); firstly, they chose, from a series of 24 audiovisual advertising messages, the six which were most representative of surprise, fear, sadness, joy, disgust and anger; we are speaking of the most representative of each emotion because it is very difficult to find one single emotion in any given advertising message. Afterwards, this group selected two

rational messages; in other words, those in which the formative content is the most important component, focussing on the product and its features and attempting to convince with logical arguments. The experts were given information in advance about the criteria for identifying each type of emotion and the task to be undertaken: selecting the eight messages which, afterwards, would serve as an experimental stimulus in the research.

Using groups of experts to evaluate the characteristics of the commercial messages is a frequent practice in research on advertising and creativity as it eliminates the possibility of bias derived from the involvement of researchers in the decision-making (Koslow, Sasser, & Riordan, 2003; Arroyo, 2006; Ariely & Berns, 2010) as each advertisment attempts to be a unique product, making it difficult to assess some of its elements, for example, the predominant emotion.

The order of the messages, which was determined randomly, was the following: 1) Disgust: NYC Health (https://goo.gl/RWgL1Z); 2) Anger: Government of Georgia (https://goo.gl/SgATDr); 3) Surprise: Lovable (https://goo.gl/UYKx8F); 4) Fear: Samsung (https://goo.gl/yzgTxZ); 5) Joy: Cadbury (https://goo.gl/YO4Grz); 6) Rational: Luna.com (https://goo.gl/Pr7tLk); 7) Sadness: SickKids (https://goo.gl/X6JsdD); 8) Rational: Square.com (https://goo.gl/naScfL).

Some 36 subjects took part in the experiment, with the values of 10 of them discarded due to defects in the quality of the signal received or because of physiological problems, to maintain the normal scientific rigour for research in clinical medicine; in the end, we worked with 26 individuals (9 male and 17 female), all of them students of different undergraduate or postgraduate degrees at the Universidad Rey Juan Carlos, between 18 and 27 years of age, resident in the Community of Madrid, not students of the Communication Faculty, fluent in English; a sample which could be considered adequate in this type of research (Vecchiato, & al., 2010; Tapia-Frade & al., 2016) as, according to Monge-Benito and Fernández-Guerra (2011: 32), "while questionnaire-based market studies require hundreds of replies, Neuromarketing consultants, such as Sands Research, assure that a sample of 30-40 subjects is enough for each demographic group to obtain results with a margin of error of 1% (...) or, depending on the margin of error permitted, with an even smaller sample group".

#### 2.4. Register of physiological signs and analysis methodology

The electrical activity of the heart was registered (ECG) using a derivation from three electrodes, positive and negative on the wrists, and the reference electrode on the forearm of the subject. From the ECG, the sign for RR intervals was obtained, i.e., the time between pulses, by identifying the peak R of the QRS complex (Sörnmo & Laguna, 2005).

For the ECG register, the BITalino system was used (Plux Wireless Bioignals S.A. Portugal), which facilitates the register of physiological signals with a frequency interval of 1 KHz (Da-Silva, Lourenço, Fred, & Martins, 2014). The electrodermal activity was also recorded (EDA) placing a couple of electrodes on the palm of the non-dominant hand. The EDA was recorded continuously for the whole duration of the videos and afterwards it was processed using our own software developed in Python. The EDA signal was measured using a band-pass filter, with high and low frequencies of 0.2 and 1 Hz respectively, with the aim of obtaining the tonic component of the EDA (Vecchiato & al., 2012; Roth, Dawson, & Filion, 2012).

The RR interval signal allows us to determine the activity of the autonomic nervous system (ANS). One of the most powerful tools for determining that activity is the heart rate variability (HRV) (Camm & al., 1996). In this work two indices were used, SDNN (standard deviation of NN intervals) and SampEn (Sample Entropy), which allows the HRV to be quantified (Camm & al., 1996; Richman & Moorman, 2000). These indices have been used widely in other fields for stratifying the risk of sudden heart attack death (Lombardi & al., 2001; Goya-Esteban & al., 2010), and also to assess healthy subjects (Goya-Esteban & al., 2012) and they are apt for the measuring of advertising.

The RR interval signal was recorded during the entire viewing of the advertisments. In the subsequent analysis, it was segmented according to the duration of each of the messages. Each segment was pre-processed to eliminate any possible artifacts and, after that, the proposed HRV indices were calculated. In addition, the time between centred heart rate (mean removed), in order to eliminate the influence of the base heart rate of each subject.

One of the aims of the piece of work is to analyse the relationship that exists between ANS activity, as measured by HRV indices, and the recall of the different messages. In order to establish that relationship, a series of dichotomous variables were created for each subject according to their answers in the questionnaire. These variables scored 1 when the subject correctly remembered the adverisement that showed the specific emotion and indicated that they had felt that emotion. In that way, two groups were created for each emotion with the aim of analysing the ANS activity and its relation to the emotion and the memory of each advertisement.

The statistical differences between each group were evaluated using a hypothesis contrast based on a bootstrap resampling (Efron & Tibshirani, 1994). The choice of this method was due to the number of subjects in each group being different and, in some cases, small. In addition, some of the group does not comply with the normality hypothesis for the application of classic methods. This type of method has been used widely in studies in the area of health (Barquero-Pérez & al., 2015).

#### 2.5. Recall measurement

The questionnaire was used to measure both the spontaneous recall and also the suggested one in order to know the relationship between the physiological measurements of the subjects and the recall of different elements of the messages.

Using the spontaneous memory, information is recovered without the need for any reinforcement; in this research, the goal is to ascertain the relationship between the predominant emotion in the message and the memory of different elements of the advertisement. The suggested recall implies the use of a series of keys which serve to facilitate the memory of the subjects.

The questionnaire has three sections:

• Demographic variables: age, gender, education and nationality.

• Spontaneous recall: the individual is asked about their direct remembrance of the brands which appear in the messages, the sector or activity of each advertiser and



Figure 1. Representation of the mean value of heart rate in each advertisement, by gender.

the message which is transmitted in the advertisments. They are also asked what emotions they have felt and in relation to which advertisements.

• Suggested recall: the subject is asked what brands they remember seeing from a list of brands which includes those which appear in the messages used in the experiment; they are also shown a series of different situations, some of which really contain the messages, so that they associate them with the brand which they have recognised



beforehand.

#### 3. Results

# 3.1. Activity of the autonomic nervous system of the subjects grouped by gender

Following the structure set out in the methodology, we develop the results obtained from the ANS according to gender, in three stages.

In the first one (Figure 1) we can see the heart rate using the time between pulses, once the median has been eliminated. Even though the sample size means that the differences between men and women cannot be considered statistically significant, we do find important differences in advertis-



ment 5 (joy) and in number 1 (disgust). It is worth noting, in the case of men, a high heart rate (small values for the time between pulses) in advertisment 5, and a considerable fall in the same in advertisment 1.

Secondly, we found that the electrodermal activity (EDA) did not reveal significant differences between men and women, in any of the messages.

Finally, the results obtained in relation to the SampEn indices (Figure 2a) and SDNN (Figure 2b), show that, in both cases, the largest differences in terms of values are once again found in advertisment 5, with this message being the only one in which the complexity of the activity of the ANS, measured by SampEn, is greater in women that in men.

# 3.2. Activity of the autonomic nervous system of the subjects as grouped by memory-emotion

During the viewing of the advertisements, the emotions which triggered

SNA activity which was significantly different when the message was remembered were: joy, anger and surprise. The other emotions did not generate changes in ANS activity, irrespective of their recall.

Figure 3 shows the SDNN index, where we can see a greater value for subjects who remembered and felt joy with advertisement 5, which implies a greater HRV.

Those subjects who remembered advertisement number 3, and said that they felt surprise, registered a significantly lower heart rate (greater time between beats) as is reflected in Figure 4 (next page).

Those subjects who remember advertisment 2 and felt the emotion of anger, experienced a significant increase in their heart rate (shorter time between beats) (Figure 5) (next page).

As with the analysis of the differences according to gender, the EDA did not provide information which allows us to identify significant differences in any of the emotions analysed.

#### 3.3. Memory of brands, activities and messages

It was observed that the spontaneous memory of brands is quite low: none of the subjects remembers the brands that appear in the first three audiovisual messages: NYC Health, Government of Georgia and Lovable; 3 subjects remember Samsung; 2 Cadbury; 6 Luna.com; 1 SickKids; and 1 Squire.com. This memory does not depend on the position of the advertisment in the experiment nor the previous knowledge of the brand as the best-remembered one does not have activity in our country and corresponds to a purely rational message.

When individuals are asked about the spontaneous memory of the activities of the advertisers, without asking them to do so in the order in which they appeared, the results are quite high: twenty subjects remember the one



Figure 3. Deviation of the HRV measured by SDNN between the subjects who remember and feel the emotion of joy with advertisement 5, and those who do not.

Figure 2(b). Average SDNN value for each advertisement, by gender.

which corresponds to message 7, 18 to one and three, 11 to two and eight, 10 to four, 9 to five and four to six. As regards the recall of the message which adver-

As regards the recall of the message which advertisements transmit, without asking the subjects –once again– to do so in the order in which they appeared, we find: 25 remember the message transmitted by advertisment 7, 22 number one, 19 number 3, 17 number twelve, 10 number 5, 8 number four, 7 number sixteen and 6 number eight.

With the suggested recall, the subjects remember a considerable number of brands, irrespective of their position or the previous knowledge. SickKids (advert 7) is the best-remembered (16 subjects) whereas a well-known brand such as Samsung (message 4) is only remembered by 5 individuals and the first advert (NYC Health) is only remembered by 6. These data are related to the messages' appeal and ability to catch the attention: for 12 subjects, the most attractive one was SickKids, for 10, Lovable, and, for 9, NYC Health. The ones which were considered least attractive were the two rational advertisements (only one subject considered them attractive).

Finally, the subjects had to relate different situations, some of which appeared in the advertisments shown (suggested recall), to the brands which appeared in the messages; the two advertisements which were considered the most appealing obtained the best results: advertisment 3(Lovable) and advertisement 7 (SickKids); in both cases, more than half of the subjects correctly related the situations to their respective brands.



Figure 4. Deviation of time between pulses between subjects who remember and feel the emotion of surprise with advertisment 3, and those who do not.

#### 4. Discussion and conclusions

Firstly, in accordance with what Shen y Morris (2016) state, we can conclude that the advertising research improves its efficiency when it integrates, within the same design, techniques of Neuromarketing and conventional techniques which are sufficiently proven, for example the questionnaire. In this piece of work, we have used the first to record the subject's emotional answer, while they view the advertising messages, and, with the second, it has been possible to gauge the efficiency of the messages by measuring the recall of different elements of the advertisements – this cannot be obtained using only Neuromarketing techniques.

We can conclude that using emotions in advertising messages influences the recall, both in brands and the messages they transmit. This is so because these advertisements have obtained better results than the rational messages, as was pointed out by Wood (2012), among others.

It has been shown that the activity of the Autonomic Nervous System (ANS), quantified by means of the variation in the heart rate (HRV) of the subjects, was significantly different in those participants who remembered those advertisments which transmitted joy, surpise and anger, even though the direction of the variation differs depending on the emotion analysed. In particular, those who state they felt joy and correctly recalled the brand of the communication had a higher ANS activity. The heart rate was higher in the subjects who stated they had felt anger and remembered the message correctly. On the other hand, the heart rate was significantly lower in the subjects who felt surprise and remembered the advertisement.

It has been shown that when the subject considers the message attractive or it has a higher capacity to catch the attention, the recall of the brand and the message it transmits is greater. However, it would be interesting to ascertain to what extent the experiences and previous knowledge of the subject influence these results (McClure & al.,



Figure 5. Variation of the time between heartbeats for subjects who remember and feel the emotion of anger with advertisement 2, and those who do not.

2004).

As regards the recall of the message which is transmitted by each advertisement, the one which is associated with the emotion of sadness (broadcast in the seventh position) is the one which obtains the best results: 25 subjects remembered the message; the second-best in terms of recall corresponds to the emotion disgust (22 subjects), shown first; the third corresponds to surprise (19 subjects) broadcast third. In this case, the messages which are least remembered correspond to the rational communications.

Unlike the results obtained in other studies which conclude that greater brand recall is generated by the messages which appear first (Li, 2010), it has been shown that the order in which the advertisements are shown to subjects does not have a

determining effect on the recall thereof as the first message shown in the block (emotion disgust for NYC Health) did not obtain the best results in the spontaneous recall or the suggested recall.

With the indices used in this work to determine HRV and EDA, we created models of latent variables, using "partial least square path modeling", in order to obtain an objective characterisation of the ANS activity in relation to the brand recall in advertising messages. Long term, the aim is to have a model to help with the design of advertisements to maximise brand recall.

Regarding the significant differences between genders in the emotion variables, (Vecchiato & al., 2014), although the data do reveal differences, the high standard error makes it impossible to reach that conclusion, based on the results obtained. It would be interesting to do a more in-depth study along those lines to ascertain whether or not there are significant differences between men and women when it comes to watching advertising messages in which different emotions predominate.

Finally, Neuromarketing as a recent discipline has shown itself to be a very important tool in the efficiency of the research of advertising market. One of the most frequent criticisms of Neuromarketing has been the cost of the research when this type of technique is used; however, with this research it has been shown that the cost of measuring the electrical activity of the heart (ECG) and the electrodermal activity (EDA), when a group of subjects is exposed to advertising stimuli, is slightly superior to that which means turning to more conventional research techniques, for example, the focus group. It is important to bear this factor in mind as, a Graves states, "we are at an exciting moment for understanding consumers. The breakthroughs in social psychology, research on the brain and in different technologies which trace the movements of buyers offer new information about what people do and why" (2011: 287).

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# Connective Intelligence for Childhood Mathematics Education





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#### ABSTRACT

The construction of a connective brain begins at the earliest ages of human development. However, knowledge about individual and collective brains provided so far by research has been rarely incorporated into Maths in Early Childhood classrooms. In spite of that, it is obvious that it is at these ages when the learning of mathematics acts as a nuclear element for decision – making, problem –solving, data– processing and the understanding of the world. From that perspective, this research aims to analyse the mathematics teaching-learning process at early ages based on connectionism, with the specific objectives being, on the one hand, to determine the features of mathematics practices which promote connections and, on the other hand, to identify different types of mathematics connections to enhance connective intelligence. The research was carried out over two consecutive academic years under an interpretative paradigm with a methodological approach combining Action Research and Grounded Theory. The results obtained allow the characterization of a prototype of a didactic sequence that promotes three types of mathematics connective intelligence in young children: conceptual, giving rise to links between mathematics concepts; teaching, linking mathematics concepts through an active methodology, and practical ones connecting maths with the environment.

#### RESUMEN

La construcción de un cerebro conectivo comienza en las edades más tempranas del desarrollo humano. Sin embargo, el conocimiento que ya se tiene sobre los cerebros individual y colectivo apenas se ha incorporado en el desarrollo del pensamiento matemático en Educación Infantil, donde comienzan a gestarse elementos clave para tomar decisiones, resolver problemas de la vida cotidiana, tratar con datos y comprender el entorno. Desde esta perspectiva la presente investigación marca como objetivo general analizar el proceso de enseñanza-aprendizaje de las matemáticas en Educación Infantil a partir del conexionismo, considerando como objetivos específicos, por un lado, determinar las características de una práctica matemática que promueva las conexiones y, por otro lado, identificar los distintos tipos de conexiones matemáticas para fomentar la inteligencia conectiva. La investigación se lleva a cabo a lo largo de dos años consecutivos bajo un paradigma interpretativo con un enfoque metodológico basado en el uso combinado de Investigación-Acción y Teoría Fundamentada. Los resultados han permitido concretar un prototipo de actividad o conjunto de actividades que, en forma de secuencia didáctica, promueve tres tipos de conexiones matemáticas para desarrollar la inteligencia conectiva en Educación Infantil: conceptuales, que producen nexos entre contenidos matemáticos diversos; docentes, que vinculan diversos conceptos matemáticos a través de una metodología activa y de vivenciar las experiencias matemáticas con otras materias; y prácticas, que relacionan las matemáticas con el entorno.

#### KEYWORDS | PALABRAS CLAVE

Connectionism, connective brain, mathematics education, teaching-learning, didactic method, didactic strategies, didactic application, early childhood education.

Conexionismo, cerebro conectivo, educación matemática, enseñanza-aprendizaje, metodología didáctica, estrategias didácticas, aplicación didáctica, Educación Infantil.

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#### 1. Introduction

The classic definition of ecosystem establishes the importance of the harmonious combination of the environment and the community of living beings, as well as the relations between these beings and between them and their environment. From a social point of view, we are part of an enormous ecosystem whose balance is complex and highly dependent on the decisions made by those who live within it, which are influenced more and more by their capacity to access and interpret the vast quantity of information that is added to the realm of social communications on a daily basis. This information is catalysed by the intense barrage of information and communication technologies (ICT), whose capacity for evolution and metamorphosis is several degrees greater in magnitude than that which the human brain can accommodate. Given these conditions, theories are emerging from the field of neuroscience, focusing attention on collective intelligence and consciousness, which are also presented as connected (Pitt et al., 2013). Within this framework, connections not only help to maintain balance in an ecosystem exhausted by the dizzying social and informational changes mentioned above, but also act as drivers to change and transform the ecosystems themselves towards more sustainable and –why not?– more fair realities.

Concerning our interpersonal connections, and beyond the obviousness of the global communication that the Internet and social networks facilitate, we know that we are indeed connected as suggested by the curious "six degrees of separation" theory, which states that, even if they do not know each other, any two people could send each other a personal message through a chain of contacts of no more than five links. This theory, proposed in 1929 by Frigyes Karinthy through a story called "Chains", has also been subsequently considered and analysed by sociologists and mathematicians (Watts, 2004), who have aimed to demonstrate the theory and to endow it with logical rigour. That said, these kinds of connections only allow for the classic form of communication between transmitter and receiver through the establishing of suitable and reliable channels. The question lies more in the extent to which this apparent structure of online social connectivity can be exploited in order to make shared decisions which are good for the collective, and to drive forward and enrich a collective intelligence that manages this decision-making appropriately, that encourages the critical participation of citizens, and that is protected from the manipulations of small groups pursuing their own vested interests as opposed to the social good.

The construction of a connective brain starts in the early ages of human development, in which infants are still protected, to a large extent, from the barrage of messages sent by the media, with the exception, possibly, of television (Santonja, 2005), and the impact of ICT as an additional element of social communication. It is in this point that education plays a particularly relevant role, especially if we attend to the question of how the knowledge we already have about individual and collective brains may be incorporated into early childhood classrooms and, specifically, in the area of mathematical thinking, in which core elements start to emerge in relation to decision-making, problem-solving, data handling and understanding the environment. It was not in vain that Van-Overwalle (2011) highlighted the evidence indicating that many judgements and biases in social cognition can be understood from a connectionist perspective. Furthermore, he also pointed out that said judgements are underpinned by basic associative learning processes, often centred on an error minimisation algorithm. In relation to teaching, these ideas are already reflected in studies from the 90s, such as that of Askew, Brown, Rhodes, Wiliam and Johnson (1997), in which the connectionist teacher is characterised from the perspective of maths education.

#### 1.1. Connectionism and learning

The learner and education are situated in live and dynamic contexts. Throughout history, different theories have emerged providing frameworks that aim to link research with educational reality. Some of the main theories of human learning started to be disseminated during an era in which technological resources were of little importance in people's lives. However, from the Second World War onwards, with the arrival of the technological revolution, psychological research resumed its interest in the human mind as an object of study and the computer began to acquire importance (Martorell & Prieto, 2002). As indicated by Caparrós (1980), dissatisfaction with the different versions of behavioursm led to an increase in new theoretical models that aimed to express human cognitive processes. Miller, Galanter and Pribram (1983) provide an overview of the works that constitute the beginning of the cognitive paradigm that attempts to explain how information is made available in the mind, through the elaboration of theoretical models that are subsequently validated through experimental techniques, computer simulations, or a combination of both, in order to describe knowledge. On the other hand, in constructivism, students are active since they organise their understanding by comprehending their experiences (Driscoll, 2005).

Given this dichotomy, the appearance of connectionism resulted in a revitalisation of cognitive psychology and,

as an educational approach, also generated considerable interest among researchers (Siemens, 2004; Downes, 2008; Bell, 2011), offering advancements which are potentially applicable in the field of mathematics education.

Since cognitivism is the most significant precursor to connectionism, it is worth highlighting the differences and similarities between both theories, which are summarised in Figure 1.

The architecture of the connectionist mind is based on artificial neural networks which are more or less complicated systems, made up of simple processing units. These units play a role analogous to neurones and relate to each other through connections of specific weights (different strengths) and generate complex systems of parallel computing (Crespo, 2007).

In these models, a minimum number of processing units allows different types of knowledge and the relations between them to be represented, whereby the loss of some units does not necessarily lead to the loss of information. Once trained in a particular task, these connectionist networks are resistant to contamination and enable the brain to acquire the learning of concepts, while also executing processes that, in line with McLeod, Plunkeett and Rolls (1998), tend to appear as mental processes in connectionist models. Namely:

• The combination of neural information is produced in parallel, even though the neurones are made up of different types. A large number of neurones are activated at the same time to complete the information by working together.

• The transmission of information is obtained through the relation between some neurones with others, in which the activation of processing units occurs as a result of different perceptions.

• The neurones are distributed in strata or independent cerebral layers and information is transmitted from one layer to the other or between different layers.

• Changes produced depend on the weight and strength of connection of the neurones, which are established through relations between responses or output units and transmitter or input units.

• Neurones constantly receive external stimuli which they process and modify. As a result, learning occurs

thanks to changes in the weights and strengths of the connections between such units, which are determined by perceptions.

According to Cobos (2005), the result of this is that the information received is coded through the neurones in a distributed manner, since various neurones are needed for us to be able to represent an object and, moreover, these neurones are an integral part of the representation of others.

This focus allows us to consider connectionism as a new bridge between cognitive science



Figure 1. Similarities and differences between cognitivism and connectionism.

and neuroscience (Caño & Luque, 1995), and invites us to analyse its repercussion on learning.

#### 1.2. Connectionism and early childhood mathematics education

According to Merzenich and Syka (2005), one of the most relevant factors in the achievement of effective learning and the development of memory is attention, understood as "the main process involved in the control and execution of action" (Llorente, Oca, & Solana, 2012: 47). Accordingly, this is the faculty of choosing notifications out of the different senses that people perceive in the successive moments of their lives and of driving cerebral processes (López, Ortiz, & López, 1999). Thus, in order to be able to process information, children must be attentive, but it is also important that the processes used to develop learning are suitable.

In this sense, connectionism is adopted as a teaching model and as a model for the analysis of mathematics learning in Early Childhood Education, taking into account that the capacity to connect, associate and recreate are the identifying traits of this theory (Siemens, 2004). Returning to the questions related to mental processes that tend to appear in connectionist models, the following analogies are established to work on mathematics at early ages:

• Neurones are related to each other in parallel to develop information: mathematics activities should not be presented in a linear manner given that different factors intervene when concepts are being evoked. As a result, it is vital to touch and see different material, but not in isolation.

• Neural information reaches the brain through perceptions: the visual, auditory, tactile, and olfactory stimuli that come from the external world are vital in attracting the child's attention and interpretations of these stimuli play a very important role in learning.

• In the same way that the information of cerebral layers is transmitted from one layer to another, mathematics concepts are built on each other, progressing gradually from the simplest to the most complicated one (Skemp, 1980).

• The more connections, the greater the evocative capacity, and as a result, concepts are fixed more strongly in the memory, are remembered with greater clarity, and at the same time, conceptual relations are recuperated better since different connections participate in our memory footprints, with each of these supporting numerous different footprints (Rumelhart & McClelland, 1992).

From this perspective, connectionism advocates a holistic form of education in which the development of contents following a temporal sequence is replaced by global development. According to this view, concepts are presented at the same time so that, on invoking some of them, not only are specific storage units activated, but also the units that save the mental images of related concepts, thus improving the evocation conditions. Specifically, early childhood mathematics education should be a coherent system which prioritises the mental construction aspect of the elaboration of an internal framework, in which different concepts are developed at the same time, leading to the subsequent creation of new concepts and mathematical processes.

This approach has already been discussed to some degree by different organisations and authors. From the approach of Realistic Mathematics Education (RME), Freudenthal (1991) proposes the beginnings of interconnection, according to which the blocks of maths content should be connected to each other. The National Council of Teachers of Mathematics of the United States (NCTM, 2000) considers connections as one of the five fundamental mathematical processes that should be worked on at all ages: Teaching programmes at all ages should equip students to: recognise and use connections between mathematical ideas, understand how mathematical ideas are interconnected and built on top of each other to produce a coherent whole, and recognise and apply mathematics in non-mathematical contexts (NCTM, 2000: 68).

On the basis of these ideas, Alsina (2012) outlines different types of connections and numerous Early Childhood Education mathematics teaching-learning contexts. Specifically, he presents two main types of connections: a) connections between the different blocks of mathematics content and between mathematical contents and processes (intradisciplinary connections), b) mathematical connections with other areas of knowledge and with the environment (interdisciplinary connections).

Some preliminary studies have provided evidence concerning the positive effects of working on different concepts at the same time (Ortega & Ortiz, 2003; Vicario-Solorzano, Gómez, & Olivares-Ceja, 2014). But as far as the authors are aware, no research has been carried out in early childhood mathematics education which are based on connectionism. To advance in this direction, this study analyses the process of teaching-learning mathematics in Early Childhood Education on the bases of connectionism, with the specific objectives being, on the one hand, to determine the characteristics of a mathematical practice which promotes connections, and, on the other hand, to identify the different types of mathematics connections required to foster connective intelligence.

#### 2. Material and method

The study presented here has been carried out under an interpretative paradigm. From the perspective of research into mathematics education, it is understood that this paradigm focuses on describing the personal significance of facts, the analysis of relations between people and their environment, as well as the cognitive and attitudinal aspects of the participants (Godino, 1993). From this research perspective, and in line with the objectives proposed, a qualitative methodology has been applied to obtain data (Pérez, 1994). Specifically, two methods have been used: a) the Action-Research method (AR) (Kemmis & McTaggart, 1992), comprising six cycles which will be specified below, and b) Grounded Theory (Strauss & Corbin, 1998), to analyse the data obtained in each of the AR cycles and to obtain categories.

#### 2.1. Participants

The study has been carried out in the Early Childhood and Primary School known as "Federico García Lorca" in Valladolid (Spain), considering the mathematical activities of two consecutive years carried out with 271 children of the different levels of Early Childhood Education (3-6 years old), having previously obtained the necessary informed consent of their parents. The study has been conducted with the participation of six teachers with considerable professional experience, who are also active in ongoing educational innovation processes, which they provided information on for each six-month period in which the study was carried out. In addition, the study also counted on the participation of an external agent, a support teacher from the school with thirty years' teaching experience in Early Childhood education, specialised in mathematics education at this level.

#### 2.2. Design and procedure

In the first instance, different meetings were planned with the researchers and the Early Childhood Education teachers. In the first meeting, connectionism was presented as well as its teaching potentiality. Subsequent meetings discussed ways in which mathematical activities could be carried out from this perspective and debates were set up aimed at clarifying how to collect the data.

The six participating teachers elaborated documents in which they reflected on all the activities carried out on a daily basis and during the different periods of the study, outlining the concepts worked on in a connected way, as well as their observations and the results of the activities. In addition to these reports, other six were obtained in which the external observer commented on her reflections of the teaching during each experimental period and the degree of satisfaction of the teachers.

The periods in which the reports were elaborated corresponded with the months of November, February and May of each academic year, resulting in the six cycles of AR. In a complementary manner, video recordings were

carried out during maths dictations (blank sheets of paper with maths instructions duly sequenced and adapted to their level) in the first year of the study and in the second year to test the children's progress in the development of logical mathematical reasoning.

In summary, each AR cycle takes into account the f o 11 o w i n g aspects:

• Reports of the six participating teachers: they



Figure 2. The Action-Research cycles.

record the content worked on during the term corresponding to each educational level in a coded format that records the day, month, academic year, educational level, group and connection of concepts. For example, code 2N11B (2, 3) corresponds to the activity carried out on November 2<sup>nd</sup> of the first year of the study, in class Year 1 B, with the concepts worked on at the same time indicated in parenthesis. The organisation of the data is structured in tables with the following headings: code of the activity, observations and possible categories.

• External observer's report: reports on the most noteworthy aspects of the teaching with absolute freedom, without any influence from the research team. Specifically, the protocol followed comprises seven items with different sub-sections: 1) the child and aspects of logic, 2) the child and quantity, 3) the child and geometrical and topological aspects, 4) the child and aspects of measurement, 5) the child and stories, games and problematic situations, 6) teacher's level of satisfaction, 7) other observations of interest.

• Video recordings: video recordings are made to be able to observe the children in action. Recording times oscillate between approximately 10 and 30 minutes.

• Evaluation of the activities: a count of the positive responses made by the child in relation to the connected activities they have carried out in each working day.

• Establishing of categories: the data collected in the reports, the video analyses and the tables are compared in order to establish emerging categories.

The flow diagram shown in Figure 2 summarises the followed procedure.

• The "Constant Comparison Method" of Grounded Theory (Strauss & Corbin, 1998) has been used to obtain the categories. The following levels of analysis have been considered: First level of analysis: the first steps consisted in reading and re-reading the information obtained through the different research instruments, in order to become familiar with the content and to develop a first impression. Following this, the information was segmented into fragments according to the ideas contained, identifying those expressing similar or related ideas through a common denominator. At this first level, the information received is organised by fragmenting or segmenting it into units: as the information is read, the different mathematical connections detected are highlighted and noted. In other words, the "raw data" (original material) starts to be transformed into "useful data" through initial coding and classification.

• Second level of analysis: on the basis of this first coding and classifying of the information obtained through the different instruments, group categories are established, such as "connections between different mathematical content" or "connections between mathematics and other disciplines", among others. In this sense, the coding and categorising process involves the triangulation of comparing, ordering and structuring to establish categories that enable the data to be compared (Gibbs, 2012).

• Third level of analysis: the categories are renamed, using the "Constant Comparison Method" described by Strauss and Corbin (1998), which includes the comparisons carried out in relation to the similarities, differences and connections of and between the data. The units capture and encapsulate meanings and actions. Thus, as relations are created and units compared in order to forge a preliminary analysis of the ideas, the names and content of the units also change, highlighting new relations and possible interpretations between categories. In this way, units are renamed, eliminated, compared, etc. and attention is focused on discovering them.

#### 3. Analysis and results

In the first place, an example of an activity carried out with 23 three-year-old students at the end of the third term of the first year of the study is shown, and, in the second place, the qualitative analysis of the activity is presented to establish a prototype of connectionist mathematical practice and the system of categories obtained from it.

#### 3.1. Description of connectionist mathematical practice

The main objective of the activity presented is that the three-year-old children understand some basic aspects of the relativity of mathematical concepts.

Before starting the activity, and in order to contextualise the situation, the children had worked on the red and blue colours of the long and short rods as an introduction to measuring, and had played freely with the material used previously. When the activity in question starts, the children are seated in a circle and the teacher places different materials in the centre (Figure 3), such as a box of different sized ropes, some Cuisenaire rods and a worksheet.

With regard to the sequencing of the activity, it is presented in four different parts: 1) the comparison of the length of different ropes from the box is worked on through observation, 2) the children are asked to measure two ropes laid out along the floor with the number 2 rod and the number 9 one, and they are asked which rope they

put more rods next to (the difference must be significant for them to say that there are a lot next to one and only a few next to the other), 3) the rods used to measure each rope are put into different piles to be able to see the difference more clearly and, one by one, the children are asked to turn around and estimate which is short and which is long through touching them, 4) individual work is carried out on a worksheet, colouring two hose-

pipes –one short and one long– following the code indicated by the mascot on the worksheet, who points to a short red rod and to another long blue one.

Throughout the



Figure 3. Comparing lengths, starting to measure with rods and individual work.

didactic sequence, the teacher asks different questions to guide the students in the process of discovering the reason for the relativity of some concepts. An extract of the transcription of the activity is provided below by way of illustration:

- Teacher: "Today we've brought in a very special box".

- Maria 1, smiling: "What's this box called?"

- Everyone: "The box of rope".

One of the girls remembers the special name they gave to the box.

- Maria 2: "The box of mice".

- Teacher: "The box of mice because we have mice tails inside. And if we pull the mouse's tail and it says 'ouch', it's because there's a mouse inside. Is there a mouse?"

- Everyone: "Yes! It's inside".

The teacher takes the "mouse box".

Numbering and calculating

Identification of the number 2

and associating it with a

Discriminating quantities: a

few/many.

quantity

Measuring

- Teacher: "Let's see if there's a mouse inside. Let's see, let's see... let's see if it comes out".

The teacher shakes the box and pretends to play with the mice, putting her hand inside.

Table 1. Connections between the different blocks of mathematical content

characteristics

Interpreting codes

colour

objects.

- Teacher: "Let's see. Keep still little mouse. Will you keep still, please?! It can't wait to get out! My oh my. Let's close the box or it will escape".

The teacher shows the ropes (which represent the mice tails) as she takes them out of the box.

Logic

Recognising the properties of objects:

Discriminating the differences between

Differentiating sizes through the senses

Relating elements with the same

(sight and touch): long and short.

- Teacher: "Ok. Let's see if there are a lot of mice or just a few. How many do you think there are? A lot? Or just a few?

Geometry

Identifying

positions:

inside and

outside

- Everyone: "Looooooots".

# 3.2. Results extracted from the qualitative analysis

On the one hand, the detailed analysis of the teaching activities of the six AR cycles has led to the establishment of a basic mathematical practice prototype

for teaching-learning mathematics in Early Childhood Education and, on the other hand, to the establishment of a system of categories.

#### 3.2.1 Prototype of connectionist mathematical practice

A teaching sequence following a connectionist approach should follow the guidelines provided below:

• Organisation and group presentation of the different didactic material.

• Asking the students well-formulated questions one by one to help them start to discover the different mathematical content.

• Presentation of the content involved in the activity to help the children understand it.

• Repetition of the activity so that the children can practice all the content worked on.

• New period of dialogue through "mathematical conversations" about their experiences to increase the force of the connections made between content.

• Asking of new questions to help the children internalise the connections.

• The need to bring collective experiences to the level of personal experience by representing on paper to help memorise the contents worked on.

#### 3.2.2 System of categories

As a result of the process of constantly comparing the data, three categories have been obtained which represent the baseline upon which the subsequent theory has been delimited:

• Conceptual connections: responsible for producing links between different mathematical content.

• Teaching connections: responsible for establishing links between different mathematical concepts through an active methodology and by working with mathematical experiences linked to other areas.

• Practical connections: establish relations between mathematics and the environment.

At the same time, these categories are interconnected, forming a neural network which has enabled us to establish which type of connections appear in each of them with more precision (Figure 4):

• Conceptual connections: the identification of sensorial qualities, of quantities of a numerical series, of forms of spatial situations, of aspects of measurement, of similarities and differences between scenes; grouped according to the following criteria; association of number and quantity; discrimination of quantities, of forms, of aspects of measurement; different relations, such as the pairing of the same objects, classifications, series, sorting, comparing objects; simple graphic representations; and starting to use mathematical language.

• Teaching connections: active methodology, holistic teaching, evaluation and assessment.

• Practical connections: mathematics in the environment, as well as stories, games and didactic material.

It is important to highlight the relevance of the practical categories of connection in relation to the objectives of



Figure 4. Structure of categories of emerging connections.

this study, since these connections are needed if children in schools are to carry out activities in which logic, numbers, information handling, geometry and measurements appear in a connected way, both in relation to their daily lives and with the use of different teaching-learning resources (stories, proverbs, poems, didactic material, etc.).

#### 4. Discussion and conclusions

This article presents some advances concerning the role of mathematics education in the construction of connective intelligence in the early ages of human development, assuming that mathematical thinking plays an
important role in the individual's capacity to make decisions, solve problems, process data and understand their social environment.

While traditional channels of access to mathematics knowledge were based on the transmission of information in a sequential and linear manner, our study has explored the elements that should be taken into consideration in education in general, and in teaching in particular, to promote a new approach to the teaching-learning of mathematics which takes into account and fosters connections between different knowledge, as an essential element in developing citizens with the skills needed to manage decision-making tasks in a critical way. In this sense, in the field of mathematics education, over recent decades different organisations and authors have been advocating the importance of presenting mathematics knowledge in a connected way from early ages (Freudenthal, 1991; NCTM, 2000; Alsina, 2012). Despite this, research into early childhood mathematics education has not provided findings that offer specific guidelines for teachers to foster connective intelligence. In order to develop this specific line of enquiry, a study has been carried out over two consecutive years which has enabled us to establish a prototype of activity or set of activities, in the form of a didactic sequence that promotes connections between contents. Up to

the time of this study, some authors in the field of Early Childhood mathematics education have contributed data on learning trajectories in order to sequence (and be able to connect in a suitable way) mathematics contents of the same block (Clements & Sarama, 2009), or have explored the phases that should be taken into account in the design, management and evaluation of competency-based mathematical activities that include connections, among other processes (Alsina, 2016). However, no prior studies are available on the specific elements that should be

We present a prototype of an activity or set of activities that, in the form of a didactic sequence, promotes the connections between the contents in order to construct connective intelligence in the early ages of human development, assuming that mathematical thinking plays an important role in the individual's capacity for decision-making, problem-solving, data-processing and the understanding of the world.

considered in order to carry out mathematical practices from a connectionist perspective. The establishment of a prototype of connectionist activity thus represents an innovation in education, which is the result of specific research in this area, in the sense advocated by Llinares (2013).

Another important contribution of the study lies in the establishment of different kinds of connections. The interpretation of the results offers a body of central connections, with all the potential relations that exist between the different categories of each group, and which also depend on and interrelate with other groups, thus configuring a new way of working on the development of mathematical thinking in Early Childhood Education.

In order to promote connective intelligence in the classroom from early ages of human development, it seems more than apparent that the formats derived from education or, in other words, training models, should aim to provide teachers with in-depth knowledge of these different types of connections and the ways to develop them in their students, considering the features of a connectionist teacher as proposed by Askew and his colleagues (1997).

In summary, considering the objectives of our study, the main conclusions are as follows:

• Mathematics education can play an important role in the construction of a connective brain from early ages of human development, considering its role in relation to decision-making, problem-solving, data processing and understanding the social environment.

• The promotion of connectionism in early childhood mathematical practices requires a didactic itinerary characterised by a planning and management process including six phases: the use of didactic material for working in groups, asking the students' questions, group discussion, subsequent mathematical conversations, the asking of new questions and the individual representation on paper of the knowledge acquired.

Connectionist practices present three main types of connections: conceptual, teaching and practical.

• Practical connections have particular relevance since they are responsible for connecting knowledge related to everyday life.

• Teachers should have in-depth knowledge of the different types of connections and the ways of developing them with their students.

In this regard, some of the main limitations of this study have been the fact that no prior analysis was carried out of the participating teachers' knowledge of connectionism, and the fact that no comparison was made of the students' mathematics learning in relation to other groups of students who have not learned mathematics in this way. Future studies will therefore be needed which use a specific model to explore mathematics teachers' knowledge, such as Mathematical Knowledge for Teaching (MKT) by Hill, Rowan and Ball (2005) and Hill, Ball and Schilling (2008), or the Didactic-Mathematical Knowledge Model (CDM) of Godino (2009), and Godino, Ake, Gonzato and Wilhelmi (2014), in order to conduct a more precise analysis of Early Childhood teachers' knowledge of connectionism and ways of implementing it in mathematics practice. Likewise, in order to validate the classroom application of this teaching model, whose goal is to foster connective intelligence, new quasi-experimental quantitative studies should be designed to compare the performance of students who learn with a connectionist approach with others learning with more traditional methods that do not take into account connections.

A more precise diagnosis of the question will thus help to establish a set of lines of practice which are much more appropriate in relation to both pre-service and in-service teacher training, given the increasing importance of fostering the connective intelligence of our students, considering the contributions of Neuroscience and other related sciences, which propose radical changes to the way in which individuals access knowledge.

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### The Cognitive Processing of an Educational App with Electroencephalogram and "Eye Tracking"

El procesamiento cognitivo en una app educativa con electroencefalograma y «Eye Tracking»

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#### ABSTRACT

The use of apps in education is becoming more frequent. However, the mechanisms of attention and processing of their contents and their consequences in learning have not been sufficiently studied. The objective of this work is to analyze how information is processed and learned and how visual attention takes place. It also investigates the existence of gender differences. The responses to 15 images are analyzed using "Eye Tracking" and EEG in a sample of 22 young students. The recall and liking of the stimuli is also analyzed. The characteristics of the images are evaluated by experts. The results indicate that there is a different pattern of visual activity between men and women which does not affect subsequent recall. The recall is determined by the emotional value of the image and its simplicity: more complex images demand more time of visual fixation but are less remembered. EEG responses confirm the importance of the playful component of the memory and low involvement processing. The conclusion is that the behavior against an app of this type resembles the low commitment behavior of advertising itself. Finally, some considerations for the app content design are proposed.

#### RESUMEN

El empleo de apps en educación es cada vez más frecuente. Sin embargo, no se han estudiado suficientemente los mecanismos de atención y procesamiento de sus contenidos y sus consecuencias en el aprendizaje. El objetivo de este trabajo es analizar cómo se procesa y aprende la información y qué tipo de atención visual se le presta. También se investiga la posible existencia de diferencias de género. Sobre un total de 22 jóvenes se analizan las respuestas de «Eye Tracking» y electroencefalograma (EEG) frente a 15 estímulos de una app de educación en salud. También se analiza el recuerdo y agrado de los estímulos por parte de los sujetos. Las características de las imágenes son evaluadas por expertos. Los resultados indican que existe un patrón de actividad visual diferente entre hombres y mujeres el cual no incide sobre el recuerdo posterior. El recuerdo viene determinado por el valor emocional de la imagen y su simplicidad: las imágenes más complejas absorben más tiempo de fijación visual pero son recordadas menos. Las respuestas del EEG confirman la importancia del aspecto lúdico sobre el recuerdo. La conclusión es que la conducta frente a una app de este tipo se asemeja a la conducta de bajo compromiso propio de la publicidad.

#### KEYWORDS | PALABRAS CLAVE

Neuromarketing, neurocommunication, health communication, app, gamification, eye tracking, attention. Neuromarketing, neurocomunicación, comunicación y salud, app, gamificación, eye tracking, atención.



#### 1. Introduction and state of the art

The aim of this study is to analyse how cognitive processing is produced when using an educational application. The objective is to conduct this analysis using the recent techniques provided by Neuromarketing, more specifically, EEG (electroencephalogram) and Eye Tracking. In this way, the research work will try to set the basis of the new area of neurocommunication, an area that although stemming from Neuromarketing, possesses its own characteristics and objectives. The application of neuroscience to communication studies has very recent origins (Timoteo, 2007). It stems from the evolution produced within the field of neurology, especially in the branch applied to behavioural neurology, which seeks to explain the relationship that exists between neurological processes and their behavioural manifestation. Although it is often forgotten, the origins of this model come from Russian psychophysiology with the works by Pavlov on "conditioned reflexes", where the neuroanatomical and functional basis that would later be used to connect the brain and the behavioural processes, volitional as well as automatic or preconscious, were established. Posteriorly, other Russian authors delved deeper into the discovery of the functional basis of the brain, providing then the basis of the future field of neuroscience. Vygotski's disciple, the neurologist Alexander Luria is notable as well. He authored "The Working Brain" (1973), and "The human brain and psychological processes" (1966). At present, neuroscience is a discipline that incorporates different sciences that together share the objective of studying, from a multi-disciplinary perspective, the structure and the functional organization of the Nervous System, particularly, the brain.

It is from neuroscience and its posterior applications that neuroscience of the consumer and Neuromarketing were born. Disciplines that combine psychology, neuroscience and economy to study how advertising and marketing campaigns affect the minds of potential consumers (Lee, Broderick, & Chamberlain, 2007; Madan, 2010). The term "Neuromarketing" was coined for the first time in the 1980's by Ale Schmidts, Nobel prize winner and professor at the Department of Marketing at the Rotterdam School of Management in The Netherlands (Ramsoy, 2015). Human behaviours are marked by operational processes that are shaped under the threshold of consciousness (Calvert & Brammer, 2012), so that delving into the unconscious plane to understand what brings the consumers to activate a behavioural process is vital for the making of decisions. It is evident that the brain's activity can provide information that is otherwise not able to be obtained through traditional methods of research such as "focus groups", questionnaires or interviews (Ariely & Berns, 2010). A research methodology should be made available that allows for the reaching of these objectives and the understanding of the human cognitive system. Therefore, the direct reaching into the human brain is necessary (Le-Doux 1996; Zaltman, 2003). The use of methodologies that simultaneously combine the techniques of "Eye Tracking" with EEG could be relevant for obtaining information outside of the range of capacities of conventional methodologies. The biometric technique "Eye Tracking", or monitoring of eye movement, allows for the analysis of patterns of visual attention in terms of visual fixation, as eye movement is linearly identified with visual attention (Duchowski, 2013; Añaños-Carrasco, 2015) and offers results on the communicative impact with respect to the variables impact, appeal and effectiveness (Arbulú & del-Castillo, 2013). There is solid empirical evidence that shows the relationship between the stimuli shown and the brain reactions measured with an EEG (Ohmea & al., 2009). All of this allows us to think that these methodologies, which are usually employed in the field of Neuromarketing, could be very useful for the study of communication foundations, thereby constituting the new field of "neurocommunication".

Also, the ICT (Information and Communication Technologies) are defining a new way to communicate, in which the digital audiences demand interactive content that can be adapted to a new pattern of media consumption, in which the "smartphone" and "tablets" occupy a dominant place. These digital natives demand content that connects their information needs, but also their leisure, social and educational needs as well. In this scenario, it is easy to understand the rapid rise of the applications (apps). According to the "5th report on the apps in Spain", presented in 2014 by "The App Date", there are 23 million active app users, 3.8 million apps are downloaded per day, and there is an average of 39 apps installed per "smartphone" (Niño & Fernández, 2015). One of the sectors that has quickly progressed is the sector of health apps. This new field of activity is identified by the concepts "eHealth" and "mHealth", which is an answer to medical practice and public health through mobile devices. The apps used in this field are tools that allow for the fomenting and development of care and prevention of health, and their use in education is becoming ever more frequent. However, until now, the mechanisms of attention and processing of the app's images and content, as well the manner in which these processes influence learning have not been sufficiently studied.

The main objective of this study consisted in analysing a few of the cognitive elements (such as attention and recall) that lie underneath the cognitive process of communication. More specifically, it focuses on the study of these

mechanisms just as they are produced during the processing of content (images and texts) that are habitually used in specific apps, since, in spite of their increased use (especially among the young), their mechanisms of action have hardly been experimentally studied. In this research work, we have focused the study on the images from a health education app for the younger population: the application Viquiz. This application uses a game-oriented procedure, or "gamification", in the framework of the so-called "serious game", within the context of education entertainment ("edutainment"). We will try to analyse the processing of prototypical images and texts from these apps, employing objective research techniques: the EEG and "Eye Tracking", belonging to the area of neurocommunication. Additionally, we will explore the gender differences in this field, with the objective of understanding the possible existence of different patterns of visual and cognitive conduct.

As the secondary objective, we will try to contribute objective and empirical data that allow the academic community to move forward in the

construction of the field of neurocommunication, recovering and adapting techniques and procedures belonging to Neuromarketing to the science of communication and education. There is a limited number of research works that, by applying the techniques of neuroscience and psychobiology, propose the study of cognitive processes of communication. In general, these types of works have focused on applying the result of the brain, visual, electrodermal, cardiac, etc. responses to the study of communication efficiency (advertising, almost always). Hence their origins are Neuromarketing. However, in

To achieve greater learning, it is necessary that the content incides in the leisure aspect of the activity, avoiding complex content, as it is not well remembered later even though it captures the attention of the subjects. Also, the data presented indicate the need to be prudent with the application of neurocommunication techniques to academic research. The data indicate that the fact that the subjects focus their vision on specific areas of interest does not imply that there is a greater active attention that results in better recall.

this work, we present a different focus, in which the main objective is to understand the mechanisms that regulate the cognitive responses when subjects are faced with specific stimuli. Also, we are especially interested in developing this area in the fields of communication and education, more than in the fields of advertising and marketing. Likewise, within the context of the ICT, which are especially important for the young, and more specifically, within the education apps through "gamification", the use of neurocommunication techniques will allow us to objectively study specific gender differences as just discussed. There is empirical evidence that women, in general, pay more attention to health information than men, and also have more interest for the health ICT (Cuesta, 2016). However, objective measurements of visual attention or differences in EEG have never been taken. In this context, the hypothesis of the research planned is the following:

• Hypothesis 1: Women will score higher in the indexes of attention, appeal and recall. On the other hand, taking into account the existing works on attention and perception (Goldstein, 2005; Pinillos, 1975), which suggest that complex images require more time for extracting their meaning ("prise of signification"), we hypothesise that:

• Hypothesis 2: The more complex images will require more time for analysis, which will translate into longer times of observation of the image (ocular fixation time in milliseconds, ms).

Lastly, as we are dealing with a leisure activity belonging to "edutainment", the subjects will find themselves in a situation of "low cognitive involvement", which will induce peripheral processing of information (Petty & Cacioppo, 1983; Cuesta, 2006). Peripheral processing is characterised for extracting meaning through simple processing routes, through "heuristics". Therefore, we hypothesise that:

• Hypothesis 3: Recall will not be linked to the complexity of the stimulus, but to its ability to "appeal", meaning more linked temotional than rational attraction.

#### 2. Materials and methods

Images from the Viquiz app were used as the stimuli. Viquiz is a mobile application for fomenting healthy habits through gaming or gamification, developed by Wake App Health, and has counted with the financial support of the FECYT, the Spanish Foundation for Science and Technology from the Ministry of Economy and Competitiveness. It is available in Google Play for Android devices. It can be downloaded for free through the following link: http://bit.ly/1sX1db1. For the selection of images, the following criteria were used: "All the images on the homescreen or the ones from the start screen from each different section of the game".

A total of 15 images that allowed for studying the interest created by each screen were chosen, allowing for a comparison between the different types of images. Among these 15 images, the first one of them is the homescreen image (image "entry"), and has the advantage of offering, within the same image, different "areas of interest", that are very suitable for being studied through the use of the "Eye Tracking" technology. There is a total of 9 "areas of interest" (entry 1, entry 2, entry 3...). The homescreen image, along with its 9 areas of interest (AI) are shown in figure 1, which also shows the average values obtained with the "Eye Tracking" technology.

The entry images were classified by 2 judges who were experts on "edutaiment" apps, with the aim of classifying them as a function of 2 variables:

• Variable "complexity of the image", using a Likert scale from 0 to 7, with 0=not complex, and 7=very complex, as a function of semionarrative interpretation complexity. It was conducted with the usual "interjudge agreement" (Dubé, 2008). The agreement's Cronbach's coefficient was 100%.

• Variable "type of image", with dichotomic values that depended on the predominance, within the image, of an emotive figure or text, with values being 1=emotive picture, 0=text.

As the measuring tool, the "Eye Tracker" model Tobii X60 (www.tobii.com) was used. For the filtering of data and clean-up of noise, the software program used by Fusión Comunicación based on the methodology and software by SMIVision (www.smivision.com) was utilized. For a review on the use and analysis of data with "Eye Tracking" and the state of the art, please consult the work by Blascheck, Kurzhals, Raschke, Burch, Weiskopf and Ertl (2014). After performing an initial calibration for each subject, a minimum of 95% of the visual recordings were attained. For EEG monitoring, the unit "Emotiv EPOC" was used. This is a high-resolution unit for the monitoring and processing of the neuronal electrical signal that monitors 14 EEG channels. The electrodes were distributed in the positions labelled in Figure 2, according to the "International system of electrode placement" guidelines (Cacioppo, Tassinary & Berntson, 2000). The signals from the prefrontal, frontal, temporal, parietal and occipital regions were recorded. The EEG signal was monitored and recorded continuously during the viewing of the images

on the screen.

The study was divided into two different phases as far the procedures.

In Phase 1, EEG and the "Eye Tracking" were monitored on 22 subjects, 11 men and 11 women, who were students at the Faculty of Information Science in Madrid (aged 19-21 years old). This specific sample was used as the app analyzed was designed for



Figure 1. "entry" image where the 9 AI and the global "Eye Tracking" values are shown

a young target audience with a mid - to - hig h socio-cultural status. All the subjects took part in he study voluntarily, without receiving additional university credits. They were briefly



Figure 2. Simultaneous monitoring of the EEG and "Eye Tracking", and the position of the EEG sensors.

informed individually about the activity to perform, explaining to them that it would consist on viewing images from a health app that suggests a competitive game, but that they would not be competing. They would only view the screens. As the selection criteria, their lack of previous knowledge about the app was the deciding factor. All the subjects were subjected to the same experimental setting, and would view the same previously-mentioned stimuli while they were monitored. Therefore, an exploratory study with an intra-subject design and with the random assignment of the different levels of experimental treatment (sequences of images), is conducted. The stimuli were presented randomly, and the display of each of them was randomly rotated as well. When the monitoring was finalized, all the subjects completed a questionnaire in which they were asked about the sections or images that were most interesting to them (open-ended question), with the aim of measuring the "salience" of the images in order to detect the ones that had special impact.

During phase II of the study, the subjects were presented with a recall questionnaire a week after Phase I. This time interval is sufficient for producing a "forgetting curve" that allows for discriminating recall (Cuesta, 2006), although a few authors have proposed 3 weeks (Allende, 2010). This questionnaire evaluated two variables: a) Recall: the subjects describe the images they remember (the % recall is calculated); b) Appeal: the subjects have to score, the image's appeal, using a scale of 0 to 10 ("liking" scale).

The dependent variables were the following:

1) Degree of attention paid to the images, evaluated from the "Eye Tracking" data, measured with two of the most-utilized parameters in this type of research studies (Añaños, 2015): a) Duration of ocular fixation (in ms); b) Number of ocular fixations.

2) Cognitive activity provoked by the images according to the EEG: a) Attention: divided into short-term (instant) and long-term (minutes); b) Degree of involvement: concentration with the content of the image. Implication: the degree of cognitive re-enforcement dedicated to the image; c) Appeal: level of positive emotion that the image provokes; d) Recall and appeal of the images seven days after their viewing.

As for the independent variables, the following were used: a) The images described; b) Gender (man, woman); c) The image characteristics according to the evaluation by the experts: Complexity of the image (Likert scale 0-7) and Type of image (1=emotive, 2=text).

#### 3. Analysis and results

As shown in the heatmaps in Figure 3, the ocular fixations were concentrated in the points of greater interest for the subjects. The analysis of these ocular fixation targets comprise an objective measurement of the areas of perceptual interest of the subjects. However, the empirical evidence available is not consistent with respect to what exactly the attention given to the stimulus indicates (Ohme, Reykowska, Wiener, & Choromanska, 2009). The heatmaps are very useful when developed in the field of applied Neuromarketing, where it is used for detecting global areas of interest of the consumer. For example, to detect fixation points in a product line in a large surface area shop. However, this information is qualitative in nature, and does not allow for the empirical analysis of cognitive processes (attention, activation, recall, etc.) that underlie this behaviour.

To quantitatively analyse this cognitive-perceptual behaviour, areas of interest (AI) were defined through "Eye Tracking", as defined in the methods section and shown in Figure 1. The recording of the ocular behaviour (average time of fixation and number of ocular fixations) and the EEG recordings were simultaneously conducted for these AI. The quantitative data obtained for both cases, together with the data obtained by the questionnaires, were processed with the IBM SPSS Statistics 22 software program. The results of "Eye Tracking", did not support hypot-

hesis 1 (Women will score higher in the indexes of attention, appeal and recall). Table 1 shows results that were contrary to what was expected: women had an ocular behaviour that was characterized by a greater number of fixations (2,056 as compared to the 1,720 in men), which implied a greater frequency of fixations per second (2.34 versus 1.96 in men), as well as faster fixations (386 ms as compared to 459). This means that the ocular behaviour of women showed a faster pattern of movements. This movement was more visually "saccadic" than that of men. Saccadic movements are the fast and intermittent jumps of the eye's position when fixing onto a foveal object.

It is very likely that these results are due to the ocular behaviour pattern of women, which is independent of the type of task they are facing. Although visual conduct has barely been studied from the point of view of differences in gender according to optical psychophysiology, there is some evidence that suggests the presence of a different behaviour between men and women in this field (Stemmler, 2005). The EEG results (Table 2) show that women scored higher in the "appeal" variable with respect to the men, without showing differences in the rest of the EEG variables: attention (short and long-term), degree of involvement and implication (p < .055). However, this result was only found in the image that showed a spontaneous recall of 100% in the final questionnaire ("salience" questionnaire, or impact of stimulation), while the average value for spontaneous recall for all the images was 37%,



Figure 3. "Heat map" of the "entry" stimulus..

which allowed us to suppose that the image had a special impact on the subjects, given its high score as compared to the average recall value, and given that it was the only one that was recalled 100% (image 14 of the heading "sexual conduct", showed a condom). This result could indicate that when faced with an image of high impact (high ability of impact, in terms of Neuromarketing or advertising) the EEG shows higher values with the variable appeal, especially among the women group. Table 2 shows the results found through an ANOVA, which was performed for the 5 EEG dependent variables (short and long-term attention, appeal, involvement and implication).

A new Analysis of Variance conducted after the EEG of this high-impact image (image 4-14) as compared to a medium-impact image (image 7-17), showed the following pattern: the EEG variables involvement, attention (ST and LT) and implication had higher values (p<.000) as compared to the variable appeal with respect to the medium-impact image, while the pattern is inverted for the high-impact image. These data suggests the existence of a possible EEG response pattern in this type of experimental design, leading us to conduct an analysis of the factorial structure of the EEG responses to the entire set of stimuli presented. A principal component factor analysis with Varimax rotation was performed. The results are shown in Table 3.

The data show the appearance of 3 factors in the EEG responses:

• In the first factor, the variables "involvement" and "implication" are saturated. This could represent a factor of "cognitive effort", as both involvement and implication are variables that have been traditionally associated to the effort a subject is willing to make when processing information.

• In the second factor, both short-term and long-term "attention" variables are saturated. This represents the degree of "focusing or overall attention" paid by the subject.

• The third factor is saturated with the variable "appeal", which represents the appeal value of the stimulus for the subjects.

The EEG factor analysis seems to indicate that the cognitive activity in this type of game-based learning tasks through an app can be grouped into three areas: a) cognitive effort; b) attention; c) appeal. Both cognitive effort and

| Table 1. Kruskal Wallis test (*p<.01)  |         |          |  |  |  |
|--|---------|----------|--|--|--|
| Analysis of the ocular fixations and their<br>duration as a function of gender | Men     | Women    |  |  |  |
| Nº total de fixations  | 1.720   | 2056*    |  |  |  |
| Frecuency of fixations per second  | 1,96    | 2,34*    |  |  |  |
| Total fixation time (ms)   | 791.729 | 758.062* |  |  |  |
| Average duration of each fixation (ms)   | 459     | 368*     |  |  |  |

appeal are not completely orthogonal, which allows for proposing the following idea: the EEG discriminates two cognitive activities between the subjects: one linked to effort and attention, and another linked to appeal. Hypothesis 2 (the most complex images will require more time for analysis,

which will translate into longer times of observation of the image) was analysed together with hypothesis 3 (recall will not be linked to the complexity of the stimulus, but to its ability to "appeal", meaning more emotional than rational attraction). Pearson's correlation was used for this, and it was conducted on all the variables included in the hypotheses: viewing time (fixation of the areas of interest in ms), recall and appeal (evaluated with a questionnaire) and emotiveness and complexity of the image (defined by external evaluators with interjudge agreement). The analysis was conducted on the 9 areas of interests (AI) of the "entry" image (home-

| Table 2. ANOVA of image "home screen 14"  |                   |                                   |    |                   |       |      |
|---|-------------------|-----------------------------------|----|-------------------|-------|------|
| Variables: EEG (ST and LT attention,<br>Appeal, Involvement and Implication)<br>and Gender (Men, Women) |                   | Sum of Degrees of squares freedom |    | Quadratic<br>mean | F     | Sig. |
| I4_ATEN_LT  | Between<br>groups | 12.525                            | 1  | 12.525            | 1.073 | .313 |
|   | Intra groups      | 233.453                           | 20 | 11.673            |       |      |
|   | Total             | 245.978                           | 21 |                   |       |      |
| I4_APPEAL   | Between<br>groups | 80.512                            | 1  | 80.512            | 4.252 | .055 |
|   | Intra groups      | 321.925                           | 17 | 18.937            |       |      |
|   | Total             | 402.437                           | 18 |                   |       |      |
| I4_INVOLVE  | Between<br>groups | .495                              | 1  | .495              | .155  | .698 |
|   | Intra groups      | 63.980                            | 20 | 3.199             |       |      |
|   | Total             | 64.475                            | 21 |                   |       |      |
| I4_ATEN_ST  | Between<br>groups | 28.865                            | 1  | 28.865            | 2.064 | .166 |
|   | Intra groups      | 279.705                           | 20 | 13.985            |       |      |
|   | Total             | 308.571                           | 21 |                   |       |      |
| I4_IMPLICA  | Between<br>groups | .409                              | 1  | .409              | ,571  | .459 |
|   | Intra groups      | 14.325                            | 20 | .716              |       |      |
|   | Total             | 14.735                            | 21 |                   |       |      |

screen). The results are shown in Table 4.

The results indicate the following: a) a statistically-significant negative correlation (p < .024) between the variables recall and image complexity; b) a positive correlation between recall and emotiveness of the image (p < .007); c) a negative correlation between emotiveness and complexity (p < .017).

Therefore, hypothesis 2 is supported, but only marginally: there is a "tendency" towards the direction proposed by the hypothesis, but the degree of significance is marginal (p<.070). In summary: the most complex images require a longer ocular fixation time (marginally significant) but are less remembered, while the most emotive images are better remembered. This could be due to the "edutainment" or a leisure game effect: the condition of a leisure context provokes a state of "low involvement ", belonging to peripheral or weak processing. This could mean that the more complex images are not remembered because the subject does not make the necessary effort for its mnesic storage.

This could also fit with the EEG pattern found after the factor analysis: the images with greater impact (salience) provoked a greater appeal according to the EEG, which would link it to the greater recall of this situation of low involvement. Something similar occurred with hypothesis 3, which was only partially accepted: recall does seem to be linked to the image emotiveness (p<.007), but not to its "appeal" or impact (measured with the "liking" scale used by the subjects). However, this result could be consistent with the current bibliography on Neuromarketing (Ariely & Berns, 2010); it is very common for authors to say that the reasoning behind the use of psychophysical measuremens (such as the EEG) in motivation research related to advertising is due to the fact that sometimes the verbal responses of the subjects do not always co-incide with the emotions they truly feel (Khushaba & al., 2013).

#### 4. Discussion and conclusions

The data seems to back the existence of a visual behaviour "model" that is different in women as compared to men: the visual behaviour of women in these types of tasks seems to be characterized by a more "saccadic" pattern as compared to the men. This means that they "travel" through the images faster than men, also blinking more times and faster than them. However, this pattern of visual behaviour does not result in greater learning (recall) of the

| Table 3. Factorial analysis of principal components |           |      |      |  |  |  |
|---|-----------|------|------|--|--|--|
| FEC Variables                                       | Component |      |      |  |  |  |
| EEG Variables                                       | 1         | 1 2  |      |  |  |  |
| INVOLVEMENT   | .974      | .126 | .069 |  |  |  |
| ATTENTION_LT  | .197      | .944 | .216 |  |  |  |
| ATTENTION_ST  | .091      | .956 | .237 |  |  |  |
| APPEAL  | .114      | .318 | .941 |  |  |  |
| IMPLICATION   | .969      | .139 | .101 |  |  |  |

stimulus, as statistically-significant differences were not found between men and women for the variable recall. Through the factorial analysis of the EEG, a pattern of responses of three factors was detected: appeal, attention and involvement. In this pattern, the variable recall was linked to the variable impact (saliency of the stimulus). However, the complexity of the stimulus would be more linked to attention and the degree of involvement with the stimulus according to the EEG pattern: it's possible that the more complex stimuli demand greater attention by the subjects, which obliges them to be more involved in their visual analysis. Nevertheless, the fact that they are more involved and dedi-

| Table 4. Pearson's correlation between variables from hypotheses 2 and 3 |                       |       |         |        |        |            |                          |
|--|-----------------------|-------|---------|--------|--------|------------|--------------------------|
| Correlations   |                       | Time  | Recall  | Visits | Appeal | Complexity | Emotiveness of the image |
| TIME   | Pearson's correlation | 1     | 744*    | 033    | 491    | .775*      | 717                      |
|  | Sig. (2-tail)         |       | .090    | .951   | .323   | .070       | .108                     |
| RECALL   | Pearson's correlation | 744*  | 1       | 227    | .313   | 870**      | .931***                  |
|  | Sig. (2- tail)        | .090  |         | .665   | .546   | .024       | .007                     |
| APPEAL   | Pearson's correlation | 491   | .313    | 638    | 1      | 527        | .620                     |
|  | Sig. (2- tail)        | .323  | .546    | .173   |        | .283       | .189                     |
| COMPLEXITY   | Pearson's correlation | .775* | 870**   | .232   | 527    | 1          | 892**                    |
| OF THE IMAGE   | Sig. (2- tail)        | .070  | .024    | .659   | .283   |            | .017                     |
| EMOTIVENESS  | Pearson's correlation | 717*  | .931*** | 472    | .620   | 892**      | 1                        |
| OF THE IMAGE   | Sig. (2- tail)        | .091  | .007    | .344   | .189   | .017       |                          |

The correlation is significant to 0.10 (2-tail).

\*\* The correlation is significant to 0.05 (2-tail). \*\*\* The correlation is significant to 0.01 (2-tail)

cate more viewing time does not mean that they will remember it more due to the "low involvement" that entails peripheral processing (Petty & Cacioppo, 1983). In this type of processing, the stimuli that are easiest to perceive are more easily memorized, although according to the Elaboration Likelihood Model (ELM), learning is also weaker, and the stimuli are forgotten sooner (Petty & Cacciopo, 1981; Petty & Cacciopo, 1986). In the present research, only a week was used as the interval of forgetfulness, which does not allow for the analysis of the forgetting curve with respect to this last item.

In summary, the results of this research can be interpreted in the following manner: women have a different visual pattern than men (they are less "saccadic"), but this differential pattern does not affect the posterior recall of the stimuli viewed. The immediate recall (impact) seems to be linked to the emotional stimulus variable (p < .007) and non-complexity (p<.024), as the recall is negatively correlated with the complexity of the stimulus. In line with this idea, the data showed a correlation between the time dedicated to the stimulus and its complexity (p < .070) and a negative correlation between time and recall (p < .090). This means that dedicating more time for viewing more complex elements in order to extract meaning does not mean that they are better memorized, as memory depends on the emotiveness of the stimuli. Also in line with this result, the EEG showed that it was the pattern of brain waves classified as appeal (due to the factorial analysis), the ones that better predicted recall. This phenomenon is similar to what has been shown in the reception to advertising: the most efficient advertisement is the simplest one and the one that touches upon the affective/valorative aspect of the spectator (audience or target). not the most rational. In 1965, Krugman named this phenomenon "learning without involvement" when speaking about passive or low involvement audiences. Later, Krugman (1971; 1980) tried to validate his theory through the analysis of an EEG during the viewing of a TV ad, becoming the pionner of modern Neuromarketing techniques.

The data are sufficiently significant as to recommend the developers of this type of app that the design of their content should be emotive and low in complexity. To achieve greater learning, it is necessary that the content incides in the leisure aspect of the activity, avoiding complex content, as it is not well remembered later even though it captures the attention of the subjects. Also, the data presented indicate the need to be prudent with the application of neurocommunication techniques to academic research. The data indicate that the fact that the subjects focus their vision on specific areas of interest does not imply that there is a greater active attention that results in better recall. These results are in agreement with other research studies using "Eye Tracking" on the usability of 2.0 tools, in which it was verified that the measurements of attention through "Eye Tracking" and the self-informed recall differed between them (Hernández-Méndez, Muñoz-Leiva, Liébana-Cabanillas, Marchito, 2016).

In the famous "Eye-mind hypothesis" from Just and Carpenter (1976a; 1976b) it was specified that a noticeable delay was not produced between the object a person fixes his/her sight on and what is being processed, so that when a person looks at a word or an object, it is cognitively processed during exactly the same amount of time of ocular fixation. This hypothesis resulted in an important boost of "Eye Tracking" studies. Already some authors have postulated on the relationship between attention and ocular fixation, specifying that the direction of the stare was linked to the focus of attention, therefore providing a mechanism with which the information received by the organism could be filtered (Deutsch & Deutsch, 1963; Posner & Peterson, 1990; Treisman, 1964). However, this hypothesis has been frequently called into question, as modern research has systematically shown that the shifting

of attention without ocular movement frequently occurs (Posner, 1980), and as soon as attention is directed to a new position, the eyes can conduct different types of fixations, which are not always linked to the stimulus that had originally capture the subject's attention (Hoffman, 1998).

The questions that arise are evident: what characteristics evoque the shifting of attention to specific stimuli?, what is the nature of the emotional and motivational processes that underlie visual attention?

The limitations of this study include the size of the sample as well as its composition. Another limitation has been the use of images that were specific to the Viquiz app. In future research, it will be necessary to increase the size of the sample in order to analyse the behaviour of adult and senior subjects. This will allow us to understand if the results found were dependent on learning or on basic cognitive principles. The young subjects (aged 19-21 years old) had a specific behaviour when facing gamification tasks using apps. It seems that these digital natives have developed specific patterns of behaviour within these audiovisual environments (Payne, 2014). It could also be, as shown by Añaños (2015), that the seniors do not modify their processes of attention, doing so with the processing of information, so that their conduct with these types of apps could be different. It would be necessary to widen the samples of stimuli to be used, within the realm of the "serious game" but widening the composition of the stimuli. The behavior in high/low involvement situations of the subjects should also be studied (manipulating the involvement through instructions, for example) and also increasing the interval of forgetfulness so that it is longer than a week.

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### Communication Efficiency in Education: Increasing Emotions and Storytelling



La eficacia comunicativa en la educación: potenciando las emociones y el relato

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#### ABSTRACT

The research supporting this paper addresses the problem of educational communication efficacy using a dual methodology strategy. Over 1.200 questionnaires were given out to professionals in four institutions dedicated to persuasive communication; two traditional –the church and schools– and two more recently created – journalism and advertising. Probably they are the four groups with more socialising force in the last centuries; For this paper the educators' responses were specifically analysed to determine their conception of the communication process and the requirements for effective communication, and these were compared with those from the other groups, especially from advertising professionals. Lastly, all the responses were compared to contributions from neuroscience that have been made in recent decades about how the human mind functions, particularly with regards to decision-making, to determine which communication proposals provide a greater guarantee of efficacy. The results indicate the need for educators to break away from a strictly cognitive polarized communication that focuses on transmission. They are more related with guaranteeing the supply than creating a demand, and open up to the communicative potential of emotions, interaction and storytelling.

#### RESUMEN

En la investigación que da pie a estas páginas se aborda la problemática de la eficacia de la comunicación educativa mediante una doble estrategia metodológica. Se administraron más de 1.200 cuestionarios a profesionales de cuatro instituciones dedicadas a la comunicación persuasiva, dos tradicionales, la iglesia y la escuela, y dos de creación más reciente, el periodismo y la publicidad. Probablemente son los cuatro colectivos con más fuerza socializadora en los últimos siglos. Para este artículo se analizaron de manera especial las respuestas de los educadores en torno a la concepción de los procesos comunicativos y a los requisitos necesarios para la eficacia comunicativa, y se compararon con las de los demás colectivos, sobre todo con las de los profesionales de la publicidad. Finalmente se confrontaron todas estas respuestas con algunas aportaciones que se han hecho desde la neurociencia durante las últimas décadas en torno al funcionamiento de la mente humana, especialmente en relación con la torna de decisiones, para ver qué propuestas comunicativas ofrecen una mayor garantía de eficacia. Del conjunto de los resultados se desprende para los educadores la necesidad de superar una comunicación polarizada estrictamente en lo cognitivo, centrada en la transmisión, más preocupada por garantizar la oferta que por crear una demanda, y la de abrirse a las potencialidades comunicativas de la emoción, de la interacción y del storytelling.

#### KEYWORDS | PALABRAS CLAVE

Education, communication, cognitive, emotions, storytelling, neuroscience, interaction, advertising. Educación, comunicación, cognitivo, emociones, storytelling, neurociencia, interacción, publicidad.

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#### 1. Introduction

The neurobiologist Giovanni Frazzetto (2014) stated that for the first time in the history of humanity we have the opportunity to know ourselves through science. This opportunity is especially useful for those communication professionals whose effectiveness depends on their ability to influence the minds of others.

However, it seems that, until now, education has not been aware of the need to take advantage of this opportunity, unlike other groups of communication professionals. When we talk about the decade of the brain, we refer to the 1990s, because it is considered that we learned more about the functioning of the human brain during this decade than in the entire previous history of humanity. Well, Neuromarketing emerged in the late 1980s before neuroscience had made its appearance. The contributions of Daniel Kahneman (2012), Nobel Prize in Economic Sciences, shattered the classical economic paradigm and led the way to Neuroeconomics and Neuromarketing (Braidot, 2005; Van-Praet, 2012). Soon new disciplines appeared that benefitted from this ground-breaking scientific knowledge about the human mind: Neuropolitics, Neuroethics, Neuropsychology, Neurosociology, etc. However, education has been slow to jump on the bandwagon. Only recently have research into and publications about Neuroeducation, Neuropedagogy and Neurodidactica began to appear (Ansari, De-Smedt, & Grabner, 2012; Bueno, 2015; Bueno, 2017; Mora, 2013; Pincham & al., 2014). Pat Wolfe (2001), however, has already affirmed that the most innovative discovery in education is neuroscience. And Leslie Hart warned that educating without knowing how the brain works is like designing a glove without ever having seen a hand (Ibarrola, 2013).

It is in this context that we must place the present research, which looks at the conceptions of communication of a group, the advertisers, that permitted to be questioned by neuroscience, and compares them with those of another group, the educators, who have lived on the outskirts of these scientific findings. Of course there are very significant differences between the communication aims and contexts of advertising and education, but they do share some concerns: they both need to overcome the indifference and reluctance of the receptors who are initially uninterested in their messages; they both aim to modify the receptors' knowledge, attitudes, values, and behaviour patterns; they both adapt their message to a defined target audience and tune it to their concerns and interests; and the effectiveness of their work is conditioned by their ability to know and manage their interlocutors' minds.

The most surprising discoveries of neuroscience have to do with the key role played by emotions and the unconscious in mental processes, including rational processes. "Emotions are the basis of everything we do, including thinking" (Maturana & Bloch, 1998: 137). "Emotions create a whirlwind of activity dedicated to one single purpose. Thoughts, unless they activate the emotional mechanisms, do not do this" (LeDoux, 1999: 337). Damasio (1996: 282): "Feeling is an integral componengt of the machinery of reasoning". And in another work (2000: 57): "Well directed and well deployed emotions seem to choose a support system without which the building of reason cannot operate properly".

The unconscious is also part of the great discoveries of neuroscience. Cordelia Fine (2006) calls it the secret command. "Most of the decisions we take have one responsible element: the unconscious" (Barchrach, 2013: 31), to the point that "unconscious judgments not only occur before the conscious ones, they also guide them" (Zaltman, 2003: 95).

From among the contributions of neuroscience we need to highlight the discovery of mirror neurons (Rizzolatti & Sinigaglia, 2006; Keysers, 2011) and the importance that storytelling acquires for being an effective form of persuasive communication (Ramachandran, 2011; Salmon, 2008).

#### 2. Material and method

#### 2.1. Objectives

The objective of the research was to determine what various groups of communication professionals understand as communication. We aimed to learn how they handle the challenge of interacting with the minds of others, what difficulties and obstacles they encounter in their communication processes and how they face them, and finally, the perception they have of their own group and the other groups of communicators. Once the most significant differences were detected, we compared them with the neuroscience findings on the functioning of the human mind in order to determine which communication proposals offer more guarantees in terms of effectiveness.

#### 2.2. Selection of the sample

The sample universe consisted of 1.272 professionals from four different fields of persuasive communication:

533 education professionals (pre-primary, primary and secondary), 295 journalists, 225 advertising professionals and 219 priests. We used a "strategic or convenience" sampling method (Cea-D'Ancona, 1996; Igartua, 2006). The "snowball" technique was used to access the research profiles and obtain the highest possible number of answers. A reliability test was applied, and an accuracy of 2.7% was obtained.

#### 2.3. Method and analysis

A quantitative methodology based on descriptive surveys was used. The analysis tool was a questionnaire developed by experts in the fields of communication and education. Apart from the identification questions –profession, age and community– there were multiple-choice questions, self-applied five-point Likert scales based on degrees of agreement, ratings or frequency, and open-ended questions. The answers to the open questions were analysed by experts who cate-

gorised them so they could be treated quantitatively.

For the pilot test, 37 online and face-to-face questionnaires were given to professionals from the different communication areas mentioned above. The face-to-face questionnaires were used to observe whether the professionals found the surveys too long or whether any questions were too difficult to understand, etc. The data obtained from the pilot test were treated with the SPSS program. The researchers made the appropriate changes based on the observations and results obtained.

The questionnaire was employed between 2014 and Descartes' error is the error of schools: divorcing the mind from the body, the rational from the emotional, the abstract from perception, the consciousness from the unconscious. It is logical that the renewal movements are based on increasing motivation and integration strategies, creating synergies between body and mind, abstraction and perception, reason and emotion. To influence others, it is more important to know about the minds of the people you want to influence than the contents through which you aim to influence them.

2015 on paper and online. An application was created for the online questionnaires that automatically determined the profile and source of each questionnaire received. Once the questionnaires were given out, a database was created in the SPSS software for statistical treatment. A descriptive univariate analysis was carried out<sup>1</sup>.

#### 3. Results

#### 3.1. The paradoxical relationship between educators and advertising professionals

One of the most surprising conclusions that emerged from the questionnaire responses is the paradoxical relationship between educators and advertising professionals. On the one hand, educators seem to hold them in great consideration. When the communicators were asked to rate from 1 to 5 the degree of influence they consider that educators, priests, journalists and advertisers have on what people do and the way they are and think, educators considered advertising professionals to be the most influential communicators. They gave them 4.01 points out of 5, while they gave their own group members 3.6.

In contrast, when asked to rate from 1 to 5 how much they believed they should learn from each of the groups, educators gave their own group 4.06 but gave advertisers 2.76, a score almost as low as the one they gave priests, 2.35 points.

It is surprising that they consider that advertisers are the communicators with the most influence, but they believe that we should not learn from them, or that, although they consider them more influential than their own group, they believe that we should learn more from educators than from advertisers.

There are data that help us understand this paradox. When communicators were asked "Who do you think could convince people most easily that a certain social value is good?", almost half of the education professionals

(49.1%; n=259) responded educators, and only 38% (n=200) responded advertisers (Figure 1) (see next page).

Similar paradoxes can be found in the responses made by priests. When they were asked to rate the level of influence of the various groups on the ways of being, doing and thinking of most people, they gave the highest score (3.75 out of 5) to advertisers, and only 2.73 to their own group. However, when asked who would be able to convince people most easily that a certain social value were good.



Figure 1. Importance that educators give to the different communication professionals in relation to their ability to convince people about a certain social value (lost cases: n=6).

almost a third (30.9%; n=67) considered it to be their group, two points higher than advertisers (28.6%; n=62) (Figure 2).

These paradoxes in the two groups reveal some shared misunderstandings: they both equate knowledge with the ability to communicate this knowledge. They naively believe that the one who knows about a content (a value in this case) will be the one who communicates it better, and that the one who is most interested in a value will be the one who spreads this interest to other people most easily.

However, when the communicators were asked to define each group with a single word, the highest percentage of educators (17.6%; n=94) used terms related to the semantic field of manipulation (manipulators, deceivers, liars, foxes, cheats, etc.) to describe advertising professionals, almost five points above those that used concepts belonging to the semantic field of creativity (12.9%; n=69) or effectiveness (12.8%; n=68).

In summary, although educators and priests consider that advertisers are the communicators who most influence the way of being, doing and thinking of most people, they believe that they are manipulative and that, therefore, they are the least effective in transmitting a positive value. They consider that communication effectiveness depends more on the content domain than on the procedure domain; that is, it depends more on the knowledge of what is to be communicated than on the knowledge about the mind of the person to whom it is to be communicated.

In the following pages we look at these paradoxes and analyse some features of the conception educators have of communication. We then contrast them with the conception held by advertising professionals. We determined three basic communication conceptions based on transmission, cognition and supply. These differences are then compared with some recent contributions from neuroscience.



#### 3.2. Transmission-focussed communication

Figure 2. Importance that priests give to the different communication professionals in relation to their ability to convince people about a certain social value (lost cases: n=2).

The communicators were asked what was the main objective they wanted to achieve with their work. Far more educators expressed a unidirectional conception of the communication process (40%; n=213) than a bidirectional conception of the process (3%; n=16): "Get across as much information as possible", "Transmit information", "That the contents get to the students", "Instil contents and values", etc. The rest of the educators gave ambiguous responses (54.2%; n=289) or responded that they didn't know (2.8%; n=15).

The trend was confirmed when

they were asked to define in a maximum of two lines what they understood by communication. Among the educators who expressed themselves explicitly (84.1%; n=448). 56.1% (n=299) conceived educational communication as a unidirectional process and only 28% (n=149) as a bidirectional process. Most considered educational communication as a transmission process consisting in "instructing", "giving information", "sending messages", "getting contents across", etc.



Figure 3. Order in which educators placed the media based on their communication effectiveness. 1 is maximum effectiveness and 6 is the minimum. (Lost cases: n=8, except for the Internet which was n=7).

The maximum expression of the transmission mentality of many educators is observed in definitions

such as "Moving a message from an emitter to a receiver", "Moving information to others". Only a minority included concepts such as exchange, interaction or dialogue in their definitions.

The answers to other questions confirm that a one-way, transmission conception of communication predominates. The communication professionals were asked to order from 1 to 6 the most effective means of persuasiveseductive communication. The options were face-to-face interpersonal communication, cinema, television, printed media, radio and the Internet. Almost half of the communication professionals (43.3%; n=541) considered face-toface interpersonal communication to be the most effective.

Interestingly, this percentage rose in the advertising group where more than half (55%; n=121) considered it to be the most effective. However, the percentage fell significantly among educators: below a third (29%; n=152) considered it the most effective. More significant is the fact that almost the same proportion of educators (27%; n=144) considered it to be the least effective (Figure 3).

The communication professionals were also asked what contribution did mobile phones and the Internet have on the efficacy of persuasive communication. More than a third of advertisers, 34.2% (n=77), highlighted the interaction possibilities offered by these technologies, but only 10.5% (n=56) of educators did so. It seems, therefore, that there is a more transmission, less interactive and dialogic, mentality among educators, even though they work in face-to-face interpersonal communication, than among advertising professionals, who mainly work in mediated communication. A new paradox.

The transmission conception of educational communication increased with the education level. Among pre-primary school teachers, 52.9% (n=36) consider educational communication to be a two-way process; among primary school teachers 29.5% (n=59) considered it two-way; and among high-school teachers 20.4% (n=54). We can also add that the lack of sensitivity regarding the need for interaction between subjects is accompanied by a lack of sensitivity regarding the need for interaction between codes. When asked what the Internet, social networks and mobile telephones contribute to the efficacy of persuasive communication, only 3.4% of educators (n=18) referred to multimedia and multimodality.

#### 3.3. Cognition-focused communication

Most education professionals understand and manage communication from strictly cognitive parameters. They focus almost exclusively on and give priority to thinking and reasoning.

Although 86.5% (n=461) of educators gave a definition of communication in which the effects to be achieved were not explained, 90.3% (n=65) of those who referred to as effects, limited themselves to the cognitive field: "Be able to make myself understood", "That the receiver grasps the meaning of what we try to transmit", "Transmit knowledge in a way that others can understand", "The extraordinary possibility of trying to explain reality to others and that they understand you", "communication is effective when the receipient is able to understand the message", etc.

When asked what is the main objective of their work, 40.5% (n=216) of educators also indicated cognitive objectives: "That the students go home understanding clearly the main message that I want to transmit" "Make myself understood", "Train people who have the capacity to understand", "Get the message across objectively and clearly", "Get them to understand", etc.

If we look only at the professionals who explain the effects that communication should produce and leave out the ambiguous or unanswered cases, we obtain that while 82.4% (n=216) of educators focused exclusively on cognition, forgetting the emotional, more than half of the advertising professionals (58.8%, n=50) included the emotional factor as a priority: "Creating a feeling of needing something", "Making people feel desire", "Fascinate, make passionate" "Moving society to achieve profound changes in it", "Seduce", "Fall in love", "Modify behaviour, change lifestyles", "Transmit a persuasive message that moves one to action", "Make a product or service attractive", etc.

Among the educators who explain the effects, only 17.6% (n=46) included emotional and attitudinal objectives: "Awaken enthusiasm, interest, curiosity", "Encourage the students' desire to learn", "Motivate" "Create interest", "Awaken the need and enthusiasm to learn and to know", "To inspire my students about the subject", etc. These are suggestive responses, but they were in the minority.

# 3.4. Supply-focused communication

When asked what is the main obstacle to achieving their desired objective. educators gave the highest score to responses about the lack of interest and motivation of the students (26.8%; n=143), which almost doubled the score given to the communicator's lack of abilities and training (13.9%, n=74)or the unfavourable environment social (13.5%, n=72), and far



Figure 4. Obstacles that educators face in order to achieve the objectives of their communicative work.

surpassed other obstacles related to the saturation of information (9.4%, n=50) and the political environment (7.1%, n=38).

On the other hand, among the advertising professionals, the responses that obtained the highest scores were related to information saturation (25.3%; n=57), followed by economic limitations (20.9%; n=47). Only 9.3% (n=21) referred to the interlocutors' lack of motivation.

Something similar happened when we asked about the weak points of their profession. Almost a quarter of educators (22.7%; n=121) referred to factors related to the interlocutors' lack of interest and motivation. Among the advertising professionals this was only 1.8% (n=4).

Therefore, unlike advertising professionals, educators consider that the greatest difficulties are beyond their responsibility. They do not consider the difficulty of motivating their students, of overcoming their indifference and their unresponsiveness, to be due to a deficiency in their training. We could conclude that they approach communication as if they were salespeople, rather than considering themselves advertising professionals.

A salesperson is a person who offers goods for those who want to buy them. If we were to adapt this definition to advertising, we would have to say, "a person who offers goods so that they want to buy them". The salesperson responds to a demand, while the advertising professional creates it. The salesperson can complain about the interlocutors' lack of interest. The advertising professional cannot because they are responsible for creating it.

The educators' complaints about their students' apathy demonstrate that consciously or not they act as salespeople. They do not hold themselves responsible for motivating their students («Motivation comes from the home").



In pre-primary. 17.6% (n=12) referred to the students' lack of motivation as the main obstacle to achieving their goals as communicators, in primary school it was 27% (n=54) and in secondary schools it was 29.1% (n=77). Moreover, the percentage who considered the students' lack of motivation and interest as the weak point of their profession

Figure 5. Obstacles that advertisers face in order to achieve the objectives of their communicative work.

was 13.2% (n=9) in pre-primary, 20.5% (n=41) in primary and 26.8% (n=71) in secondary education.

The journalists showed a similar tendency to conceive communication as supply: "Inform the public about events and opinions which could interest them", "Notify the receptor of facts of interest to them", "Transmit truthful information to interested readers". The interest is taken for granted. Lorenzo Gomis does not think so. He believes journalism is the art of making what happens interesting to people. Only one journalist responded in this line: "Make readers feel inspired when they read the story in the same way that I do".

#### 4. Discussion and conclusions

#### 4.1. The inadequacy of the cognitive focus

Advertising professionals know that knowing about a product and understanding the messages used to promote it are essential but insufficient factors to ensure adherence and acquisition. It does not matter if a potential customer knows about Pepsi Cola and understands their advertising if what they want is a Coca Cola.

Nor is the indifference to or rejection of certain political leaders solved by making their messages more understandable. Understanding must be accompanied by the activation of an emotional response. The understood message is not powerful, rather it is the message that moves you in the right direction that is effective.

A review of the scientific literature on the mechanisms that govern mental processes calls into question an educational communication focused strictly on cognition (Serrano-Puche, 2016).

Are we afraid because we tremble or tremble because we are afraid? William James (1884) asked this question more than a hundred years ago and it is still a controversy today. From the point of view of the Cartesian paradigm, there is no doubt that we tremble because we are afraid. The response of trembling (action) would be the result of a conscious evaluation (reflection) that the rational mind makes into a response to a stimulus (perception). The mind would be like a sandwich in which perception and action would be the bread and conscious cognition the filling, the substantial element that gives meaning and flavour to the whole. Emotion and the unconscious would both be irrelevant, not to mention the body.

Damasio (1996) spoke of Descartes' error to question the Cartesian paradigm. Reason and consciousness are not the pivotal axis of mental activity. Neuroscience has arrived at this certainty by discovering that although a person with lesions to their emotional brain is still able to reason, they are unable to make appropriate decisions in terms of efficacy and ethics (Damasio, 1996).

It has also been discovered that unconscious responses occur before the conscious ones and indeed condition them. Our brain processes 11 million bits every second, but only about 40 reach the conscious level (Wilson, 2004). For centuries of evolution, the human brain has learned to manage a multiplicity of stimuli by filtering them, selecting only those that represent an opportunity or a threat. The rest are relegated to indifference, to what-do-l-care.

The only stimuli that get past the what-do-l-care are those that are associated, by genetics or learning, with a somatic marker (Damasio, 1996); those that are emotionally important for the subject (Damasio, 2005). These stimuli automatically and unconsciously elicit a body response that leads to action. In short, I'm afraid because I tremble. The unconscious body reaction occurs before we know we are afraid. The rational brain can then assess this body reaction with reasoning, but conditioned by the previous emotional reaction.

Mental processes are therefore more complex than the Cartesian paradigm explains. They are integral experiences that includes the senses, the body, emotions and cognition. The emotional (often unconscious) brain is key in selecting the few unconscious stimuli that will arrive to consciousness and the few conscious ones that will trigger action.

Communication that only considers cognition is doomed to failure because the limbic system or emotional brain "is the brain's energy source" (Carter, 2002: 54). Communication efficacy requires the capacity to manage the energy source. Educational communication is ineffective when it is saturated with thoughts that do not activate emotions and, consequently, do not motivate. In the words of Kahneman (2012: 48), "the rational brain is a secondary character who thinks it is the star". Educational communication therefore needs to rewrite its scripts to include new stars in the show.

#### 4.2. The inadequacy of the transmission focus

Although the conventional culture invites us to think the opposite, the social and cultural hegemony of transmission technologies is a parenthesis in the history of communication. The printing press appeared in the middle of the fifteenth century, cinema in 1896, television in the 1930s. These technologies made it possible for a message to arrive simultaneously and unidirectional to a diverse and often dispersed multitude of receptors. The school emerged in this context and followed this communication model, which is far from the hegemonic parameters of the main part of human evolution.

Since the origin of the species, around 2.4 million years ago, our ancestors have lived some 84,000 generations as hunter-gatherers, only seven generations in an industrial era and only two in a digital era. Our minds are thus designed to solve the problems of hunter-gatherers (Van-Praet, 2012).

For millions of years the human brain evolved through processes of interaction with nature and with other human beings. Unlike unidirectional transmission, interaction allows us to adapt the message to the interlocutor's receptivity, their degree of interest, their capacity to understand and their learning pace. This flexibility is lost in transmission communication, especially when it is going from one to many.

In dialogic interaction with the teacher or the machine that facilitates learning, the subjects benefit from the possibility to control at all times both the motivation and interest of the interlocutors as well as their understanding and assimilation levels. In collaborative work the subjects also benefit from the possibility of learning by doing, creating synergies, looking at points of views and turning diversity into opportunity. As stated by Jenkins et al (2006) and Jenkins, Ito, and Boyd (2015), we live in a participatory culture, but schools are slow in reacting to this new reality and have not known how to take advantage of these opportunities. Change is necessary. Participatory culture requires us to move from individual expression to participation in the community.

In educational communication, the absence of interaction between subjects is often accompanied by the absence of interaction between codes. If the educator were to use multimodal communication, they would have the opportunity to use each expression form for the most appropriate contents and for the teaching functions that they best fulfil. The word is most useful for describing, the image for showing, the graph for structuring, and audio-visual communication for audio-visual-kinetic contents. The word works best for the abstract, the image and audio-visual to show and motivate, and the graph to systematize.

#### 4.3. The inadequacy of the supply focus: the limitations of salesperson strategies

If the educator feels uncomfortable with the invitation to behave like an advertising professional and not as a salesperson, they can consider taking on the functions of a mediator. Neuromarketing expert, Neil Rackham has devoted a large part of his professional work to investigating the strategies used by the great persuasive communicators. The main conclusion of his research is that the best negotiators and mediators devote 40% of their time to determining and managing the interests of the other party (Shell & Moussa, 2007). This strategy is a far cry from the usual practice in educational communication, fixated almost exclusively on understanding.

The educator should be closer to the mediator than the salesperson. Only this relationship can lead to communication in which motivation is assumed. If a customer comes into a shop, we can assume they want to buy the product. However, the advertising professional must start the communication process taking for granted the interlocutor's indifference. And the mediator must start by taking for granted the interlocutor's opposition. The advertising professional and the mediator will not be successful if they do not generate demand, and they will fail to generate it without the ability to manage the interlocutor's emotions. Francisco Mora (2013) states that you only learn what you love. However, according to David Bueno (2015), neuroscience shows that the expression "spare the rod and spoil the child" is correct. These two statements are not contradictory. The opposite of love for certain contents is not fear, but indifference, apathy: the what-do-l-care attitude. Love and desire are engines of action and consequently stimuli for learning, but fear can also be a stimulus. The need to free yourself from pain is a spur to action. Only indifference impedes learning.

Lack of understanding is not the main reason why some messages provoke indifference, opposition or rejection. For the educator, a lack of motivation should be more worrisome than a lack of understanding.

The apparent increase in the lack of motivation as we progress through the educational stages can be explained in this context. Going from pre-primary education to primary, and even more so in secondary education, corresponds to moving from an environment in which students have the opportunity to constantly ask about issues that concern them to another environment where they are required to continuously respond to questions they are not interested in.

#### 4.4. The inadequacy of the supply focus: the limitations of the discourse

It should not be surprising that storytelling has become a form of hegemonic communication in all areas of persuasive communication in which it is essential to create demand: from advertising to politics, as well as leadership, economics, law, management and business. There is also evidence of the effectiveness of storytelling in the education system (Bautista, 2009).

If discourse efficacy is based on the Cartesian paradigm, then storytelling is based on the mirror neurons paradigm: neurons that don't carry out just one function, like the others, but rather several functions. It's not that they have a special configuration, but rather they have a powerful associative capacity. They connect the perceptual system with the motor system, the emotions and cognition (Keysers, 2011).

When I see (in reality or in fiction, or just when I read or hear a story) that two people kiss, in addition to activating the perceptual system, thanks to the mirror neurons, the motor system is also triggered (they activate my neurons that are activated when I kiss), as well as the emotions (I feel something similar to what I feel when I kiss) and cognition (I understand from having experienced a kiss).

It matters little that the story is fact or fiction. The mind simulates it, and consequently, makes it real, experiences it as real, involved in a unifying experience.

It is the system by which human beings have learned for 86,000 generations of hunter-gatherers. The learning experience of adolescents who accompanied adults to find food was similar to that of the child who listened to the stories of their adventures around the fire in the evening. In both cases the learning is achieved not through a discourse, which tends to activate only the rational system, but through storytelling: an integral and synergistic experience in which the perceptual, motor and emotional systems play an essential role in driving cognition.

#### 4.5. Final thoughts

We know from science that the most appropriate metaphor for defining the mind is the network. Well, if educational communication aims to influence the mind it must adapt to the interactive demands of the network metaphor.

The educator must be able to create networks of interaction in collaborative work, in the dialogical relationship between teacher and student, the synergistic relationships between students, the integration of technological tools, the interaction between codes to create an expressive synthesis (multimedia communication), and the combination of codes to get the most out of each expression form (multimodal communication).

They also need to create interaction networks to enhance cerebral modularity. Descartes' error is the error of schools: divorcing the mind from the body, the rational from the emotional, the abstract from perception, the consciousness from the unconscious. It is logical that the renewal movements are based on increasing motivation and integration strategies, creating synergies between body and mind, abstraction and perception, reason and emotion.

To influence others, it is more important to know about the minds of the people you want to influence than the contents through which you aim to influence them.

The brain's energy centre is not the cognitive system but rather the emotional system. The greatest enemy of persuasive communication is not the difficulty of understanding but rather indifference, the "what do l care" attitude. Enhancing the emotional dimension in educational communication involves designing strategies that address the

multitude of different interests that motivate students. Ultimately, the most valuable skill of an educational communicator is their ability to motivate, to get students involved through participation and interaction.

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# M-learning and Augmented Reality: A Review of the Scientific Literature on the WoS Repository



M-learning y realidad aumentada: Revisión de literatura científica en

el repositorio WoS

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#### ABSTRACT

Augmented reality emerges as a tool, on which it is necessary to examine its real educational value. This paper shows the results of a bibliometric analysis performed on documents collected from the Web of Science repository, an Internet service that concentrates bibliographic information from more than 7,000 institutions. Our analysis included an overall universe of 12,000 indexed journals and 148,000 conference proceedings. From those, we selected a sample targeting the terms "mobile-learning" or "m-learning" and "augmented reality" as descriptors or components of titles of scientific works. The analysis on journals (n=741) and in conference proceedings (n=913) reveals a differentiated perspective in each area in the last two years. A qualitative analysis of 67 scientific productions addressing these subjects complements the research. This highlights five themes: conceptualization of the phenomenon, development of new methodologies, motivation, spatial delocalization, and implementation in subject-matter areas. The research highlights logical changes, such as greater and differentiated access to information; transcendent innovations, such as increasing informal and ludic activities, insertion into virtual environments, membership of specific groups, and networks of friendly interaction, along creation of new scales of values. These elements are now beginning to constitute fundamental parts of teaching methodologies. Education appears to be subsidiary to technical advances, thus imposing a drastic methodological change.

#### RESUMEN

La realidad aumentada surge como un útil sobre el que se precisa examinar su real implementación educativa. Esta investigación hace un análisis bibliométrico sobre documentos del repositorio Web of Science. Este servicio ofrece en Internet la producción científica de más de 7.000 instituciones de todo el mundo. Se toma como base un universo de 12.000 revistas indexadas y 148.000 actas de conferencias y se selecciona una muestra centrada en los términos «m-learning» y «augmented reality» como descriptores o componentes de títulos en trabajos científicos. El análisis sobre revistas n=741 y actas n=913 en los dos últimos años muestra una perspectiva diferenciada por áreas. La investigación se complementa con un análisis cualitativo de 67 producciones científicas sobre estos descriptores en ese periodo de tiempo. En el estudio sobresalen cinco temáticas: la conceptualización del fenómeno, el desarrollo de nuevas metodologías, la motivación generada, su deslocalización espacial y las materias objeto de implementación. Las investigaciones destacan cambios lógicos, como un mayor y diferente acceso a la información, junto a innovaciones trascendentes, como el incremento de actividades informales y lúdicas, la inserción en ambientes virtuales icónicos, la pertenencia a grupos específicos, y redes de interacción amistosa dentro de nuevas escalas de valores. Todo ello hace que estos instrumentos pasen a ser partes fundamentales en las metodologías. La educación parece subsidiaria a estos avances técnicos y a sus requisitos, imponiéndose un drástico cambio metodológico en nuevos escenarios formativos.

#### KEYWORDS | PALABRAS CLAVE

Ubiquitous learning, education, online education, mobile devices, e-learning, digital literacy, m-learning, augmented reality. Aprendizaje ubicuo, educación, educación en línea, dispositivos móviles, e-learning, alfabetización digital, m-learning, realidad aumentada.

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#### 1. Introduction

The high variety and penetration of mobile devices in society impacts young users, who are also students at education centers. Portable devices have encroached into our daily lives (Weiser, 1991), thus fostering u-learning. Learning using portable digital devices, or m-learning, has now reached our regular activities linked to knowledge (Castro & al., 2016). The use of m-technologies represents a challenge for educators (Burden, & Hopkins, 2016). Therefore, research alerts about the need to continuously explore the benefits or interest that drive their use. In view of that, we review relatively recent research on m-learning and augmented reality (AR), in education. Relevant work in the first decade of the century is represented by Hwang & Tsai (2011). Toh & al. (2015) have also contributed. More recent investigation into this matter has been performed by Amara & al. (2016). All of them recognize an increase in technology development, enticing particularly younger generations, who have also become its most akin users.

Widespread use of m-learning is correlative to demographic factors, such as age, gender, and family income (Mazaheri, Mohamed, & Karbasi, 2014). Cantillo, Roura and Sánchez (2012) have drawn a below-to-media rate, at 13 years old, when adolescents pick up mobile devices. An advanced trend of m-learning is the technique known as AR. AR superposes digital information on real imagery captured on mobile devices. AR is driving spectacular innovation. It allows to aggregate data, 2D and 3D images, or allows Internet access to sites or sources, creating interactions with any environment. M-learning and AR appear as intrinsically related, and their novelty make them the object of multiple research in aimed at understanding their educational possibilities (Cabero & Barroso, 2016; Ávila & Bailey, 2016). These are emerging phenomena with implications that reach beyond the pure technological facts, that impact on methodologies, habits of students, and that have the potential of transforming our understanding of learning processes in their spatial, temporal, generational, cultural and geopolitical spheres, thus transcending the merely un-localization element of the formative framework (Vázquez-Cano, Sevillano, & Fombona, 2016). This fast evolution creates some unfilled spaces in our knowledge about how to appropriately take advantage of these tools. It creates a need to develop robust theories about learning and their underlying models. The scientific community is in need to provide answers to those questions and is urged to verify if we are facing a socio-educational problem, or a new culture-enriching phenomenon.

#### 2. Materials and methods

The common use of these devices by students, and their innovative and highly attractive features are characteristics that open multiple educational options. This potential generates a hypothesis for effective implementation in any educational setting. In this regard, this research brings together international researchers of the National Autonomous University of México (UNAM), and of the University of Oviedo in Spain, with the purpose of clarifying the didactic possibilities of m-learning and outlining concrete expectations generated by AR technology.

Therefore, this work seeks to understand where this phenomenon is heading considering previous scientific research. To attain that objective, we undertake a descriptive analysis of current findings, considering robust references, non-biased by market/commercial factors, in a time range that does not go beyond a five-year, period. This because of the high risk of theoretical and practical obsolescence of technological meanings (Martínez & Bello, 2001). We worked on the repository for scientific research Web of Science (WoS), indexed by Thomson. WoS catalogues scientific references with high impact. It comprises more than 12,000 journals and 148,000 conference proceedings. References in WoS are grouped by sciences, social sciences, arts and humanities. Although this review is not extensively based on it, we also considered Scopus which is further analysed in a different document.

For the qualitative design, we implemented a simultaneous contrast between UNAM's and University of Oviedo's teams, the latter acting as a double expert. According to literature on evaluators reliability, we followed Cohen's kappa, yet details of this specific analysis are not further described here. The approach implemented

permitted a deep review of contents, and also, the use of a high number of WoS documents: books, chapters, articles, communications and presentations in key relevant conferences. 67 documents were reviewed using the key terms under research in the Topic and in the Title, see table 5. A pair of tools supported the analysis: Codification of WoS database, and Atlas.ti-7.5.12. Due to a high number of records obtained, we

| Table 1. Number of documents in WoS records |        |       |  |  |
|---|--------|-------|--|--|
| M-learning                                  | Торіс  | Title |  |  |
| Total                                       | 1,110  | 381   |  |  |
| Mobile learning                             | Topic  | Title |  |  |
| Total                                       | 25,560 | 2,910 |  |  |
| Augmented reality                           | Topic  | Title |  |  |
| Total                                       | 10,155 | 4,262 |  |  |

incorporated temporality and appropriateness criteria to obtain a selection of samples. This approach is widely accepted, in cases that entail dealing with plenty of information (Avila, 1999).

The analysis considered the terms involved in two instances: records related to the subject, that is, terms were included in the topic (title, abstract or descriptors words). On the other hand, we looked at records where key terms were substantial to the document and appeared in the titles. Therefore, the exercise quantified

| <b>opic</b> 246 | Title  |
|-----------------|--|
| 246             | 73   |
|                 | 10   |
| Горіс           | Title  |
| 5,213           | 668  |
| Горіс           | Title  |
| 2,107           | 913  |
|                 | <b>opic</b><br>5,213<br><b>opic</b><br>2,107 |

the variables topic and title, searching for the terms "m-learning" and "mobile learning", both with sufficient range, and using complementary and exclusive elements. "Augmented reality" or "realidad aumentada" was also reviewed placing the reduced results in Spanish, within its meaning in English. Search operators "and" for records with all terms and "or" were used to locate records within the appropriate scope.

The analysis included the number of titles within WoS All Databases for all collections. For the terms "m-learning" and "mobile learning", the number of records resulted uneven, and warranted a differentiated handling (Table 1).

We obtained 26,670 documents related to m-learning, and 10,155 for augmented reality. Records for these documents include dates of registration. With that information, we considered only the most recent. Then, we refined the search with the variable "records made between January/1/2015 to November/16/2016". We obtained 913 titles for "augmented reality". Using AR as a descriptor resulted in 2,107 documents. M-learning yielded 73 titles and 246 documents, whereas mobile learning yielded 668 titles registries and 5,213 documents when using it as descriptor.

#### 3. Analysis and results

Table 3 includes the type and number of scientific papers where the terms are included as descriptor or in the title of a document. It is worth noting that some cases are included in more than one category, and that the total numbers may exceed total number of documents (n).

The period under review represents a 20% of the total number or registries of the last 24 years for both, m-learning and AR, and the production includes more articles and presentations than books, which is the least prolific product. Table 4 below features subjects and numbers of documents in each case. In some cases, records can be associated to several subjects.

When using: Theme: ("m-learning" OR "mobile learning" OR "mobile-learning") AND "augmented reality" (Table 5) (see next page), we obtained null recent reviews on these themes altogether. Note that social sciences include education.

Quantitative details for "m-learning" and "augmented reality" in the titles and period reviewed are available here: https://goo.gl/H5BjSh Results included there show a strong connection of these terms with Education and Research, and with Medicine and Engineering.

| Table 3. Type and number of documents |                 |       |            |       |                   |       |  |  |
|---------------------------------------|-----------------|-------|------------|-------|-------------------|-------|--|--|
| Торіс                                 | Mobile learning |       | M-learning |       | Augmented reality |       |  |  |
| Type of document                      | n= 5,213        | %     | n=246      | %     | n=2,107           | %     |  |  |
| Article                               | 2,877           | 55.18 | 113        | 45.93 | 1,110             | 52.68 |  |  |
| Presentation/Communication            | 2,525           | 48.43 | 135        | 54.87 | 1,110             | 52.68 |  |  |
| Review                                | 77              | 1.47  | 3          | 1.22  | 57                | 2.70  |  |  |
| Summary                               | 21              | 0.40  | 5          | 2.03  | 19                | 0.90  |  |  |
| Editorial                             | 36              | 0.69  |            |       | 29                | 1.37  |  |  |
| Other                                 | 182             | 3.49  |            |       | 34                | 1.54  |  |  |
| Title                                 | Mobile learning |       | M-learning |       | Augmented realit  |       |  |  |
| Type of document                      | n= 668          | %     | n=73       | %     | n=913             | %     |  |  |
| Article                               | 346             | 51.79 | 35         | 47.94 | 452               | 49.50 |  |  |
| Presentation/Communication            | 318             | 47.60 | 40         | 54.79 | 500               | 54.76 |  |  |
| Review                                | 15              | 2.24  |            |       | 12                | 1.31  |  |  |
| Summary                               | 7               | 1.04  |            |       | 12                | 1.31  |  |  |
| Books                                 | 5               | 0.74  |            |       | 18                | 1.97  |  |  |
| Other                                 | 16              | 2.69  |            |       | 62                | 6.70  |  |  |

#### 4. Qualitative analysis

Contents analysis resulted in five major subject-matter areas differentiated and contrasted by the two teams. These areas are the following: a) Conceptualization and typology; b) Methodology; c) Factors of use and the ludic-motivational dimension; d) Spatial delocalization; e) Educational subjects for AR implementation. Comunicar, 52, XXV, 2017

The work of Toh & al. (2015) constitutes a salient piece of scientific literature in m-learning. Yousafzai, Chang, & Gani (2016) present a taxonomy of technical variables on m-learning applications with multi-media capacities, linkage to heterogeneous devices, network needs, user's expectations typology and characteristics of contents.

In this context, m-learning represents an advance of portable technology and a manner to introduce resources in an online environment. Richardson (2016), and Kim & Hyun (2016) feature a clear relationship between AR and the potential of intelligent portable devices and smartphones. Delocalization demands a new denomination for learning in undefined spaces and timing. Students now have access to a myriad of digital services when and where they need them. They can use video, multimedia and AR, a mixed-reality where you can interact with objects. Research show new virtual rooms with tools created and managed by students and instructors like in-real- life practice. Heradio & al. (2016) review virtual labs and the reduction of costs in equipment, space, maintenance, security enhancement, micro or macro experiences and

| Table 4. Subjects and number of documents |       |       |  |  |
|---|-------|-------|--|--|
| M-learning                                | Topic | Title |  |  |
| Social Sciences                           | 182   | 56    |  |  |
| Technological Sciences                    | 152   | 52    |  |  |
| Engineering and Computing                 | 137   | 46    |  |  |
| Sciences                                  | 11    | 4     |  |  |
| Biomedicine                               | 21    | 10    |  |  |
| Arts and Humanities                       | 15    | 2     |  |  |
| Mobile learning                           | Topic | Title |  |  |
| Social Sciences                           | 2,372 | 423   |  |  |
| Technological Sciences                    | 4,405 | 468   |  |  |
| Engineering and Computing                 | 4,023 | 416   |  |  |
| Sciences                                  | 1,047 | 53    |  |  |
| Biomedicine                               | 916   | 87    |  |  |
| Arts and Humanities                       | 203   | 42    |  |  |
| Augmented reality                         | Topic | Title |  |  |
| Social Sciences                           | 755   | 319   |  |  |
| Technological Sciences                    | 1,888 | 811   |  |  |
| Engineering and Computing                 | 1,694 | 726   |  |  |
| Sciences                                  | 302   | 174   |  |  |
| Biomedicine                               | 464   | 105   |  |  |
| Arts and Humanities                       | 158   | 66    |  |  |

accessibility to people with disabilities. Tools for flexible and comfortable learning with multiple support, whether they are portable computers, tablets, smartphones or multimedia players. El-Kabtane & al. (2016) highlight a rapid change of meaning for e-learning after the emergence of the Internet. Before that, the term meant any kind of learning with electronic machines; currently, it is associated with online learning. In that context, it is necessary and also appropriate to redefine categories, distance learning, open courses MOOC, etc. All that configures new models that begin to be systematized (Potkonjak & al., 2016).

#### 4.2. Records on educational methodology

M-learning represents a shift in teaching methodology, reaching beyond a purely instrumental component of technology for education. It facilitates the use of strategies based on a myriad of learning theories, such as constructivism (Sun & Shu, 2016), connectivism, or conceptual maps techniques, among others (Marzal & Pedrazzi, 2015).

As more ergonomic equipment is built and pedagogic use is facilitated, new user-friendly interfaces surge (Navarro & al. 2016). On the one hand, m-learning creates collaborative dynamics to learn and interact, which are basic elements in teaching. These options open possibilities and yet they bring procedural issues. (Al-Emran,

| Table 5. Search ("m-learning" OR "mobile learning" OR "mobile-learning")<br>AND "augmented reality" |             |       |     |              |  |  |
|---|-------------|-------|-----|--------------|--|--|
|   | Topic Title |       |     |              |  |  |
| Type of document  | n=59        | %     | n=8 | %            |  |  |
| Article   | 31          | 52.54 | 7   | 87.50        |  |  |
| Presentation/comunication   | 32          | 54.24 | 1   | 12.50        |  |  |
| Book  | 2           | 3.39  | 1   | 12.50        |  |  |
| Subject   | Topic Title |       |     | <b>Fitle</b> |  |  |
| Social Sciences   |             | 46    |     | 6            |  |  |
| Science and Technology  |             | 39    |     | 5            |  |  |
| Arts and Humanities   |             | 7     |     | 1            |  |  |

Elsherif, & Shaalan, 2016). On the other hand, learning at a personal, informal, spontaneous and creative learning is fostered (Gimhyesuk, 2016). This, enhanced by commonalities such as accessibility, motivation, self-control and enjoyment. This suggests learning traits (Castro & al., 2016). Research has docu-

mented methodological implications in different areas and levels. Castro & al. (2016) review m-learning in secondary education, math methodology using SMS, social networks such as Facebook and Twitter, and learning objects (LO) looking at new styles and learning contexts. Rodrigo (2016) reviews tablets and makes a difference in elementary and secondary school methodologies. He discusses that their use is conditioned by their initial purpose for purchase, by pedagogical strategies in the classroom, by educational level, and by resources utilised. In more basic levels, tablets are used in a more traditional fashion, more centered in activities than in contents, and competencies are left aside. Games are part of the learning process, project method and new opportunities where tablets

may reach beyond traditional strategies (Suarez-Guerrero, Lloret-Catala, & Mengual-Andres, 2016). AR calls for a more appropriate use of methodology to attain effective implementation (Chen, Chou, & Huang, 2016). Pejoska & al. (2016) place the narrative component of AR in purely audiovisual language.

The benefits of virtualization seem more evident in self-formation (Hackett & Proctor, 2016), and in collaborative interaction, from person-to-person in or out of the classroom, or from a person to groups (Lindsay, 2016). Amara & al. (2016) call this Mobile Computer Supported Collaborative Learning (MCSCL). They underscore the lack of systematic analysis on methodologies in group interaction and in solutions that could be generalized. Technology can increase the drive to learn more about environments; however, the use of technology may come along with issues when used in the classroom. M-learning may disrupt normality in this setting, more often in exams as reviewed by Kaiiali & al. (2016). Use of mobile phones at school is problematic and many instructors are unwilling to use them because of attention deviation, cyberbullying and other issues.

#### 4.3. Records on factors of use and the ludic-motivational dimension

Penetration of ICT is linked to infrastructure. Burden & Hopkins (2016) identify physical contexts and personnel training as barriers to their development, followed by attitudes and beliefs. In upper-level education, classroom management and manager's traits are crucial (Alrasheedi, Capretz, & Raza, 2016). Chang & al. (2016) discuss a positive correlation between environment perception and creative performance. They establish m-learning generates motivation in educational managers and organizations.

Because of the recreational character that stems of its experience, a fundamental component of m-learning is motivation. Several analysis cross-connect interest, concentration and performance. According to Karimi (2016), individual characteristics drive students to the educational use of these devices, reinforcing their ludic style for learning, in a formal and informal setting. Ruiz & Belmonte (2014) identify that university students at a young age display a positive attitude towards applications downloading, installation and use. Hsia (2016) identifies stress in students for what is expected from them; classroom environment conditions, behavior, and this belief significantly affects their level of achievement.

One cannot leave aside the commercial drive underlying ICT market, this creates more affordable mobile devices with more functionalities, including AR in educational materials, such as interactive publications. This trend grows nurtured by economic investment (Kopecky & Szotkowski, 2016). Kim, Chun & Lee (2014) identify that the extent to which students utilize technology is conditioned by its affordability.

The unyielding environment of traditional teaching contrasts with learning based on games and story-telling as salient strategies to create external motivation. Furio & al. (2015) compare mobile to traditional learning. Although they do not find significant differences, they discuss that a student may feel more suited for learning through games, since it connects ludic challenges to rigidness of the real world, abstract concepts to practical deeds, learning processes in real contexts to virtual contexts in AR. Different research documents give account of the attractive potential of AR for students (Cubillo & al., 2015). Sakr & al. (2016) explore emotional implications of students that learned about Second World War by means of the multimodal approach of AR. Laine & al. (2016) combine these ideas in an AR platform where they develop science learning games that interact with the environment.

#### 4.4. Records on spatial delocalization

A variable specifically reviewed in m-learning is the modification of learning spaces by moving the educational phenomenon outside the traditional classroom. Lin & Yang (2016), and Welsh & al. (2015) review possibilities for mobile devices in field trips. Reychav, Dunaway, & Kobayashi (2015) characterize three types of m-learning use: a) teaching-and-learning activity as an extension to the classroom in outdoor settings where objectives, activities and tools remain similar to those created in a traditional curriculum, b) learning activities set forth by the student that is actively searching for new knowledge; and, c) spontaneous learning created in daily activities occurring in non-planned environments. These synthetize m-learning out of the class as formal or informal; planned or spontaneous; guided by the educator or by the student; in a school or work environment. Often, non-planned learning is driven by commercial interests (Pavlou & Fygenson, 2006). It seems that learning outside formal settings does not create bold changes in behavior and patterns, and it is difficult to control its efficacy. Usually, the researcher uses behavioral patterns of the use of mobile devices in daily activities of the user as a reference. Such patterns, not necessarily educational, are significant since they help draw lines of delocalized learning.

Expected behaviour with these devices seem to be geared at gaming and leisure activities. Agarwal & Karahanna

(2000: 673) introduced the concept of "cognitive absorption". This is defined as a state of deep implication with the tool that could be used a foundational basis for motivation for learning outside of the classroom with mobile devices.

AR emerges as a substitute to outdoor experiences as the device itself (Harley & al. 2016) is used to enter immersive and interactive environments, virtual rooms, or scenarios designed to support learning (Nagata, Giner, & Abad, 2016). Tan & Chang (2015) have put forth a scientific algorithm directed at identifying reality objects that can be utilized along with AR for educational purposes. Also, Tarng & al. (2015) develop a new methodology able to reproduce an ecological system, resembling a garden, where students interact with one another and see insects grow. García, Guerrero, & Gra-

Qualitative analysis points at five groups of key descriptors in research for m-learning and AR: terminological conceptualization, methodological changes, analysis of use factors, motivational and ludic dimension, delocalization and selected subject-matter with higher implementation of AR. These are references to educative institutions that do not play a key role when confronted to informal actions, use of tools for m-learning, immersive virtual environments outside of teaching guidelines, MOOC courses, hybrid models, and b-learning. In addition to benefits such as quantitative enrichment due to more access to information, this phenomenon creates innovative frameworks for activities such as focused virtual groups, rewarding interaction, and new scales of values, that are situated outside of administrative regulations that nonetheless, can become successful learning experiences.

nados (2015) identified good formative virtual practices, concluding that students are able to learn, when situated in a place where they can experiment, and achieve a high degree of interaction that can be assimilated as real. These are beneficial common places for social dialogue and playful experience (Tscholl & Lindgren, 2016).

# 4.5. Records related with subjects with AR implementation

Not all subject-matter implements new technology at the same pace. We have detected that AR is still scarcely linked with formation and learning, as pointed out by Abate & Nappi (2016), and by García (2016). Tscholl & Lindgren (2016), Laine & al. (2016), Liou, Bhagat & Chang (2016), among others, describe the benefits of AR in learning sciences. Most of the references appear in technology and Medicine. In this, Huang, Liaw & Lai (2016) descri-

be the use of human simulators for patients and systems of virtual environments. Acceptation of these virtual reality (VR) learning environments is high among students, with a positive impact on perceived usefulness and easy-to-use features. Heradio & al. (2016), and Potkonjaj & al. (2016) organize formative experiences in engineering, and analyse literature on virtual laboratories, since its early days to 2015.

Another area where AR implementation has occurred is language learning, Mobile Assisted Language Learning, and notably in English (Gimhyesuk, 2016). Liu, Lu & Lai (2016) reviewed WoS literature through data mining and address specific abilities enhanced in each case. Kim (2016) presents positive results in listening comprehension where levels of interest and motivation, along with autonomy of university students in their own learning, play an important role. Sung, Changb, & Liua (2016) analyse autonomous learning of English and its impact on listening skills. We cannot put aside the great market behind foreign language formation where strong commercial strategies, gaming and the enticing capacity of AR combined are driving components of activities even at upper language levels (Richardson, 2016).

#### 5. Discussion and conclusions

Scientific literature reviewed demonstrates that it is urgent to assemble a theorical and conceptual framework agreed and assimilated by the educational community. Several works, including those of Mohd & al. (2014) call for a reorientation in the realm of Philosophy of Education, seeking not to underestimate creative and ludic drivers of the teaching-and-learning process. We coincide with several authors in witnessing the surge of these instruments motivating methodological changes, and as mechanisms for modulation of the educational interaction, overcoming the mere space-time delocalization (Vázquez-Cano, Sevillano, & Fombona, 2016). In line with Davies & al. (2010), we believe that the overall technological implementation process should not be regarded in a systematic manner, but rather, it should be addressed in perspectives tailored to specific subject-matter.

Data show the situation of the phenomenon at the moment of the review. Because of the importance of the sources reviewed, the trend can be considered as a true image of the level of penetration that m-learning and AR technology have achieved in scientific research, making this paper a timely reference for subsequent sectorial research.

Qualitative analysis points at five groups of key descriptors in research for m-learning and AR: terminological conceptualization, methodological changes, analysis of use factors, motivational and ludic dimension, delocalization and selected subject-matter with higher implementation of AR. These are references to educative institutions that do not play a key role when confronted to informal actions, use of tools for m-learning, immersive virtual environments outside of teaching guidelines, MOOC courses (Aguaded, Vázquez-Cano, & López-Meneses, 2016), hybrid models, and b-learning (Mittag, 2016). In addition to benefits such as quantitative enrichment due to more access to information, this phenomenon creates innovative frameworks for activities such as focused virtual groups, rewarding interaction, and new scales of values, that are situated outside of administrative regulations that nonetheless, can become successful learning experiences.

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# Formative Assessment, Communication Skills and ICT in Initial Teacher Training



Evaluación formativa, competencias comunicativas y TIC en la formación del profesorado

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#### ABSTRACT

The purpose of this study is to analyze the perception of students, graduates, and lecturers in relation to systems of formative and shared assessment and to the acquisition of teaching competences regarding communication and the use of Information and Communications Technology (ICT) in initial teacher education (ITE) on degrees in Primary Teaching Physical Education (PTPE) and Physical Education and Sports Science (PESS). An ad hoc questionnaire was applied to a total sample of 1,243 students, 487 graduates and 345 lecturers from 24 Spanish universities that cover most of Spain's Regional Autonomous Communities. The results from the questionnaires indicate that for all three groups the most relevant element in the assessment process is the teacher-student interaction, and the second most relevant are the competences in interpersonal relationships. Significant differences are also found in practically all the items in the questionnaire between the responses of lecturers and students and between those of students and graduates. In our detailed study of the perceptions of students regarding their competence in ICT, those taking the degree in PTPE perceive a greater use of ICT than those taking the degree in PESS. The same difference was found with students under 22 years of age in relation to the older students. No gender differences were found.

#### RESUMEN

La finalidad de este estudio es analizar la percepción del profesorado, alumnado y egresados en relación a los sistemas de evaluación formativa y compartida y a la adquisición de competencias docentes respecto a la comunicación y al uso de las TIC, en la formación inicial en el Grado de Maestro de Primaria (Educación Física) y en el Grado en Ciencias de la Actividad Física y el Deporte (CCAFD). Se ha aplicado una escala diseñada «ad hoc» en una muestra total de 1.243 estudiantes, 487 egresados y 345 profesores de 24 Universidades españolas que abarcan la mayoría de las Comunidades Autónomas. Los resultados indican que para los tres colectivos el elemento más relevante en el proceso de evaluación es la interacción profesores-estudiantes y, en segundo lugar, las competencias en relaciones interpersonales. También que existen diferencias significativas en prácticamente todos los ítems entre los profesores y los estudiantes, los procedentes del Grado de Maestro de Primaria perciben una mayor utilización de las TIC pue los de CCAFD; lo mismo ocurre con los menores de 22 años en relación a los más mayores. No se han encontrado diferencias en función del género.

#### KEYWORDS | PALABRAS CLAVE

Formative assessment, higher education, teacher training, skills communicative, university students, graduate, university teacher. Evaluación formativa, educación superior, formación profesorado, competencias comunicativas, estudiantes universitarios, egresados, profesorado universitario.

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#### 1.1. Formative and shared assessment in Higher Education

University teaching demands excellence (European Association for Quality Assurance in Higher Education, ENQA, 2014), for which it is necessary to foster an environment of student participation, involving them in their learning and assessment (Boud & Falchikov, 2007; Brown & Glasner, 2003, Falchikov, 2005, López-Pastor, 2009; Zabalza, 2007). This means that lecturers have to implement changes in their teaching and assessment, an uncommon occurrence in Spanish universities (Zabalza, 2003) although in recent years there have been some notable advances (Fraile, 2006; Palacios & López-Pastor, 2013; Ruè, 2013).

One strategy that has been used increasingly in European countries to support the move towards convergence of practice as required in the European Higher Education Area (EHEA) is for university courses to directly address the development of professional competencies that, in turn, help to establish an appropriate culture of assessment (Dochy, Segers, & Dierick, 2002). This means that courses should incorporate systems of formative and shared assessment (F&SA) aimed at improving, not merely measuring, learning. Formative assessment (FA) involves a process of verification, assessment and decision-making, whose purpose is to optimize the teaching-learning process (López-Pastor, 2009). Shared or co-assessment represents the process of dialogue between the lecturer and their students on the assessment of their learning. Key to this process is communication and how communication channels are established and implemented.

There are a number of basic techniques that can be used to encourage student participation in assessment (López-Pastor, 2009): self-assessment, co-assessment, peer assessment, and shared assessment. They can all be implemented as standard assessment processes for different learning activities. On the other hand, to enable students' participation in the process of grading assessments, we can incorporate self-grading and negotiated grading, both of which should be supported by effective channels of communication.

In recent decades, evidence has emerged from studies, such as those mentioned below, that indicates how the use of F&SA in Higher Education significantly improves the quality of learning as well as the development of competences linked to metacognitive abilities and lifelong learning. F&SA increases the motivation and involvement of students and provides opportunities for the correction of errors. It represents a learning experience in itself, developing students' responsibility, autonomy, and communication, improving their capacity for self-reflection and academic performance (Boud & Falchikov, 2007; Brown & Glasner, 2003; Falchikov, 2005; Fraile, López-Pastor, Castejón, & Romero, 2013; Knight, 2005; López-Pastor, 2009; Martínez, Santos, & Castejón, 2017; Romero, Fraile, López-Pastor, & Castejón, 2014).

#### 1.2. Formative assessment, communication, and the use of ICT

Formative assessment is a mode of assessment that provides guidance to students and helps them learn. It must therefore be adapted to their needs and be fully integrated into the teaching-learning process (Brookhart, 2007; López-Pastor, 2009; Yorke, 2003). To do this requires effective communication, which enables real progress to be made in learning and in the academic outcomes achieved (Ferguson, 2011, Johnson & Burdett, 2010, Nicol & Macfarlane-Dick, 2006). There are, however, some challenges, both in implementation of strategies that introduce F&SA (Gikandi, Morrow, & Davis, 2011; Li, Xiong, Zang, Kornhaber, Lyu, & al., 2016) and in the type and mode of feedback provided (Evans, 2013). ICT can play an important role in reducing these challenges. The flexibility offered by F&SA in enabling different instruments to be employed means that assessment can be varied and adapted to the context and needs of students (Arazy, Yeo, & Nov, 2013; Capllonch & Castejón, 2007), and it is an important resource for lecturers whose own competence in the use of ICT is crucial in order to ensure the quality of the communicative process (Salinas, 2004).

#### 1.3. Communicative skills and use of ICT in Initial Teacher Education (ITE)

The current academic scenario is focused on the development of competencies (Perrenoud, 2005). Competence-based work requires a coherent teaching-learning approach that entails aligned teaching (Biggs & Tang, 2007), where methodology and assessment form part of the process. It requires a participatory methodology in which students assume responsibility for their learning (Knight, 2005; Rué, 2007), and a learning-centered assessment approach that takes precedence over grading (Ramsden, 2003).

Changes in the use of ICT as a support for teaching has been an important aspect in the training of teachers (Bautista, Borges, & Forés, 2006), as well as in the way students use it (Turner & Croucher, 2014). However,

Gutiérrez-Martín and Tyner (2012) warn of two possible dangers: the restriction of media education to the mere development of digital skills, and the reduction of digital skills to their most basic technological and instrumental dimension. To avoid this, they recommend reinstating the most critical and ideological approaches to the development of media literacy and digital competence. Gutiérrez-Martín, Palacios, and Torrego (2010) argue that such changes are not as immediate and beneficial as the dominant discourse makes us believe, and that they actually generate multiple and varied transitional situations that have come to characterize current university education.

In essence, the challenges for teachers and students in implementing F&SA are affected by their own communicative competence and their use of ICT. According to Bullock (2004), teachers' attitudes towards these technologies are one of the main predictors as to whether their use in the teaching process is viewed as positive or negative by their students. Positive attitudes enhance motivation and interest in learning, while negative ones lead to weaknesses in both areas (Albirini, 2006). The simple introduction of ICT within the teaching process does not automatically represent an innovative change (Bates, 2009). What is required are real changes to the roles of both

the teachers and the students and in the methodology and assessment systems implemented.

Following the implementation of the EHEA, ICT has not been able to maintain its role as the environment in which digital skills are developed. ICT has not been given any greater presence within teacher education degrees (Losada, Valverde, & Correa, 2012). In contrast, students demand to use in their courses the tools they use most in their daily lives (blogs, instant messaging, social networks...), as has already been shown in the study by Trinder, William, Margaryan, Littlejohn and Nicol (2008).

Various studies indicate the perspectives of lecturers, students, and graduates regarding the In recent decades, evidence has emerged from studies, such as those mentioned below, that indicates how the use of F&SA in Higher Education significantly improves the quality of learning as well as the development of competences linked to metacognitive abilities and lifelong learning. F&SA increases the motivation and involvement of students and provides opportunities for the correction of errors. It represents a learning experience in itself, developing students' responsibility, autonomy, and communication, improving their capacity for selfreflection and academic performance.

use of F&SA during initial teacher education (ITE) with differences of opinion being seen between all three groups (Gutiérrez-García, Pérez-Pueyo, & Pérez-Gutiérrez, 2013; Martínez, Castejon, & Santos, 2014, Martínez & al., 2017, Romero, Castejón, & López, 2015). Although the results of these studies generally show that using formative assessment does deliver considerable improvements, similar improvements are not, however, evidenced in relation to the use of ICT and its role in F&SA. The objective of this study is, therefore, to verify the perception of lecturers, students, and graduates about the use of F&SA and its relationship with the development of teaching competences in the use of ICT in initial teacher education on degrees in Primary Teaching in the specialist areas of Physical Education (PTPE) and Physical Education and Sports Science (PESS).

This current study is part of another wider project, aimed at analyzing the perception of lecturers, students, and graduates on the acquisition of teaching competences and the use of F&SA systems in initial teacher education. In the present study, we will limit ourselves to analyzing the issues that relate to communication and the use of ICT.

#### 2. Materials and methodology

#### 2.1. Participants

A non-probabilistic sample representing most of the Regional Autonomous Communities in Spain was used. It consisted of participants from 24 Spanish universities, including Alcalá de Henares, Almería, Autónoma de Barcelona, Autónoma de Madrid, Barcelona, Burgos, Castilla la Mancha, Granada, Huelva, La Coruña, Leon, Lleida, Murcia, The Basque Country, Ramón Llul, Salamanca, Cantabria, Seville, Tenerife, UCAM, Valencia, Valladolid, Vic and Zaragoza). They all share the following characteristics: a) university lecturers in initial teacher

| Table 1. Percentage of participants by gender, degree and age (of the students) |       |                         |      |      |      |      |      |
|---|-------|-------------------------|------|------|------|------|------|
|   |       | % Gender % Degree % Age |      |      |      |      |      |
|   | N     | М                       | F    | PTPE | PESS | <22  | >22  |
| Students  | 1,243 | 56.5                    | 43.5 | 68.0 | 32.0 | 69.8 | 30.2 |
| Lecturers   | 345   | 56.8                    | 43.2 | 60.4 | 39.6 |      |      |
| Graduates   | 487   | 58.9                    | 41.1 | 39.0 | 61.0 |      |      |
|   |       |                         |      |      | I    |      |      |

education (ITE) that have taught on those degree courses in any of the four previous academic years; b) fourth-year students of ITE degrees in 2014-2015; c) graduates of the above-mentioned degree courses from any of the last five academic years (Table 1).

#### 2.2. Instruments and materials

An "ad hoc" baseline questionnaire was drawn up, entitled "Teaching competencies in ITE", of which three versions were created, each adapted to the specific participating populations. The competences used for the study were those included in the White Paper on the Degree in Primary Teaching and the Degree in Physical Education and Sports Science (ANECA, 2005a, 2005b). The validation process of the questionnaire was: a) inclusion of a large number of items from the White Papers; b) revision of this first version by a group of 10 university lecturers, experts in Physical Education Didactics, who have participated in research projects on university teaching and have maintained a commitment to frequent publication of their research in specialized Spanish and foreign journals (2 - 3 per year); this resulted in 82 items; c) application of a first pre-test with a group of students to analyze the degree of understanding and relevance, until the final version was arrived at; d) finally, calculation of the reliability of the instrument using Cronbach's Alpha, obtaining values between .879 and .954.

The final version of the questionnaire consisted of 12 questions and 79 separate items. Questions were asked to identify: a) to what extent the courses studied helped to develop teaching competences; and b) the degree to which participants agreed with statements related to the development of the subject areas. The evaluation was undertaken using a Likert scale with five points of agreement: between 0 (none, nothing) and 4 (a lot, very high). The present paper focuses on the items related to: a) the assessment and communication system; b) competences that require communication skills; and c) competences in the area of ICT.

#### 2.3. Procedure

The definition of the sample and the application of the questionnaire were undertaken in April 2015. Students and lecturers were given questionnaires in paper format, and graduates were given electronic questionnaire (Google), given the difficulty in accessing this group. The approximate duration for completion was forty minutes. Anonymity was guaranteed by coding the completed questionnaires.

#### 2.4. Statistical analysis

Two studies were carried out: a) results by items for the three participant groups: descriptive (Mean and Standard Deviation - SD); and comparisons: ANOVA and multiple comparisons with Bonferroni test applied; b)

| Та   | ble 2. List of items and short titles   |                                      |
|--|---|--------------------------------------|
| 1. The assessment and<br>communication system    | 1.1. Assessment tasks are agreed<br>with the students   | (Negotiated assessment)              |
|  | 1.2. Grading is done through peer assessment,   | (Grading using peer<br>assessment)   |
|  | 1.3. Grading is achieved using<br>negotiation and agreement between<br>lecturers and students | (Negotiated grading)                 |
| 2. Competences that require communication skills | 2.1. The interaction between<br>lecturers and students assists the<br>assessment process      | (Student-lecturer interaction)       |
|  | 2.2. Oral and written communication in the native language                                    | (Native language<br>communication)   |
|  | 2.3. Knowledge of a foreign language  | (Knowledge of a foreign<br>language) |
|  | 2.4. Competence in interpersonal relationships  | (Interpersonal relations)            |
| 3. ICT skills                                    | 3.1. Knowledge of IT in relation to the<br>subject area                                       | (Specific IT knowledge)              |
|  | 3.2. Use of Information and<br>Communication Technology                                       | (Use of ICT)                         |

detailed study of students' responses based on the variables: gender, age and degree, with Student's t test applied, according to the characteristics of our sample. Both Excel\_2007 and SP-SS\_v19 programs were used, establishing a significance level of  $p \le .05$ .

#### 3. Analysis and results 3.1. Results for students, graduates, and teachers

The interval within which the mean scores of all three

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groups varied in each of the items did not exceed six decimal places, except for the single item "Negotiated assessment" (Table 3).

For all three items relating to "Assessment and communication system", there were low values in general from students as well as from graduates and lecturers. The

| Tabla 3. Tabla general de medias, DT (entre paréntesis) y ANOVAs de la valoración<br>de las competencias por cada grupo |           |           |           |        |      |  |  |  |
|---|-----------|-----------|-----------|--------|------|--|--|--|
| Profesores Estudiantes Egresados F p<br>(N=351) (N=1243) (N=491)  |           |           |           |        |      |  |  |  |
| 1.1. Evaluación acordada  | 2.3 (1.2) | 1.8 (1.2) | 1.7 (1.2) | 33.974 | .000 |  |  |  |
| 1.2. Calificación con coevaluación  | 1.5 (1.2) | 1.4 (1.1) | 1.3 (1.0) | 7.934  | .000 |  |  |  |
| 1.3. Calificación dialogada   | 1.5 (1.2) | 1.4 (1.2) | 1.0 (1.1) | 21.840 | .000 |  |  |  |
| 2.1. Interacción profesores-estudiantes   | 3.6 (0.6) | 3.2 (0.8) | 3.5 (0.8) | 55.410 | .000 |  |  |  |
| 2.2. Comunicación lengua nativa   | 2.7 (1.0) | 2.5 (1.0) | 2.6 (1.0) | 10.079 | .000 |  |  |  |
| 2.3. Conocimiento lengua extranjera   | 1.1 (1.1) | 1.3 (1.1) | 1.1 (1.1) | 5.825  | .003 |  |  |  |
| 2.4. Relaciones interpersonales   | 2.9 (1.0) | 2.8 (0.9) | 3.0 (0.9) | 5.884  | .003 |  |  |  |
| 3.1. Conocimiento informática específica  | 2.0 (1.1) | 1.8 (1.1) | 1.9 (1.1) | 7.453  | .001 |  |  |  |
| 3.2. Utilización de TIC   | 2.6 (1.0) | 2.3 (1.1) | 2.3 (1.1) | 11.479 | .000 |  |  |  |

highest scores were for "Negotiated assessment", the lecturers' scores being the highest, followed by graduates' and students' scores. The same order was repeated in "Grading using peer assessment" and in "Negotiated grading", with the scores from the graduates the lowest of the whole study.

As for the block "Competences requiring communicative skills", the item "Student-lecturer interaction" obtained the highest mean scores in the study for all three groups. For the other three items, the one with the highest scores from all three groups was "Interpersonal relations". All three groups scored it more highly than "Native language communication" with this item scoring higher than "Knowledge of a Foreign Language".

In the ICT skills section, all three populations scored the "Use of ICT" more highly than "Specific IT knowledge".

From the analysis of variance in each of the items it was found that there were significant differences between lecturers, students, and graduates (Table 3).

From the data of the ANOVAs, multiple comparisons (Bonferroni) were made to identify between which groups the differences occurred (Table 4). Of the 27 possible combinations, differences were found in 18 of them. Of the remaining nine, five were in the binomial graduate-lecturers (items 2.1 to 2.4 and 3.1); three in student-lecturers (1.2, 2.4 and 3.2); and one in student-graduates (3.1) (Table 4).

For the items in the "Assessment and communication system" category, (1.1 to 1.3, Table 3), the ANOVA showed significant differences between all three. In subsequent multiple comparisons (Table 4), significant differences were found in all possible combinations except for one. In the student-graduate binomial, differences appeared in all three cases (p=.038, p=.002, and p=0). In graduates-lecturers this was also the case (p=0 in all three cases), while in the student-lecturer binomial there were significant differences in "Negotiated Assessment" (p=0) and "Negotiated grading" (p=.045), but there were discrepancies in "Grading using peer assessment".

Regarding the block of items "Competences that require communication skills" (items 2.1 to 2.4, Table 3), differences were found in all four items (p=0, p=0, p=.003; p=.003, respectively). Subsequently the three groups were compared in order to identify where the differences occurred (Table 4). For the item "Student-lecturer interaction" they were found between the students and the other two groups (p=0, in both cases). In the case of "Native language

| Tabla 4. Comparaciones múltiples (Bonferroni) (solo valores con significación) |            |            |      |  |  |  |  |
|--|------------|------------|------|--|--|--|--|
| Variable dependiente   | E          | Bonferroni |      |  |  |  |  |
| 1.1. Evaluación acordada   | Estudiante | Egresado   | .038 |  |  |  |  |
|  |            | Docente    | .000 |  |  |  |  |
|  | Egresado   | Docente    | .000 |  |  |  |  |
| 1.2. Calificación con coevaluación   | Estudiante | Egresado   | .002 |  |  |  |  |
|  | Egresado   | Docente    | .000 |  |  |  |  |
| 1.3. Calificación dialogada  | Estudiante | Egresado   | .000 |  |  |  |  |
|  |            | Docente    | .045 |  |  |  |  |
|  | Egresado   | Docente    | .000 |  |  |  |  |
| 2.1. Interacción profesores-estudiantes  | Estudiante | Egresado   | .000 |  |  |  |  |
|  |            | Docente    | .000 |  |  |  |  |
| 2.2. Comunicación en lengua-nativa   | Estudiante | Egresado   | .017 |  |  |  |  |
|  |            | Docente    | .000 |  |  |  |  |
| 2.3. Conocimiento de lengua-extranjera   | Estudiante | Egresado   | .019 |  |  |  |  |
|  |            | Docente    | .025 |  |  |  |  |
| 2.4. Relaciones interpersonales  | Estudiante | Egresado   | .002 |  |  |  |  |
| 3.1. Conocimientos de informática-específica                                   | Estudiante | Docente    | .000 |  |  |  |  |
| 3.2. Utilización de TIC  | Estudiante | Docente    | .000 |  |  |  |  |
|  | Egresado   | Docente    | .002 |  |  |  |  |

communication", students' scores differed from graduates' (p=.017) and from lecturers' (p=0), and the same happened with "Knowledge of a foreign language" (p=.019 and p=.025, respectively). In "Interpersonal relations", the significant differences were only found between students and graduates (p=.002).

In summary, multiple comparisons showed significant differences between students and the other two groups in all items in this block, with the exception of "Interpersonal relations", in which students' scores only differed from the graduates'.

Regarding the competences (3.1 and 3.2) referred to in the third block

of items studied, "ICT Skills" (Table 3), significant differences were found in both cases (p=.001 and p=0). These were (Table 4) between students and lecturers in both cases (p=0), as well as between graduates and lecturers in "Use of ICT" (p=.002).

A second in-depth study was carried out in relation to "ICT Skills" among students, according to gender, age, and degree (PTPE vs

PESS). After applying the Student's t-test to two independent samples, no significant differences were found

| Tabla 5. Medias, DT, Levene y t de Student en función de la titulación de los estudiantes |            |  |     |     |       |      |       |                 |                 |
|---|------------|--|-----|-----|-------|------|-------|-----------------|-----------------|
|   | Estudios   | Estudios N Media DT Prueba de Levene Prueba t para la igualdad de medias |     |     |       |      |       | aldad de medias |                 |
|   |            |  |     |     | F     | Sig. | t     | gl              | Sig.(bilateral) |
| 3.2. Utilización de TIC   | Magisterio | 854  | 2.3 | 1.1 | 6.287 | .012 | 2.931 | 744.876         | .003            |
|   | CCAFD      | 372  | 2.1 | 1.0 |       |      |       |                 |                 |
|   |            |  |     |     |       |      |       |                 |                 |

for either gender or age. In terms of the degree studied, Student's t-test was also applied. The Levene test yielded a value lower than .05, so different variances were assumed. Significant differences (p=.003) were found between

| Table 6. Means, DT, Levene and Student's t test in function of the students' age |     |     |      |     |                    |      |       |         |                 |
|--|-----|-----|------|-----|--------------------|------|-------|---------|-----------------|
|  | Age | N   | Mean | DT  | Levene test t Test |      |       |         |                 |
|  |     |     |      |     | F                  | Sig. | t     | gl      | Sig.(bilateral) |
| 3.2_Use of ICT   | <22 | 269 | 2.4  | 1.0 | 3.069              | .08  | 2.643 | 472.717 | 300.            |
|  | >22 | 932 | 2.2  | 1.1 |                    |      |       |         |                 |
|  |     |     |      |     |                    |      |       |         |                 |

students of PTPE and students of PESS with the former's values being higher (Table 5). In the case of differences between stu-

dents as a function of age, the Student's t-test was applied to two independent samples. The Levene test yielded a value lower than .05 so different variances were assumed. The results showed significant differences between the groups only in the item "Use of ICT", with the younger students producing higher values (Table 6).

#### 4. Discussion and conclusions

The present study reveals differences in the perceptions of students, graduates, and lecturers involved in certain degree courses in ITE for Physical Education in Spain, regarding the degree to which communication and ICT skills are acquired on these courses, and regarding certain aspects of the assessment in which communication is a key factor.

With regard to the aspects of communication that can influence the use of F&SA (the first block of items considered), there were significant differences in the responses from the three populations, with the highest average always coming from lecturers and the lowest from graduates. The results were low, both for "Negotiated grading" and for "Grading using peer assessment", and somewhat higher for «Negotiated Assessment». The lecturers agreed with the students regarding the minimal use of co-assessment, and scored the use of "Negotiated grading", and, in particular, "Negotiated assessment", more highly than students and graduates, in line with Gutiérrez-García and others (2013), López-Pastor (2009) and Romero and others (2015). It is possible that, although lecturers may believe that their performance has evolved and improved (Gutiérrez-García & al., 2013), students and graduates consider that certain practices, in which communication is important, are not implemented effectively. However, the differences found between students and graduates reinforce the tendency found in other studies (Palacios & López-Pastor, 2013) that F&SA practices are evolving positively in Spanish universities.

As for the category "Competencies that require communication skills", all populations agreed strongly that "lecturer-student interaction" enhances the assessment process (a highly-valued item in the study). This is a very positive aspect, given that many authors maintain that the participation of students in their education and assessment is key to the development of their competencies (Brown & Glasner, 2003; Zabalza, 2007), especially in ITE (Palacios and López, 2013; Hamodi, López-Pastor, & López-Pastor, 2017), and helps to achieve the excellence referred to in the ENQA (2014). However, these results do show some inconsistency in the low values given to "Negotiated Assessment" and "Negotiated grading", both of which require student-lecturer interaction.

The next most highly rated item of the second block was "Interpersonal relations". All three groups agreed that ITE significantly improves this competence, and it is the only item in the whole study in which the scores from graduates were greater than those from the lecturers. This may be because, as newly active professionals, they place greater value on a competence that has proven to be very important in their professional practice, since it helps to develop socio-affective skills in order to interact with students, their fellow lecturers, and other socio-educational agents (Aparicio & Fraile, 2016). In addition, these results coincide with Abarca, Marzo and Sala (2002), who focus on the presence of emotional competencies in initial teacher education. As well as with the study by Aparicio and

Fraile (2016), carried out with ITE students in which skills that foster interpersonal relationships (the teacher's ability to empathize, as well as to recognize their own feelings and emotions) are the most highly valued.

The competencies related to "Oral and written communication in the native language" represented the third most highly valued item by all three groups. In the case of the students, in accordance with the study by Hermosilla, Clemente, Trinidad and André (2013), in which students considered oral expression to be a very useful tool for their future professional life. The scores of the lecturers and graduates were higher than those of the students, probably influenced by their involvement in the workplace, as mentioned above. The scores of the lecturers exceeded those of the students, which is common in studies on the perception of competency development in ITE (Almerich, Suárez-Rodríguez, Belloch, & Bo, 2011).

The item "Knowledge of a foreign language" produced the lowest mean scores of the second block and of the entire study. These results indicate that ITE in Spanish universities has not yet fully incorporated the use of foreign language skills required within the new multicultural context (De-Pablos, 2010), although it is moving towards a progressive implantation of English language study. Student mobility has also experienced a notable increase within Spanish universities, which is an important factor in continuing to effect valuable structural modifications (Belvis, Pineda, & Moreno, 2007).

With regard to the acquisition of "Competences in the area of ICT", the scores for "Specific IT skills" were medium-low and medium for the "Use of ICT" in general. These results contrast with the fact that both lecturers and students consider ICT skills as key to improving teaching and learning processes (Pino & Soto, 2010). A competency-based system "cannot be developed through the mere transmission of knowledge" (Gutiérrez-Martín & al., 2010: 165). Rather, it is necessary to use didactic resources to deliver formative assessment and continuous and effective feedback (Torrance, 2012), in which ICT plays a crucial role. As Ferguson (2011) points out, the appropriate use of communication and feedback offered to Physical Education students can lead to important advances in their learning and academic achievement. On the other hand, however, Gutiérrez-Martín and others (2010) suggest that the impact of ICT in Higher Education is being overestimated.

Regarding the item "Use of ICT", the results showed significant differences between students' and lecturers' scores, as well as between graduates' and lecturers' scores. In both cases, the highest perception was that of the lecturers, representing an habitual discrepancy, as mentioned above. Students' scores were the lowest, unlike in the study by San-Nicolás and others (2012), whose students state that they have sufficient skills in using ICT. Although there is a general perception that all students are experts in ICT, the evidence does not seem to support this. On this issue, Kirkwood and Price (2005) point out that very few have high skill levels in the use of applications. Furthermore, Gutiérrez-Martín and others (2010) question the myth that ITE students are digital natives and, in any case, there seems to be a wide disparity in literacy levels (Lorenzo, Oblinger, & Dziuban, 2006).

On the other hand, this raises questions of why, in spite of the generalized spread of platforms like Moodle, Blackboard, etc., levels of competence in the use of ICT are not more highly valued. In their study, Losada, Valverde and Correa (2012) do not identify any increase in the presence of ICT in ITE courses since the introduction of the EHEA. However, as indicated above, students demand the introduction of the usual tools they use in their daily life. One reason for this may be the attitude of lecturers to the use of ICT, which strongly influences students' acceptance or rejection of ICT in teaching processes (Bullock, 2004). However, changes in the role of the lecturer, the role of the students, the methodology and the assessment system are all necessary, since the introduction of ICT in teaching activity alone does not represent an innovative change (Bates, 2009).

The second stage of analysis of the results focused on the students as a group and their perception of the acquisition of competences in the use of ICT during their ITE. No significant differences were detected in terms of gender, which contradicts other studies which do find differential aspects, suggesting a "digital gender gap" (Gil-Juárez, Feliu, & Vitores, 2012), which is a matter of concern in the academic world.

In relation to the degree studied, there were significant differences for the item "Specific IT skills", for which the students of PESS gave lower scores. One possible explanation is the one suggested by Maquilon and collaborators (2013), that students of social and legal sciences consider ICT skills as essential, taking first place in the list of important "macro areas" on their courses with 38.2%, while in the area of health sciences this declines to 13.9%.

Finally, in terms of age, differences were only established for the item "Use of ICT", where higher values were found among students below 22 years of age. This coincides with the results of the study by Maquilon and others (2013), in that age is a factor in terms of students' perception of their competence in ICT.

In conclusion, the results demonstrate the existence of differences in the perception of lecturers, students, and

graduates of ITE and Physical Education degrees regarding the acquisition of teaching competences related to F&SA, communication and the use of ICT. These results indicate an important path for future development in ITE. The main suggestions are as follows:

a) There is a gap between the assessment systems that relevant literature considers as the best way to generate learning and competences in ITE and what predominates in reality. Therefore, it seems important to insist on ever greater implementation of F&SA systems within these courses.

b) We suggest that greater emphasis should be placed on the development of competences linked to interpersonal relations in ITE for Physical Education, as they are often forgotten or diluted in many subject areas, although they are actually the competencies most highly valued by graduates in their professional practice.

c) Because of their importance in professional practice, the presence of competences that relate to "oral and written communication" should be prioritized in all ITE courses, as they are in courses where other languages, such as corporal, are very relevant.

d) There seems to be a wide disparity in the digital literacy levels of ITE for Physical Education students. It would therefore be advisable to incorporate more opportunities for the use of and changes to the way digital skills are developed in ITE for Physical Education.

We believe that this current article may be of great interest to university lecturers involved in ITE and, more specifically, to those interested in research into the use of ICT in ITE, as well as to those who research into F&SA systems within higher education.

In future studies, it will be important to undertake research to a) identify methodological strategies and practices in the design and use of ICT for teaching staff at all levels within education; b) analyze good practice in the development of new technologies within educational contexts; and c) verify how ICT skills can be transferred to real professional practice within educational establishments.

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# Music and its Significance in Children Favourite Audiovisuals

La música y sus significados en los audiovisuales preferidos por los niños



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#### ABSTRACT

Audiovisual media are part of children's daily life. They build and/or replace a part of the reality that is sometimes preceded. This paper is interested in one of the elements of the audiovisual binomial, the soundtrack, in order to analyse its meaning and sense from the children's point of view. The objectives are: to determine if the audiovisual media clips to which children are exposed (sound, image and all) are perceived differently; to establish the possible differences in the assessment they make when comparing the sound and image presentation modalities. Fourteen audiovisual media (movies, series, cartoons and documentaries) were identified by 115 children (10-12 years old) as preferred. Audiovisuals were edited in three modalities (sound, image, and all) and grouped into different series of three clips, which were watched in group sessions by 547 Spanish and Argentinian children (mean age: 11 years old). An Assessment Questionnaire of audiovisual clips was designed and implemented. Results showed differences in the meaning of the soundtrack in three of the five categories of the questionnaire. The significant predominance of the sound in series, documentaries and, especially, movies is highlighted. Contextual space-time elements, affective implications, feelings, and empathy as well as assessment of the experience are all perceived by means of the sound (the music).

#### RESUMEN

Los audiovisuales forman parte de la vida cotidiana de la infancia, construyendo con ellos una parte de la realidad que muchas veces se anticipa y otras sustituye. Este artículo se interesa por una de las partes del binomio audiovisual, la banda sonora, con la finalidad de conocer su significado y sentido desde la propia interpretación infantil. Sus objetivos son determinar si los niños perciben de modo diferente los clips audiovisuales a los que son expuestos (sonido, imagen y todo); establecer las posibles diferencias en la valoración que realizan comparando las modalidades de presentación sonido e imagen. Se identificaron 14 audiovisuales preferidos (películas, series, dibujos animados y reportajes) por parte de 115 niños de 10 a 12 años. Fueron editados en tres modalidades (solo sonido, solo imagen y todo) y agrupados en series de tres clips, que fueron visionados en sesiones grupales por 547 niños, españoles y argentinos, con una edad media de 11 años. Se diseñó y utilizó un cuestionario de valoración de clips audiovisuales. Los resultados mostraron diferencias sobre el significado de la banda sonora en tres de las cinco categorías del cuestionario, destacando el predominio significativo del sonido en series, reportajes y, de manera destacada, en películas. Se perciben por el sonido (la música) elementos contextuales espacio-tiempo, la implicación afectiva, sentimientos y empatía así como la valoración de la experiencia.

#### KEYWORDS | PALABRAS CLAVE

Childhood, soundtrack, audio-visual, cinema, television, meaning, sense, multimodal. Infancia, bandas sonoras, audiovisual, cine, televisión, significado, sentido, multimodal.

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#### 1. Introduction

#### 1.1. The audiovisual binomial in the children's daily life

Eco (1972: 26) notes that culture as a whole can be better understood if it is approached from the semiotic plane. Audiovisual media today form part of an infant's daily life. Within this living environment, music and Media form an inseparable binomial. Film and television are produced industrially, and are directed to a large unknown audience, separated by age groups, but are always received individually and privately (Benjamin, 1983: 7-8). It is in this manner, individual and private, that the music develops significance and meanings with which the children interact and understand the world that surrounds them. Therefore, music from audiovisual media is similar to the functions of popular music as according to Frith (2001): "the creation of identity, the management of feelings and the organization of time". At present, children live in a world that is shown in screens, sometimes preceding or substituting what is real. From the audiovisual binomial, we are interested in the soundtrack, comprised of texts or speeches (Cohen, Manion, & Morrison, 2013), which we will approach through their modes of listening (Porta, 2014).

#### 1.2. Audiovisual media tell stories and construct worlds

When reviewing the literature, different works were found that analysed audiovisual media as constructors of the infant's reality (Del-Río, Álvarez, & Del Río, 2004). Multiple authors have studied their music (Aguaded, 2010; Denora, 2000; Morley, 2003; Porta, 2007, 2011; Sloboda, 2005). In film, diverse works were also identified (Adorno, 2009; Campbell, 2010; Chion, 2013; Hauser, Tovar, & Varas-Reyes, 1969). Among the functions of music, the transmission of emotions that intervene in the tension of the events and characters is noted (Tan, Cohen, Lipscomb, & Kendall, 2013). In Spain, Fraile (2007) proposed a functional analysis of music, identifying features that were expressive and those that were significant/narrative. More specifically, children's audiovisual media tell stories and create worlds, so that they require specific treatment, with different approaches studied from different points of view. Also, Xalabarder (2006) thinks of music in a film as a narration tool. Similarly, Igartúa and Muñiz (2008) have studied the emotions provoked by psychoanalytical models, opting for open-ended questionnaires and interviews after their viewing. Lastly, Salomon, Perkins and Globerson (1992) have studied their cognitive effects and of meaning, creating approaches that are indispensable for cognitive development, psycholinguistics and communication systems. Their studies on the singularity of mental processes, produced by the media, the development of specific skills and its system of symbols, are highlighted.

#### 1.3. Modes of listening

The origin of the word modes in film studies come from the dissatisfaction when isolating its elements and the need to observe it as parts of a whole (Kress & Van-Leeuwen, 2001). This approach coincides with the integrative approaches from inter-cultural studies and critical pedagogy (Hargreaves & North, 1999; McLaren & Kincheloe, 2008). As for listening, Swanwick (1991), coming from music education, has established three related modes: idiomatic, symbolic and systematic, highlighting in this research the systematic one, which explains how the musical experience is transformed into complex conceptual and analysis schemes. The third element that should be noted comes from ethnomusicology. Pelinski (2007) points to three modes of listening to the sound environment: natural listening, linked to sensation and the pre-conscious; reduced listening, a focused listening that links alert consciousness as the previous state of the analytical and conceptual functions through auditory perception; and lastly, privileged listening, a type of listening that is able to integrate emotional processes with analytical ones and the pre-conceptual perception, all of this joined to the consciousness of the musical properties of the object experienced.

#### 1.4. To understand the meaning and sense of the music from audiovisual media

The habitat comprises the space where meaning and sense are initially and preferentially constructed, immersion being the most important aspect, which is constructed with what is found on the road to understanding. The organizer of this complex process is initially perception, an element that generates thought through selective attention ruled by the laws of perception: structural unity, perceptual constancy and figure-ground perception. The structure of musical comprehension and the meaning of the world of music is constructed on its base. The music from film and television that children listen to has a discursive and multimodal character. It is not a unidirectional space, it is a space of interaction created by commercial means in which a story is told with music and moving

images (Ma, 2014). Audiovisual media transport the children to a space of fiction, with characters that live a story in which they participate and understand due to the sum of its languages, producing meaning. This article aims to explore this space of interaction from the music angle. In the review of the subject, the search engines that have given form to the design of the research have mainly been territory, meaning, film and television as a space for communication (Porta, 2007); secondly, meaning and sense, as studied through Semiotics (Peirce, Bonfantini, & Grassi, 1980) and meaning (Greimas, Bardón, & Sierra, 1973; Pitt & Hargreaves, 2016); and third, its understanding, approached through Psychology and Education (Tan & al., 2013). Lastly, for its understanding, the re-structuration theories from Cognitive Psychology are taken into account. These theories, constructive in character, use molar units due to their important character, and are considered by authors such as Piaget (1975). Vygotsky (1996) and the Gestalt school (Koffka, 2013; Perls, 1969).

This contribution is extremely valuable, as it moves the load towards context, its habitat and elements of

meaning that, as experienced, never appear to be separated. With this triangulation of elements, a research design is constructed, based on modes, the individual character and the use of molar units in the analysis. Starting with these principles, the initial basis of this research was created: a) to use separate versions (only sound, only image and all); b) Complete scenes and c) Search of coincidences and singularities with closed and open questions. In this article, the quantitative analysis of numerical data is presented with two objectives: 1) To determine if children

perceive, in different ways, the

It was verified that in many occasions. music made sense by itself, many times being more significant than the image. In this study, the participants indicated that music provided them with space-time guiding elements, requiring more attention and maintaining interest. These elements are decisive in the world of fiction that the audiovisual media create, a world that would be different if the music was different. Likewise. the loss. first of interest. and later of meaning, was observed when music disappeared.

categories that comprise the audiovisual media clips to which they are exposed. 2) To establish, in each one of the audiovisual media clips employed, the possible differences in their assessment when comparing the sound and image modalities of presentation. The starting hypothesis is that differences will be found in the children's perception as a function of the audiovisual modality presented.

The aim of this article is to understand the meaning and sense of the children's favourite audiovisual soundtrack, after their presentation, in line with previous studies (Ma, 2014; Tan & al., 2013).

#### 2. Materials and methods

#### 2.1. Participants

An incidental type, non-probabilistic sampling was employed, in which a sample was selected due to the accessibility to the educational centres. 547 students participated, from which 375 were Spanish (68.6%) and 172 Argentinian (31.4%). From Spain, seven cities from three provinces participated: Castellón (31.8% of the total sample), Valencia (24.1%) and Granada (12.6%). In Argentina, the children lived in three cities from two communities: Chaco (24.1%) and Corrientes (7.3%).

According to gender, 242 were boys (44.2%) and 305 girls (55.8%), aged between 9 and 15 years old, with an average age of 11.42 years old (SD=.84).

They belonged to 22 educational centres. 72.8% (n=398) studied in public centres. 11.9% in private/public centres, and 15.4% in private centres (n=84).

As for the educational stage, 367 were enrolled in the third cycle of Primary Education (67.1%), with a greater number in sixth grade (n=321, 87.5%) and 180 were enrolled in the first cycle of Secondary Education (32.9%), main from the first year (n=160, 88.9%).

#### 2.2. Instruments

Different audiovisual media clips and an associated questionnaire that the students had to complete were used as the tools for gathering information. These are described below.

#### 2.2.1. Audiovisual media clips

Initially, an exploratory study was conducted in order to establish a relationship between the films, cartoons, series and documentaries that the children aged between 10 and 12 years of age preferred. For this, 115 children participated, and they were asked what their favourite was from each of the four types of audiovisual forms. Also, their character (local, national or international) and their characteristics were determined in order to extract clips.

Once the audiovisual media and their characteristics were obtained, the most frequent ones were selected. Thus, 14 audiovisual clips were selected, of which five belonged to films ("The Croods", "The Lion King", "Oz, the great and powerful", "Titanic", "Toy Story III"), four were cartoons ("The Simpsons", "Sponge Bob", "Doraemon", "Dragon Ball Z"), four were television series ("Violetta", "La que se avecina", "Good-Luck Charlie", "iCarly"), and one was part of a documentary ("The lions of Busanga").

Each of the clips was edited into three versions: sound (S), image (I) or all (A). Then, the children from each class were subjected to a sequence comprised of three clips, each clip with a different version (S, I or A). The sequence could be, as a function of the audiovisual form, cartoons-documentary-film (sequences 01 to 12) or film-series-documentary (sequences 13-24). Table 1 shows each sequence. The first element of each clip refers to the audiovisual form, meaning, F=film, C=cartoons, S=series, D=documentary. The second element, in the case of three elements, was the number relating to the film, cartoons or series in question. Lastly, the third element (or second when there were only two) was related to the audiovisual version, meaning, S=sound, I=image, A=all.

#### 2.2.2. Questionnaire for the assessment of audiovisual clips

A questionnaire for the assessment of the audiovisual clips was designed. For the validation of the content, 14 experts from different areas participated (music, image and methods). The criteria by Barbero (2006) were used for the interjudge validation. This means that the experts were asked to show their degree of agreement with respect to the suitability of the items in each category, and later, the degree of interjudge agreement was established. For this, the mean, median, 50th percentile and interjudge dispersion (75th and 25th percentile) were used.

The final questionnaire, adapted to each audiovisual modality (S, I, A), was composed of 53 items that were grouped into five categories:

• Contextual aspects of space and time (items 1 to 7). For example, "it was daytime during the story".

• Characters and story (items 8 to 21), for example, "a character is identified".

• Musical aspects (items 22 to 31), for example "musical instruments could be heard".

• Affective implication, feelings and empathy (items 32 to 37), for example, "I would like to be in that story".

• Assessment (items 38 to 53), for example, "what was presented captured my attention".

In the first four categories, the items had dichotomous answers (Yes or No), including some open-ended questions. The last category was structured around a four-answer, Likert-type scale (Nothing, Little, A lot, Much).

A pilot test was conducted with 23 children aged 10 years old, with the aim of determining if they could understand the questionnaire by themselves. Also, the reliability of the questionnaire was calculated once the questionnaire was completed by all the participants of the study through the internal consistency Alpha of Cronbach index, obtaining a value of .972. Likewise, for the each of the audiovisual versions, we found: Sound,  $\alpha = .885$ ; Image,  $\alpha = .858$ ; All,  $\alpha = .934$ .

| Table    | 1. Sequer | nce of aud | iovisual c | lips  |
|----------|-----------|------------|------------|-------|
| Sequence | Clip 1    | Clip 2     | Clip 3     | Time  |
| SEQ01    | C3I       | DA         | F5S        | 5'58" |
| SEQ02    | C3T       | DS         | F5I        | 5'57" |
| SEQ03    | C3S       | DI         | F5A        | 5'57" |
| SEQ04    | C 4I      | DA         | F1S        | 5'46" |
| SEQ05    | C 4T      | DS         | F1I        | 5'51" |
| SEQ06    | C 4S      | DI         | F1A        | 5'49" |
| SEQ07    | C 11      | DA         | F2S        | 6'31" |
| SEQ08    | C 1T      | DS         | F2I        | 6'31" |
| SEQ09    | C1S       | DI         | F2A        | 6'28" |
| SEQ10    | C2I       | DA         | F1S        | 5'45" |
| SEQ11    | C2T       | DS         | F1I        | 5'43" |
| SEQ12    | C2S       | DI         | F1A        | 5'40" |
| SEQ13    | F1S       | S3I        | DA         | 4'29" |
| SEQ14    | F1I       | S3A        | DS         | 4'48" |
| SEQ15    | F1A       | S3S        | DI         | 4'47" |
| SEQ16    | F2S       | S4I        | DA         | 5'00" |
| SEQ17    | F2I       | S4A        | DS         | 4'55" |
| SEQ18    | F2A       | S4S        | DI         | 4'59" |
| SEQ19    | F3S       | S1I        | DA         | 6'03" |
| SEQ20    | F3I       | S1A        | DS         | 6'36" |
| SEQ21    | F3A       | S1S        | DI         | 6'36" |
| SEQ22    | F4S       | S2I        | DA         | 4'59" |
| SEQ23    | F4I       | S2A        | DS         | 5'02" |
| SEQ24    | f4a       | S2S        | DI         | 5'02" |

#### 2.3. Procedure

#### 2.3.1. Gathering of information

Authorization was solicited from the participating educational centres. Once obtained, an hour of class was selected with the aim of briefly presenting the students the object of the study as well as explaining to them what it entailed. Each class group had been assigned with a sequence composed of three clips. When each clip ended, a questionnaire was completed as a function of the audiovisual modality within which they had been presented (S, I, A).

#### 2.3.2. Statistical analysis of data

While the items from the first four answer categories of the questionnaire were qualitative, nominal and dichotomous, the items of the fifth category were ordinal (due to the use of the Likert-type scale). A summary of the items of each of the categories was conducted in order to transform the dependent variables (the five categories of the questionnaire) into discrete quantitative variables.

Afterwards, the distribution of the data was analysed to determine the type of statistical tests to be used (parametric or non-parametric). Therefore, the Kolmogorov-Smirnov test was applied, which was found to be significant for the five categories of the questionnaire p < .001, so the data did not have a normal distribution. Also, their homos-cedasticity or homogeneity of variances through Levene's test for the comparison groups (S, I, A) was calculated. The null hypothesis was not accepted in the case of the contextual aspects space and time, F(2, 1638)=6.003, p=.003 and musical aspects, F(2, 1638)=14.193, p=.000.

Due to what has been described above, a non-parametric test was conducted (Hollander, Wolfe, & Chicken, 2014). Hence, for the analysis of the three audiovisual modalities presented, a Kruskal-Wallis H-test for K independent variables was used. Also, the Mann-Whitney U independent test for 2 samples was used for each of the two versions, i.e. Sound and Image, Sound and All and in third place, Image vs All.

In order to answer the second objective of the study, non-parametric tests were used as well. The Mann-Whitney U test was used for comparing each audiovisual clip of the modalities Sound as opposed to Image.

#### 3. Analysis and results

The descriptive frequencies are specified in this section for each audiovisual media employed as well as the sequence of the clips as a function of genre and audiovisual modality. In respect of this, the frequency and percent of the answer for each one of these clips were the following: "The Croods": 160 (9.8%); "The Lion King": 134 (8.2%); "Oz, the great and powerful": 72 (4.4%); "Titanic": 54 (3.3%); "Toy Story III": 128 (7.8%); "The Simpsons": 71 (4.3%); "Sponge Bob": 49 (3.0%); "Doraemon": 128 (7.8%); "Dragon Ball Z": 52 (3.2%); "Violetta": 72 (4.4%); "La que se avecina": 53 (3.2%); "Good Luck Charlie": 60 (3.7%); "iCarlie": 61 (3.7%); "The lions of Busanga": 547 (33.3%).

As for the audiovisual form of the clips, 547 were films (33.3%, 301 were cartoons (1.3%), 246 were series (15.0%) and 547 documentaries (33.3%). Also, as each one of the clips could be presented in one of the three audiovisual modalities planned, the frequency of each of them (S, I, A) was the same in every case, n=547 (33.3%).

The frequencies and percentages of each audiovisual sequence, according to audiovisual genre and modality, were 60 (3.7%) for SEQ01, SEQ04, SEQ07, SEQ08, SEQ12, SEQ13, SEQ14 and SEQ15. For the sequences SEQ02 and SEQ11 it was 75 (4.6%). In SEQ03=249 (15.2%); SEQ05=57 (3.5%); SEQ06=39 (2.4%); SEQ09=96 (5.9%); SEQ10=12 (.7%); SEQ16=93 (5.7%); SEQ17=42 (2.6%); SEQ18=48 (2.9%); SEQ19=66 (4.0%); SEQ20=78 (4.8%); SEQ21=72 (4.4%); SEQ22=51 (3.1%); SEQ23=69 (4.2%); SEQ24=39 (2.4%).

With the aim of determining if the children perceived the categories that composed the audiovisual clips to which they were exposed, differently as a function of the modality of presentation (S, I, A), a Kruskal-Wallis H test was used for the five categories of the assessment questionnaire of the audiovisual media clips. The results brought to light the differences, according to the audiovisual modality, in the categories of the contextual aspects space and time,  $\chi 2=49.818$ , p=.000; musical aspects,  $\chi 2=877.882$ , p=.000; and assessment,  $\chi 2=10.060$ , p=.007.

Along with the statistics analysis, the Mann-Whitney U test was used to compare, in the three categories that differed as a function of the modality presented, each pair of versions. Then, in the category Contextual aspects of space and time, the lowest scores reached were for the modality Image, so that it differed significantly from the modality sound, U=115362.000, p=.000, as well as the all modality, U=24.811, p=.000.

In the category musical aspects, all the modalities differed among them, meaning, sound as compared to image, U=23378.500, p=.000; sound as compared to all U=115543.000, p=.000; and image as compared to all,

As for the category Assessment, the modality with the highest punctuations, was All with differences found between this modality and Sound, U=133426.500, p=.002; as well as Image, U=4.107, p=.043.

On the other hand, to establish, within each of the audiovisual clips employed, the possible differences

| Table 2. Contextual aspects of space and time (***p<.001, **p<.01, *p<.05) |                            |                        |                        |           |         |  |
|--|----------------------------|------------------------|------------------------|-----------|---------|--|
| Audiovisual genre  | Audiovisual clip           | Audiovisua<br>(Average | l modality<br>e range) | U         | р       |  |
|  |                            | Sound                  | Image                  |           |         |  |
| Film   | The Croods                 | 56.65                  | 52.15                  | 1269.500  | .435    |  |
|  | The Lion King              | 49.67                  | 34.51                  | 578.000   | .004**  |  |
|  | Oz, the great and powerful | 26.89                  | 22.48                  | 233.500   | .225    |  |
|  | Titanic                    | 27.12                  | 16.67                  | 100.000   | .003**  |  |
|  | Toy Story III              | 21.63                  | 23.16                  | 221.000   | .668    |  |
| Cartoons   | The Simpsons               | 24.25                  | 28.95                  | 248.000   | .254    |  |
|  | Sponge Bob                 | 12.15                  | 14.25                  | 33.000    | .557    |  |
|  | Doraemon                   | 55.57                  | 37.20                  | 534.000   | .007**  |  |
|  | Dragon Ball Z              | 21.35                  | 14.18                  | 73.500    | .024*   |  |
| Series   | Violetta                   | 27.79                  | 18.82                  | 161.000   | .011*   |  |
|  | La que se avecina          | 18.54                  | 13.18                  | 71.000    | .048*   |  |
|  | Good luck Charlie          | 16.75                  | 24.25                  | 125.000   | .030*   |  |
|  | iCarlie                    | 19.88                  | 26.13                  | 182.000   | .108    |  |
| Documentaries  | The lions of Busanga       | 231.63                 | 170.05                 | 13049.500 | .000*** |  |

when comparing the modalities of presentation S vs I, Table 2 shows the results for the category Contextual aspects of space and time.

Differences were found in eight of the fourteen clips, which belonged to the four audiovisual forms utilised. In seven of them the contextual aspects of space and time for the modality S was higher than for I. These were specifically "The Lion King", "Titanic", "Doraemon", "Dragon Ball Z", "Violetta", "La que se avecina" and "The lions of Busanga". The modality I was only higher than S in the series "Good luck Charlie".

As for the category of characters and story, Table 3 shows the results for the two modalities of presentation analysed.

In this category, the differences between S and I were found in five clips, found in the audiovisual genres of films, cartoons and documentaries. More specifically, the scoring of the characters and history was higher in the modality I as compared to S ("Toy Story III", "Dragon Ball Z" and "The lions of Busanga").

As for the musical aspects (Table 4), the differences were significant in all the audiovisual media clips when analyzing the modality S as compared to I.

| Table 3. Characters and story (***p<.001, **p<.01, *p<.05) |                            |                      |                           |           |         |  |  |
|--|----------------------------|----------------------|---------------------------|-----------|---------|--|--|
| Audiovisual genre  | Audiovisual clip           | Audiovisu<br>(Averag | ual modality<br>ge range) | U         | р       |  |  |
|  |                            | Sound                | Image                     |           |         |  |  |
| Film   | The Croods                 | 52.84                | 54.81                     | 1335.000  | .742    |  |  |
|  | The Lion King              | 44.94                | 41.40                     | 819.000   | .503    |  |  |
|  | Oz, the great and powerful | 33.68                | 16.73                     | 84.000    | .000*** |  |  |
|  | Titanic                    | 19.68                | 21.94                     | 181.500   | .542    |  |  |
|  | Toy Story III              | 18.40                | 26.68                     | 158.000   | .032*   |  |  |
| Cartoons   | The Simpsons               | 26.83                | 24.61                     | 277.500   | .598    |  |  |
|  | Sponge Bob                 | 13.78                | 6.13                      | 14.500    | .041*   |  |  |
|  | Doraemon                   | 54.27                | 42.60                     | 642.000   | .109    |  |  |
|  | Dragon Ball Z              | 11.46                | 20.60                     | 58.000    | .006**  |  |  |
| Series   | Violetta                   | 26.31                | 20.43                     | 196.500   | .126    |  |  |
|  | La que se avecina          | 17.15                | 14.24                     | 89.000    | .346    |  |  |
|  | Good luck Charlie          | 18.05                | 22.95                     | 151.000   | .177    |  |  |
|  | iCarlie                    | 19.91                | 26.11                     | 182.500   | .133    |  |  |
| Documentaries  | The lions of Busanga       | 176.19               | 213.19                    | 15427.500 | .001**  |  |  |

It is in this category, due to the intrinsic character of what it measures (musical aspects), that the supremacy of the modality S as compared to I is found in all the audiovisual media clips used.

The category Affective implication, feelings and empathy is shown in Table 5 (see next page)..

The differences between the modalities of presentation were found in the films and cartoons audiovisual forms, without differences being

found in series and documentaries. Within the films "The Croods" and "Titanic", the category affective implication, feelings and empathy were higher in the modality S as compared to I, while in "Toy Story III", it was the opposite. In the cartoons, in "Doraemon" as well as in "Dragon Ball Z", modality S obtained higher scores than I. Lastly, Table 6 shows the answers from the category Assessment from each audiovisual clip.

Except for the audiovisual genre documentaries, differences were found in the rest, according to the audiovisual modality. Therefore in the films "The Croods" and "Toy Story III", I was better assessed as compared to S, while

in "The Lion King" modality S received a higher score. Within the cartoons, "Doraemon" was better assessed in modality S than I. Lastly, in the series "Violetta", modality S also scored higher.

# 4. Discussion and conclusions

In this work, the effects of the music from audiovisual media in children were explored, creating a rese-

|                   | Table 4. Musical aspe      | ects (***p<.00 <sup>-</sup> | 1, **p<.01)             |         |         |
|-------------------|----------------------------|-----------------------------|-------------------------|---------|---------|
| Audiovisual genre | Audiovisual clip           | Audiovisua<br>(Averag       | al modality<br>e range) | U       | р       |
|                   |                            | Sound                       | Image                   |         |         |
| Film              | The Croods                 | 68.74                       | 43.71                   | 737.500 | .000*** |
|                   | The Lion King              | 60.90                       | 18.14                   | 5.000   | .000*** |
|                   | Oz, the great and powerful | 35.50                       | 15.19                   | 44.000  | .000*** |
|                   | Titanic                    | 31.74                       | 13.40                   | 21.500  | .000*** |
|                   | Toy Story III              | 35.50                       | 13.00                   | 72.00   | .000*** |
| Cartoons          | The Simpsons               | 33.36                       | 13.61                   | 68.500  | .000*** |
|                   | Sponge Bob                 | 14.00                       | 5.00                    | 10.000  | .008**  |
|                   | Doraemon                   | 61.38                       | 13.08                   | 51.500  | .000*** |
|                   | Dragon Ball Z              | 24.65                       | 12.03                   | 30.500  | .000*** |
| Series            | Violetta                   | 32.00                       | 14.23                   | 60.000  | .000*** |
|                   | La que se avecina          | 23.35                       | 9.50                    | 8.500   | .000*** |
|                   | Good luck Charlie          | 29.00                       | 12.00                   | 30.000  | .000*** |
|                   | iCarlie                    | 39.44                       | 16.03                   | 1.000   | .000*** |
| Documentaries     | The lions of Busanga       | 304.20                      | 113.57                  | 567.000 | .000*** |

arch design that used the modes of listening as the constructive elements (Porta, 2014) and the principles of poststructuralism on the meaning (Vigotsky, 1996), with the aim of understanding from its interpretation. The experiencing of different audiovisual media in three different versions (only sound, only image and all) has resulted in a detailed analysis that has confirmed the starting hypothesis. In general terms, it can be confirmed that the soundtrack offers meaning and sense to the narrative as well as the multimedia experience. A transversal tour shows the importance of the sound in their favourite audiovisual media. As an answer to the objectives posed, the audiovisual modality of presentation of the clips was perceived differently by the participants in three of the five categories of analysis. More specifically, it affected the perception of the Contextual aspects of space and time, so that the image alone was not enough, with these aspects being understood better when only the sound or the complete version, were presented. Likewise, the Musical aspects were better perceived by the participants, in first place, when the complete audiovisual was presented; in second place when it was only the sound; and in third place, with the modality Image. Lastly, in the category Assessment, the participants had a better opinion when they counted with all the information, meaning, when the modality of presentation was All.

It is remarkable that there were no differences, as a function of the modality of presentation, in the categories Characters and story and Affective implication, feelings and empathy.

On the other hand, when thoroughly analysing each audiovisual clip, the responses of the subjects according to the modality sound and image, in the category "contextual aspects of space and time", resulted in statisticallysignificant differences in the four audiovisual forms used, meaning, in the films, cartoons, series and documentaries. As for the films, in "The Lion King" as well as in "Titanic", the scores were higher in the audiovisual modality Sound as compared to Image. Within the cartoons, "Doraemon" and "Dragon Ball Z" showed the same tendency that the previous clips. Also, in three of the four Series shown, there were differences as a function of the audiovisual modality. More specifically, in "Violetta" and "La que se avecina", the assessment was higher with the modality sound;

| Table 5.          | Table 5. Affective implication, feelings and empathy (***p<.001, **p<.01, *p<.05) |                       |                         |           |         |  |  |  |
|-------------------|---|-----------------------|-------------------------|-----------|---------|--|--|--|
| Audiovisual genre | Audiovisual media clip  | Audiovisua<br>(Averag | al modality<br>e range) | U         | р       |  |  |  |
|                   |   | Sound                 | Image                   |           |         |  |  |  |
| Film              | The Croods  | 40.85                 | 63.18                   | 807.500   | .000*** |  |  |  |
|                   | The Lion King   | 42.06                 | 45.60                   | 819.000   | .508    |  |  |  |
|                   | Oz, the great and powerful  | 25.82                 | 23.38                   | 257.000   | .531    |  |  |  |
|                   | Titanic   | 25.91                 | 17.52                   | 120.500   | .020*   |  |  |  |
|                   | Toy Story III   | 15.38                 | 29.10                   | 97.500    | .000*** |  |  |  |
| Cartoons          | The Simpsons  | 28.17                 | 22.34                   | 234.500   | .166    |  |  |  |
|                   | Sponge Bob  | 12.10                 | 14.50                   | 32.000    | .520    |  |  |  |
|                   | Doraemon  | 56.09                 | 35.03                   | 490.500   | .003**  |  |  |  |
|                   | Dragon Ball Z   | 23.46                 | 12.80                   | 46.000    | .001**  |  |  |  |
| Series            | Violetta  | 20.27                 | 27.02                   | 186.500   | .078    |  |  |  |
|                   | La que se avecina   | 18.00                 | 13.59                   | 78.000    | .160    |  |  |  |
|                   | Good luck Charlie   | 23.58                 | 17.43                   | 138.500   | .088    |  |  |  |
|                   | iCarlie   | 21.38                 | 25.35                   | 206.000   | .330    |  |  |  |
| Documentaries     | The lions of Busanga  | 202.58                | 192.66                  | 18046.500 | .378    |  |  |  |

while in the series "Good Luck Charlie", the higher scores were obtained with the modality Image. Lastly, the greater score in the modality of presentation Sound within the audiovisual form documentaries, was notable.

On its part, in the category characters and story, differences were obtained according to the audiovisual modality employed in the different audiovisual genres. except for the genre Series. More specifically, in the genre of films, the assessment by the children was higher in the modality of Sound for "Oz, the great and powerful" while in "Toy Story III". the best assessment was found in the modality of Image. Similar results were

|                   | Table 6. Assessment (***p<.001, *p<.05) |                        |                         |            |         |  |  |
|-------------------|---|------------------------|-------------------------|------------|---------|--|--|
| Audiovisual genre | Audiovisual clip                        | Audiovisua<br>(Average | al modality<br>e range) | U          | р       |  |  |
|                   |   | Sound                  | Image                   |            |         |  |  |
| Film              | The Croods                              | 45.99                  | 59.60                   | 1033.500   | .025*   |  |  |
|                   | The Lion King                           | 48.77                  | 35.81                   | 623.500    | .018*   |  |  |
|                   | Oz, the great and powerful              | 21.86                  | 26.73                   | 228.000    | .229    |  |  |
|                   | Titanic                                 | 20.53                  | 21.33                   | 196.000    | .832    |  |  |
|                   | Toy Story III                           | 12.10                  | 31.72                   | 32.000     | .000*** |  |  |
| Cartoons          | The Simpsons                            | 23.94                  | 29.47                   | 238.000    | .197    |  |  |
|                   | Sponge Bob                              | 12.78                  | 11.13                   | 34.500     | .668    |  |  |
|                   | Doraemon                                | 58.75                  | 23.98                   | 269.500    | .000*** |  |  |
|                   | Dragon Ball Z                           | 18.81                  | 15.83                   | 106.500    | .385    |  |  |
| Series            | Violetta                                | 27.17                  | 19.50                   | 176.000    | .049*   |  |  |
|                   | La que se avecina                       | 17.38                  | 14.06                   | 86.000     | .303    |  |  |
|                   | Good luck Charlie                       | 20.80                  | 20.20                   | 194.000    | .870    |  |  |
|                   | iCarlie                                 | 20.72                  | 25.69                   | 195.500    | .237    |  |  |
| Documentaries     | The lions of Busanga                    | 184.93                 | 206.39                  | 1,6930.500 | .063    |  |  |

found in the genre of cartoons, where in "Sponge Bob" the modality of Sound was prioritized, while in "Dragon Ball Z", Image was prioritized. Also, in the genre Documentaries, the Image predominated over Sound.

In the category of musical aspects, as expected, there were differences in favour of sound in all the audiovisual media clips used in audiovisual genre.

Continuing with the category of affective implication, feelings and empathy, there were differences in the forms of films and cartoons. In the films "The Croods" and "Toy Story III", the scores were higher for the modality Image, while in "Titanic" and "The Lion King", these were found in the Sound modality. Conversely, in the cartoons "Doraemon" and "Dragon Ball Z", the assessment was higher in the modality of Sound.

In the last category, Assessment, there were differences between Sound and Image in the genres of films, cartoons and series. Within films, in "The Croods" and "Toy Story III", there were higher assessments in the modality Image. However, in "The Lion King", the scores were higher for Sound. In the cartoons "Doraemon" and in the series "Violetta", the audiovisual modality of Sound also predominated.

This research has allowed for a better understanding of the meaning and sense of the music from audiovisual media with the study of their component in molar units of meaning through complete scenes from their favourite audiovisual media. It was verified that in many occasions, music made sense by itself, many times being more significant than the image. In this study, the participants indicated that music provided them with space-time guiding elements, requiring more attention and maintaining interest. These elements are decisive in the world of fiction that the audiovisual media create, a world that would be different if the music was different. Likewise, the loss, first of interest, and later of meaning, was observed when music disappeared. The importance of sound shows its superiority in half of the audiovisual media heard, and in three of the five films ("The Lion King", "Titanic" and "Oz, the great and powerful"), two series ("Violetta" and "La que se avecina") and three cartoons ("Doraemon", "Dragon Ball Z" and "Sponge Bob"). In the case of the films, it should be noted that the soundtracks that were better assessed by the participants, due to their meaning and sense in the audiovisual narrative, were also given prizes by the industry of film and music. This is the case for "The Lion King" (1994, a Grammy and two Oscars for best sound-track and song) and "Titanic" (1997, two Oscars for best soundtrack and song, a Grammy for best song). The results from these films surpassed in Image in the contextual categories of space and time, affective implication, feelings and empathy, and Assessment of the audiovisual categories of space and time, affective implication, feelings and empathy, and Assessment of the audiovisual experience.

Among the limitations of the study, it was necessary to show that the distribution of the participants was not the same as a function of the country of origin, and the audiovisual sequences were not shown in the same proportion.

The research line began contributed to the study of the daily life of children, helping to understand the context and its repercussions in education (Pitt & Hargreaves, 2016; Tan & al., 2013). This work has tried to show the road that point to education, in general as well as musical, demanding attention towards a high-impact musical environment with which its music contributes to the development of heroes, scenarios and values with a clear growing trend in a world that is increasingly viewed through the screens.

#### Funding Agency

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# Promoting Adolescents' Moral Advertising Literacy in Secondary Education



Fomentando la alfabetización ética de los adolescentes en publicidad en Educación Secundaria

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#### ABSTRACT

Minors are daily confronted with advertisements, which are occasionally controversial. In order to promote adolescents' moral advertising literacy, this intervention study explores how to stimulate secondary education students' knowledge on advertising law and their moral judgement of advertisements. Because a lot of new –especially online– advertising formats have arisen during the last years, 191 students from 12 classes were randomly assigned to either a no tablet condition or a tablet condition (to raise authenticity of learning material). The results show that students who use tablet devices perform less well on a post-test about advertising law. Regarding adolescents' moral judgement of advertisements, thematic analyses reveal that especially the use of nudity and feminine beauty are labelled as contentious in both conditions, because of, inter alia, the negative effects for adolescent girls' self-image and the desire to lose weight. After the intervention, the tablet condition has proven to be more effective in promoting critical thinking about nudity/feminine beauty in advertisements. However, none of the conditions did provide evidence that a critical attitude towards alcohol advertising is encouraged. In this regard, implications for future research in the context of advertising literacy education are discussed.

#### RESUMEN

Los menores de edad se enfrentan diariamente a anuncios que pueden resultar polémicos. Con el fin de promover la alfabetización ética en publicidad en los adolescentes, este estudio explora cómo estimular el conocimiento de los estudiantes de Educación Secundaria acerca de la ley de publicidad y su juicio moral hacia los anuncios. A raíz de los formatos de publicidad –especialmente online– que han surgido en los últimos años, 191 estudiantes de 12 clases fueron asignados aleatoriamente a una de estas condiciones: uso o no uso de tablets (para aumentar la autenticidad del material de aprendizaje). Los resultados muestran que el desempeño en el post-test sobre la ley de publicidad de los estudiantes que usaron tablet es peor. En cuanto al juicio moral de los adolescentes sobre los anuncios, el análisis temático revela que especialmente el uso de la desnudez y la belleza femenina resultan polémicos en ambas condiciones, debido, entre otros motivos, a los efectos negativos para la autoestima de las adolescentes y al deseo de perder peso. Tras la intervención, el uso de tablets ha demostrado ser más eficaz para promover el pensamiento crítico hacia la desnudez y la belleza femenina en los anuncios. Sin embargo, no se hallaron evidencias de que alguna de las dos condiciones favorezca el desarrollo de una actitud crítica hacia la publicidad del alcohol. En este sentido, se plantean futuras líneas de investigación en el contexto de la alfabetización publicitaria.

#### KEYWORDS | PALABRAS CLAVE

Moral literacy, advertising, advertising formats, secondary education, adolescence, qualitative techniques, quantitative techniques, tablet devices.

Alfabetización ética, publicidad, formatos publicitarios, Educación Secundaria, adolescencia, técnicas cualitativas, técnicas cuantitativas, tablets.

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#### 1. Introduction

These days, children and youngsters are exposed to countless advertisements through various media (Hudders & al., 2015). Due to technological developments, a lot of new (mainly online) advertising formats have been established, such as social media advertising (e.g., brand pages on Facebook) (Daems & De-Pelsmacker, 2015). Because of these changes in the advertising landscape, the importance of promoting minors' advertising literacy increases (Hudders & al., 2015). The confrontation with new forms of media requires a new set of skills to access, analyse and evaluate images, sound and text (Aguaded, 2013). In general, advertising literacy can therefore be defined as "the skills of analysing, evaluating, and creating persuasive messages across a variety of contexts and media" (Livingstone & Helsper, 2006: 562). More concretely, as depicted in Figure 1, three dimensions of advertising literacy can be distinguished.

As Aguaded (2011: 7) stated, "The citizenship should take part in associations and organizations with the aim to build a responsible and critic society in which the power of the media is increasingly pervasive". For this reason, the role of education has been repeatedly stressed to instil minors' advertising literacy (Calvert, 2008; Livingstone &

Helsper, 2006). Although some advertising literacy programmes have already been developed during the past decades (e.g., Media Smart), Rozendaal, Lapierre, Van-Reijmersdal and Buijzen (2011) advocate for reformulating their focus since especially the cognitive dimension is emphasized in the past (Figure 1). Yet, there is a lack of evidence that cognitive advertising literacy is sufficient to decrease minors' susceptibility to advertising effects (Rozendaal & al., 2011).

# 1.1. Moral advertising literacy: law versus ethics?

As shown in Figure 1, it is expected that the regulatory framework of a country –including standards for advertisers– implicitly impact one's perceptions about the appropriateness of advertising (Hudders & al., 2015; Martinson, 2001). In Flanders, a Media Decree with both general and product-specific (e.g., alcohol or medicinal products) requirements concerning advertising (towards minors) has been drawn up (Flemish Regulator for the Media, 2009; Verdoodt, Lievens, & Hellemans, 2015). In addition to law-related knowledge, "in ethics,



Figure 1. Three dimensions of advertising literacy (Hudders & al., 2015).

the question isn't whether one can do something or whether the law allows one to do it. Ethics assumes that, within the individual, there is a potential capacity for judging right from wrong" (Martinson, 2001: 132). A challenge for education is to alert students about the importance of ethics in their everyday life since it affects our behaviour and attitudes (Martinson, 2001). As De-Pelsmacker (2016) specified, there are several categories regarding ethical concerns in advertising. Next to insult and deception, another example is the use of sexist stereotypes. For instance, the contemporary norm of feminine beauty (i.e., tall, moderately breasted, and extremely thin) is fostered by the ideal bodies of ad models (Lavine, Sweeney, & Wagner, 1999). Not only advertisements spread via traditional channels as television and magazines contain gender-stereotypic images (Lavine & al., 1999), but this trend is perpetuated in Internet advertising, even on websites for adolescents (Slater, Tiggemann, Hawkins, & Werchon, 2012). Consequently, as adolescents copy ad models in their pictures on social networking sites, Tortajada, Araüna and Martinez (2013) refer to the internalization of socially constructed representations of femininity. Moreover, previous research (Grabe, Ward, & Hyde, 2008; Levine & Murnen, 2009) uncovered that stereotypical images in advertisements are correlated with drive for thinness, body dissatisfaction and disordered eating patterns in adolescent girls. Furthermore, the importance of advertising literacy education is

demonstrated by McLean, Paxton and Wertheim (2016), who found that adolescents with low critical thinking skills are more negatively affected by viewing a feminine beauty ideal in advertisements.

Besides, there are ethical issues about product-specific advertisements, such as alcohol advertising (Anderson, de-Bruijn, Angus, Gordon, & Hastings, 2009; Ellickson, Collins, Hambarsoomians, & McCaffrey, 2005). Anderson and colleagues (2009) revealed that confrontation with alcohol advertising is associated with both the onset of adolescents' alcohol consumption and increased levels of drinking among adolescents who already drunk alcohol. Additionally, because of alcohol advertising, adolescents perceive alcohol-drinking peers as more favourably and consider alcohol use as more normative (Martino, Kovalchik, Collins, Becker, Shadel, & D'Amico, 2016). About this matter, advertising literacy education is also recommended because critical thinking and alcohol advertising deconstruction skills decrease not only adolescents' intention to drink alcohol, but also their susceptibility to the persuasive appeals of alcohol advertising (Ellickson & al., 2005; Scull, Kupersmidt, Parker, Elmore, & Benson, 2010).

In recent years, ethical questions arise over new advertising formats which increasingly expect active involvement of consumers (e.g., a Facebook like Button on brand pages) and often integrate commercial content into media content. The latter is noticeable in advertising formats as product placement, i.e., the integration of brands in films, television series, etc. (De-Pelsmacker, 2016). These characteristics of new advertising formats make it more difficult for children and youngsters to detect commercial messages (Hudders & al., 2015).

#### 1.2. Constructivism as basis

To enhance adolescents' moral advertising literacy, learning material is developed in the context of this study. For this, constructivism –a learning theory that became well-known in the last decades– was taken as a starting point. The rationale behind constructivism is that meaningful learning can be seen as an active process of constructing knowledge. It is assumed that knowledge is the result of personal interpretations, influenced by learners' gender, age, prior knowledge, ethnic background, etc. By sharing multiple perspectives, individuals can adapt their personal views (Duffy & Cunningham, 1996; Karagiorgi & Symeou, 2005). In this intervention, attention is paid to constructivist principles as collaborative learning, authentic learning and active learning. According to the first principle, the learning material includes opportunities to discuss multiple perspectives about controversial advertisements. Additionally, the principles of active learning and authentic learning assume that students receive meaningful learning activities in a realistic context allowing them to think about what they are doing, instead of passively receiving information from their teacher. To ensure authenticity, technology is used in this intervention because of the growing number of new (online) advertising formats.

#### 1.3. Purpose of the current study

Until now, advertising literacy education primarily focuses on cognitive advertising literacy (Rozendaal & al., 2011) and traditional advertising formats (Meeus, Walrave, Van-Ouytsel, & Driesen, 2014). Therefore, the purpose of this explorative study is determining how adolescents' moral advertising literacy (i.e., moral judgement of advertising formats, advertising tactics and advertising messages) can be enhanced, which is becoming more important due to the growing number of new advertising formats.

The present study has two main research objectives. Firstly, we want to determine if advertising literacy education leads to better knowledge about advertising law. Secondly, this study provides an opportunity to advance knowledge of adolescents' moral judgement of controversial advertisements. Therefore, the second research objective is twofold, namely (1) revealing which advertisements are labelled as contentious by adolescents; (2) determining whether there is a difference between students' moral judgement about nudity/feminine beauty in advertisements and alcohol advertising on Facebook after an educational intervention.

#### 2. Methodology

#### 2.1. Study participants

An intervention study was set up in 12 classes (n=191) belonging to grades 9 and 10 of the Flemish education system. More concretely, the participating classes were part of general secondary education. This track was chosen based on an analysis of the curriculum standards (Adams, Schellens, & Valcke, 2015).

The students were between 14 and 18 years old (M=15.42; SD=0.67), and were primarily girls (81%). Although 12 classes were involved, only nine teachers participated because three of them were responsible for the

lesson in two classes of the same school. Informed consent was obtained from all teachers. Moreover, a letter -which included both information about the study and the option to refuse participation- was distributed to the adolescents parents.



# 2.2. Design and procedure

Participating classes were randomly divided



into two conditions, one with and one without the use of tablet devices. Figure 2 shows a detailed overview of the learning material used in the tablet (TC) and no tablet condition (NTC).

As Vanderhoven and colleagues (2014) show that a one-hour media literacy course could be effective, we consciously chose for a short-term intervention. To assure external validity, the intervention took place in an authentic classroom setting. Since the regular teacher gave the lesson, a manual was developed, including back-ground information about advertising and detailed step-by-step instructions about how to teach the lesson. The first author of this paper verified if the lesson was taught as prescribed.

#### 2.3. Measurements and analyses

As depicted in Figure 2, a pre- and post-test were used to reveal effects of advertising literacy education on both students' knowledge about advertising law and their moral judgement of contentious advertisements. The pre- and post-test were given to the students a few days before and immediately after the intervention respectively, via an online link that they need to fill in at home. On the one hand, these tests included five true/false statements (Table 1) about law-related topics that were tackled during the lesson. On the other hand, students were confronted with two controversial advertisements to explore whether students' critical thinking can change through advertising literacy education (Figure 3).

The first image is a television advertisement of a Flemish chain store that was labelled as provocative in 2013, because of the naked/feminine beauty models. The second image was an alcohol advertisement of a new beer type on Facebook. In this message it is suggested to make a selfie that resembles the depicted image in order to win a ticket for "the party of your dreams" or a "Limited Edition pack" of this beer. Because there are strict rules concerning alcohol advertisements directed to minors in Flanders (Flemish Regulator for the Media, 2009), ethical questions arise regarding alcohol advertisements on Facebook, which is still the most widely used social networking site by Flemish adolescents (Apestaartjaren, 2016). Students' opinions were measured through the Inference of Manipulative Intent (IMI) Scale (Campbell, 1995) and an open-ended question. The IMI-scale originally consists of six items (Cronbach's alpha=0.93), which were –because of linguistic reasons– reduced to four in this study. For instance, one of the IMI-items is: "The advertiser tried to manipulate the audience in ways that I don't like". The items were rated on a 6-point Likert scale (1 completely disagree; 6 completely agree). Reliability analysis generated acceptable Cronbach alpha's (Nuditypre=0.85; Nuditypost=0.81; Alcoholpre=0.82; Alcohol-post=0.79). Quantitative data obtained by the pre- and post-test were analysed using the statistical software pro-

gram SPSS. The data of the open question (i.e., "Why is this advertisement (not) acceptable for you?") were processed through thematic analysis (see below). In the post-test, students also received guestions related to their perceptions of the lesson (e.g., "I learned more in the lessons about advertisements than in other lessons because of the use of tablet devices"). Unfortunately, although several reminders were sent to the students, 148 students fully completed both



Figure 3. Two controversial advertisements incorporated into pre- and post-test.

pre- and post-test (TC: n=66; NTC: n=82). In other words, the dropout rate was 22.5% of the students (n=43). As presented in Figure 2, students were expected to write a business letter to JEP during the lesson. In the context of the second research objective, these letters were used as measurement instrument. Therefore, the process of writing the business letters is made as standardized as possible. Students were, namely, given instructions about how to write a business letter (Figure 2). Additionally, templates were developed for both conditions, as a consequence the structure of the letters was fixed making them comparable. Regarding the content, there were three requirements: (1) indicate which advertisement is seen as contentious; (2) give some underpinned arguments; and (3) give advice to JEP about prohibiting or modifying the advertisement. In total, 133 business letters were written (TC: n=54; NTC: n=79). Because of time constraints in some classes, students started with reflecting on ethical advertising issues as a duo task in classroom, but had to fulfil individually their letter at home. When the letters of students belonging to one group were quite different, we analysed them separately. Thematic analysis was used to identify categories in both controversial advertisements and main arguments. First, to become familiar with the data, the letters were read and reread by the first author. The process of rereading the business letters allows to determine preliminary themes. Next, important text passages were highlighted and initial codes were assigned to these units of analysis. Through this iterative and bottom-up process, more general themes and sub-themes were gradually unveiled by grouping the different codes (Howitt, 2010).

#### 3. Results

#### 3.1. Does advertising literacy education lead to better knowledge about advertising law?

To determine whether the knowledge of students about Flemish advertising law increase after the intervention, students had to respond on five statements. For both conditions, the results obtained from the pre- and post-test were compared in Table 1. In the pretest, the majority of the students already knew some basic rules about advertisements on cigarettes and alcohol. However, descriptive data shows that all five statements were answered more correctly after the lesson. Nevertheless, students in the no tablet condition, who individually reflected on law-related topics before the class discussion, perform better in the post-test compared with students in the tablet condition who examined the subject matter in duo. McNemar's tests, moreover, revealed significant differences for two [toothbrush, Flemish Regulator for the Media] and three statements [toothbrush, Flemish Regulator for the Media, medicinal products] for the tablet and no tablet condition respectively.

From the data on students' perceptions about the use of tablets, we can see that many students (89.4%) did not have any experience with tablet devices in an educational context. Although most students in the tablet condition (83.4%) argued that the lessons about advertising were better than other lessons due to the tablet devices, 60.6% of the students admitted that they have not learned as much as in other lessons.

#### 3.2. Which advertisements were judged as controversial by adolescents?

#### 3.2.1. Which advertisements are seen as controversial in the business letters of both conditions?

In the tablet condition, students actively searched for a contentious advertisement on the Internet. The chosen

| adverti-   |   |                         |           |       |
|------------|---|-------------------------|-----------|-------|
| aavorti    | Table 1. Students' knowledge about advertisi                              |                         |           |       |
| sements    |   | Tablet condition (n=66) |           |       |
| can be     |   | Pre-test                | Post-test | McNe  |
| divided    |   | N (%)                   | N (%)     | p-val |
| into five  | 1) Advertising for cigarettes and other tobacco                           | 50                      | 55        |       |
| main       | products may be displayed on television, radio<br>and/or Internet.        | (75.8%)                 | (83.3%)   |       |
| themes,    | Answer: wrong [Cigarettes]  |                         |           |       |
| namelv     | 2) Television advertising for sweets containing                           | 12                      | 59        | <.(   |
| (1) sexist | sugary should show a picture of a toothbrush during<br>the advertisement. | (18.2%)                 | (89.4%)   |       |
| images     | Answer: correct [Toothbrush]  |                         |           | _     |
| leo        | 3) If we had an ethical complaint about an                                | 3                       | 21        | <.0   |
| (0.8.)     | advertisement, we would send it to the Flemish                            | (4.5%)                  | (31.8%)   |       |
| nudity)    | Regulator for the Media.  |                         |           |       |
| (n=26),    | Answer: wrong [Flemish Regulator for the Media]                           |                         |           |       |

4) Alcohol advertising is allowed.

Answer: correct [Alcohol] (84.8%) (87.9%) (80.5%) (89%) sexual 5) Advertisements for medicinal products that are 29 37 .13 38 52 .02\* (56.1%) (46.3%) available on prescription, is allowed (43.9%)(63%) stereoty-Answer: wrong [Medicinal products] p e S Note. The students were given three response options: "Right", "Wrong", and "I don't know". The table shows a comparison of (e.g., the the students who correct answered the statements.

56

about advertising law

McNemar

p-value

<.001

<.001

.75

.33

Pre-test

N (%)

(84.1%)

69

23

7

66

(28%)

(8.5%)

58

No tablet condition (n=82)

McNemar

p-value

24

<.001\*

<.001\*

.18

Post-test

N (%)

(91.5%)

(95.1%)

(57.3%)

75

78

47

73

stereoty-

2 )

(

pical ideal of feminine beauty) (n=23), (3) discrimination (e.g., with respect to well-rounded persons, immigrants, etc.) (n=18), (4) violent (e.g., gunman) (n=5), and (5) unhealthy food (e.g., soft drinks) (n=8). An important remark is that 18 of the 54 letters belonged to more than one theme. The most common combination is 'sexually oriented – beauty ideal' (n=14).

In the no tablet condition, eight controversial advertisements -about which JEP or similar foreign organisations recently received complaints- were integrated into the learning material. Students generally considered the first advertisement of Appendix 1 (https://doi.org/10.6084/m9.figshare.4789189) -including a beauty ideal and nudityas most controversial (n=24). In addition, 21 and 11 letters were respectively written about an advertisement of a Flemish clothing chain that promotes plastic surgery (Advertisement 2, Appendix 1) and an advertisement of a clothing brand in which an appeal is made to a very skinny model (Advertisement 4, Appendix 1). Both advertisements referred to beauty ideals. To a lesser extent, the remaining five advertisements were seen as contentious by students: Alcohol advertisement on Facebook (n=3), the use of Photoshop (n=6), deception in advertisements for smartphones (n=3), an unsafe situation - namely a model on a railway (n=7), and a sexually oriented advertisement of a perfume brand (n=4). Nevertheless, we surmise that students of the no tablet condition did not always find the advertisement they had in mind. Of the 82 students, 52 reported that the option to search for an advertisement via Internet would be interesting, instead of choosing one integrated in the learning material.

Across both conditions, as shown in Appendix 2 (https://doi.org/10.6084/m9.figshare.4789405), there are a number of recurrent arguments given for different advertisements. First, the argument that an advertisement is not suitable for children or youngsters was found in several business letters. Regarding a violent advertisement for an amusement park at Halloween time, a student group wrote down: "I find it too scary, certainly for an amusement park where children come. If children see this on television, they probably cannot sleep at night" (BL Q1 TC). Closely related, in various letters, students stated that a bad role model was shown: "It is unjustifiable that a 14-yearold sits on a railway in a mournful mood. This is a bad example for other young people" (BL W3 Advertisement 5, Appendix 1). In addition, students frequently referred to the consequences of advertisements. Because the use of stereotypical beauty ideals in advertisements was often seen as controversial, students repeatedly pointed to their possible effects on the self-image of especially adolescent girls or the desire to lose weight possibly resulting in eating disorders: "They use in this advertisement the quote "perfect body", however, there are not many people who can have such a body. [...] and therefore want to diet more and more, and will develop an eating disorder and receive health problems" (BL M2 TC).

Thirdly, the reason that there is no link between the product and the advertisement was mentioned by the students. Neither do students tolerate too much nudity in advertisements. Both arguments are combined in the following quote: "Naked women really have nothing to do with sport shoes" (BL C4 Advertisement 1, Appendix 1). Finally, the argument "insult" is frequently given by students in the tablet condition (TC: 31.5%; NTC: 10.1%),

and the argument "deception" is more found in letters of student groups in the no tablet condition (TC: 1.5%; NTC: 22%). In only one business letter of the tablet condition (category: unhealthy food), the argument "deception" is mentioned: "These hamburgers look delicious and large at the picture, until you see them in real" (BL\_K2\_TC).

# 3.2.2. What are students' opinions about nudity in advertisements and alcohol advertising before and after the lesson?

To explore whether students' critical thinking can change through advertising literacy education, two controversial advertisements (Figure 3) were integrated into the pre- and post-test. In general, as presented in Figure 4, students are more critical about nudity in advertisements than alcohol advertising on Facebook.

Regarding students' answers on the IMI-scale for the advertisement that includes naked models, the paired sample t-test showed a significant difference between the pre- and post-test results of students in the tablet condition [t(65)=2.36, p=.02, Cohen's d=0.29], and not for the no tablet condition [t(81)=0.34, p=.73]. To explain this significant effect, students' reactions on the open question of the post-test "Why is this advertisement (not) acceptable for you?" were analysed. On average, it is remarkable that students in the no tablet condition wrote down more arguments (M=1.26; SD=0.66) compared to students in the tablet condition (M=1.18; SD=0.58). However, whereas students in the no tablet condition gave more general answers as "too naked" (TC=36.4%; NTC=40.2%), the arguments of students in the tablet condition were more underpinned. They labelled the advertisement more as unacceptable for reasons as "no link between the advertisement and clothing store" (TC=25.8%; NTC=19.5%), "not suitable for children and youngsters" (TC=16.7%; NTC=13.4%), and "models with an ideal female body" (TC=15.2%; NTC=9.8%). Furthermore, more students in the no tablet condition agreed with this advertisement, predominantly because the main parts are shielded through black cubes (TC=4.5%; NTC=13.4%).

As illustrated in Figure 4, most students accepted the Facebook advertisement about alcohol. Although descriptive data uncovered, especially for the no tablet condition, a more critical attitude towards this specific advertisement after the lesson, the paired sample t-test did not show significant differences between the pre- and post-test results of students in the tablet condition [t(65)=0.16, p=.87] and no tablet condition [t(81)=1.59, p=.12]. In the post-test, proponents often generally answered the open question with reactions as "I find this advertisement acceptable, there is nothing wrong shown" (TC=33.3%; NTC: 31.7%). In addition, the argument that it

is a humorous and smart idea of advertisers to integrate a competitive element was regularly given NTC= (TC=22.7%; 23.2%). Nevertheless, the latter was also seen as negative by opponents (TC=3%; NTC=9.8%): "I find this advertisement a form of blackmail because they can only win if they buy the drink" (Student 17 NTC). Other arguments of students who find the advertisement unacceptable are: (1) encouragement to drink alcohol (TC=21.2%; NTC= 17.1%); (2) not suitable for children and youngsters



Figure 4. Students' opinion about nudity in advertisements and alcohol advertising. TC = tablet condition; NTC = no tablet condition. The numbers represent M(SD), measured on a 6-point Likert scale (1 completely disagree - 6 completely agree). \* p<.05.

(TC=13.6%; NTC=14.6%), including one explicit reference to the display of this advertisement on Facebook that is frequently used by youngsters, and (3) disagreement with alcohol advertising (TC=7.6%; NTC=11%). Besides, students learned during the lesson that alcohol advertising is only allowed under strict conditions. For example, neither a direct address to minors nor a link between using alcohol and improved performances or a calming effect

is permissible. Despite the integration of this subject matter, only four students (TC: n=2; NTC: n=2) explicitly referred to law aspects in the post-test. A clarifying quote: "Only adults take part in this commercial and nobody drives with a car. I think it is an appropriate advertisement" (Student 92\_TC).

#### 4. Discussion and conclusion

Nowadays, enhancing minors' advertising literacy is becoming more important due to the growing number of new advertising formats (Daems & De-Pelsmacker, 2015). During the past decades, advertising literacy programmes have already been developed (Meeus & al., 2014). However, Rozendaal and colleagues (2011) indicated that existing educational programmes mainly emphasize the cognitive dimension (i.e., recognizing several advertising formats, understanding persuasive tactics, etc.). In the context of this study, learning material aimed at enhancing adolescents' moral advertising literacy (i.e., moral judgement of advertising formats, tactics and messages) is developed. In line with research of Martinson (2001), who refers to the difference between advertising law and ethical issues in advertisements, this learning material is divided into two parts. The first part is about Flemish advertising law (Flemish Regulator for the Media, 2009), from the perspective that its (implicitly) influencing one's perceptions about the appropriateness of advertising (Hudders & al., 2015; Martinson, 2001). In the second part, attention is paid to ethical advertising concerns (De-Pelsmacker, 2016).

An initial objective of this intervention study is identifying whether advertising literacy education leads to better knowledge about advertising law. The results show that students know more about advertising law after the lesson. Nevertheless, students in the no tablet condition, who individually reflected on law-related topics before the class discussion led by the teacher, seem to learn more than students in the tablet condition who processed the learning content in duo via a tablet application. A possible explanation is found in data about students' perceptions on using tablet devices in education. Although most students in the tablet condition perceived the advertising lesson more enjoyable than other lessons, they realize that it had a negative effect on their learning performances. This result is in accord with a study of Montrieux and colleagues (2015) indicating that students, aside from recognizing the added value of using tablet devices in an educational setting, also admit that their learning capacity has not increased as well as that tablet devices cause distractions.

The second research objective is twofold, namely (a) revealing which advertisements are labelled as contentious by adolescents, and (b) uncovering adolescents' moral judgement of nudity/feminine beauty in advertisements and alcohol advertisements before and after the course. Regarding the first part (RO2a), we analysed students' fictive business letters to the Jury for Ethical Practices in Advertising (JEP) about a selfchosen controversial advertisement. In both conditions, advertisements containing sexual stereotypes and nudity are especially selected. Because of a significant effect, we can assume that students of the tablet condition have a more critical attitude towards feminine beauty/nudity in advertisements after the intervention (RO2b). The significant effect could be attributed to the way students choose a controversial advertisement. As observed in classrooms, the student groups in this condition immediately talked about nudity and feminine beauty in advertisements after hearing the task (i.e. collaborative learning). They actively looked for such advertisements, confronting them probably with a number of examples and (newspaper) articles including arguments against such advertisements (i.e. active and authentic learning). Next to feminine beauty and nudity in advertisements, students of the tablet condition do not tolerate discrimination and violent as well as advertisements about unhealthy food. In the no tablet condition, elements as using Photoshop and depicting an unsafe situation are also seen as contentious. Notwithstanding, we can surmise that students in the no tablet condition did not always find the advertisement they had in mind, because most of them reported that the option to search for an advertisement via Internet would be interesting.

Across the various controversial advertisements, students in both conditions justify their choice with similar arguments in their business letters. To start with, there is repeatedly referred to consequences of advertisements. In case of sexual stereotypes in advertisements, students often refer to the possible negative effects for adolescent girls' self-image and the desire to lose weight. Consequently, adolescents are aware of these effects which are also confirmed by prior studies (e.g., Grabe, Ward, & Hyde, 2008; Levine & Murnen, 2009). More than once, students also refer to the following arguments: (1) not suitable for children or youngsters, (2) no link between the product and the advertisement, (3) nudity, and (4) insult and deception. Insult is more mentioned by students in the tablet condition, especially in business letters written about discriminatory advertisements. Deception is particularly raised in the no tablet condition, probably because more examples of misleading advertisements were provided in the learning material of this condition. Hence, students select misleading advertisements when it is offered, but they are not consciously looking for it. Therefore, an important issue for future research is providing different categories of controversial advertisements and their consequences, allowing students to get acquainted with and to think critically about a variety of ethical matters in advertisements. For example, it is advisable to pay more attention to alcohol advertising. As indicated by Martino and colleagues (2016), adolescents seem to be accustomed to the presence of alcohol advertisements. Despite the incorporation of learning content about this matter, students in both conditions scarcely refer to alcohol advertising in their business letters (RO2a). Based on pre- and post-test findings (RO2b), this study does not show any significant increase in adolescents' critical attitudes towards alcohol advertising. Since previous research (Ellickson & al., 2005; Scull & al., 2010) demonstrated that a critical attitude and alcohol advertising deconstruction skills decrease negative effects of such advertisements, further research is required to explore educational interventions that can anticipate on this. The same applies to critical thinking about new hidden and interactive advertising formats. In other words, in contrast to judging an advertisement because of the format, students chose advertisements based on substantive issues.

A note of caution is necessary, because of the gender bias of the sample. Since the participating classes predominantly include female students, future research needs to be conducted in gender-balanced classes to discover whether the same advertisements were seen as contentious and whether the same underpinned arguments were provided. In addition, the findings of this study may be somewhat limited by measuring students' opinion through both business letters and a pre- and post-test. Unfortunately, some student responses are rather superficial. For that reason, it can be suggested

that additional in-depth interviews

Until now, advertising literacy education primarily focuses on cognitive advertising literacy and traditional advertising formats. Therefore, the purpose of this explorative study is determining how adolescents' moral advertising literacy (i.e., moral judgement of advertising formats, advertising tactics and advertising messages) can be enhanced, which is becoming more important due to the growing number of new advertising formats.

with students would be a good alternative to get more insight into their moral judgement of unethical advertisements before and after the lessons.

As a conclusion, it can be stated that the lesson aimed at enhancing youngsters' moral advertising literacy is effective in raising knowledge about advertising law. In addition, students were challenged to think critically about contentious advertisements, and to provide underpinned arguments for these advertisements. Nevertheless, this study shows that more research is needed to reveal appropriate class exercises to encourage students' moral judgement of various unethical themes in advertisements.

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# Digital Reading and Reading Competence: The influence in the Z Generation from the Dominican Republic



Lectura digital en la competencia lectora: La influencia en la Generación Z de la República Dominicana

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#### ABSTRACT

Most Latin American countries are focused upon improving learning quality by providing schools with technological resources, as if their sole presence was enough to develop 21st Century skills. Digital reading is not an end in itself; it is a tool that a user selects, depending on the desired purpose and uses it in specific contexts. Adolescents access Internet with at least four purposes: academic, recreational, socialization and communication. This study describes said purposes in adolescents from the Dominican Republic and relates them to their reading literacy proficiency level in two educational contexts: public and private schools. The sample group included 382 students in their fourth year of secondary school (10th grade). Two instruments were used: CoLeP, based on texts from PISA, and a Scale to measure reading frequency, which classifies the four reading purposes in two formats: printed and digital. The conclusion is that most students access and use the Internet for academic purpose, regardless of the educational sector. Nevertheless, reading literacy proficiency differs significantly with students from public schools being in lower levels. This minimizes the opportunities of the most vulnerable social sectors producing reading illiterates that have high economic costs for the nation.

#### RESUMEN

La mayoría de los países latinoamericanos están focalizados en elevar la calidad de los aprendizajes mediante la dotación de recursos tecnológicos a los centros educativos como si su mera presencia bastara para desarrollar las competencias fundamentales del siglo XXI. La lectura digital no es un fin en sí mismo, es un medio a disposición del usuario que la selecciona según sus propósitos y las utiliza en contextos socioculturales específicos. Los adolescentes acceden a Internet, al menos con cuatro fines: académicos, recreativos, para participar en la sociedad y comunicarse. Este estudio describe dichos fines en jóvenes de la República Dominicana y lo relaciona con el nivel de competencia lectora en dos contextos educativos, escuelas públicas y privadas. La muestra está compuesta por 382 estudiantes de cuarto de Secundaria. Se aplicaron dos instrumentos: CoLeP, basado en los textos liberados de PISA y una Escala de Práctica de Lectura, que clasifica los cuatros fines de lectura en dos formatos, impreso o digital. La conclusión es que casi todos los estudiantes acceden a Internet y lo utilizan para fines académicos sin importar el sector educativo, sin embargo, el nivel de competencia lectora difiere significativamente, ubicándose los estudiantes de las escuelas públicas en los niveles más bajos, lo que resta oportunidades a sectores socialmente más vulnerables y produce neoanalfabetos con altos costos económicos para la nación.

#### KEYWORDS | PALABRAS CLAVE

Internet, digital reading, reading competence, reading illiterates, digital gap, Z Generation, Secondary, social network. Internet, lectura digital, competencia lectora, neoanalfabetos, brecha digital, Generación Z, Secundaria, redes sociales.

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#### 1. Introduction

Access and use of information and communication technology (ICT) are fundamental to participate in today's society. However, a lacking adequate development in reading literacy –defined as: "understanding, using, reflecting on and engaging with written texts, in order to achieve one's goals, develop one's knowledge and potential, and participate in society "(OECD, 2009: 23)– entails the dangerous possibility of sailing adrift through the vast ocean of online information.

Dominican Republic students have the lowest levels in Reading, Mathematics and Science of the Latin American Region. PISA test results show that 70.7% of all 15 year-olds have below- minimum proficiency for the established requirements in the three subjects mentioned above (OECD, 2016a). These results coincide with those from the Third Regional Comparative and Explanatory Study (TERCE) at the primary level (UNESCO, 2016). Low quality learning is not only a matter of personal wellbeing. Lynch (2015), in his report for the "Washington Center for Equitable Growth" concludes that citizens' development with an elevated level of cognitive ability would significantly increase the economic growth of a country.

Although several authors propose that the use of technology does not necessarily affect learning processes (Cassany, 2012; Fernández-Cruz & Fernández-Díaz, 2016), "the real challenge... is how to use it" (Drucker, 2004: 269). Most Latin American educational systems, including the Dominican Republic, focus on narrowing the digital gap by accessing the Internet through broadband and digital tools for students and teachers in the schools located in areas with the lowest income (CEPAL, 2013).

Van-Deursen and Van-Dijk (2010) state that countries that have reduced obstacles to access the digital world have focused on developing digital skills rather than accessing technology. This lack of digital competence creates a "new gap" that is even more dangerous as it tends to disguise the absence of basic proficiency, such as reading. At the same time, it increases social inequalities as well as being a powerful placebo that distorts the objectives of the educational systems.

Choque-Aldana (2009) proposes that researchers assess the multidimensional phenomenon of the digital gap: the width that established the dimensions between the number of people with access to a specific technology and its depth. In other words, it is a matter of motivation, learning and integrating "digital life" with real life.

#### 1.1. Generation Z

The term Generation Z was adopted by Schroer in 2008 to designate those born after the millennium. Their main characteristics are: "1) Experts in technological comprehension; 2) Multitaskers; 3) Socially extroverts in virtue of technologies; 4) Quick and impatient; 5) Interactive; 6) Resilient" (Fernández-Cruz & Fernández-Díaz, 2016: 98). Also, this generation has spent more time in school than have Generation X parents and teachers. A number of metaphors have been created to describe the use of ICTs. Perhaps one of the most used is Prensky's (2001) native and immigrant digitals. Date of birth does not evidence a standard generation, nor is the common use a dichotomous classification (Jones & Binhui, 2011). Furthermore, there are other factors such as tools, location and access space to the Internet. Thus, by using the White & Le-Cornu (2011) metaphor, Generation Z could be visitors or residents.

Research focuses on the secondary level which is the last opportunity for the pre-university educational system to contribute to the learning process. Therefore, it is an opportunity that affects the quality of life of young adults who failed to develop basic competency in primary school (Bravo, Dante, & Osvaldo, 2002; Slavin, Chambarlain, Daniels, & Madden, 2009). Several neurological studies prove that new neurologic connections, those in charge of executive functions, are still being formed in the prefrontal area of the brain until the age of 25 (Blakemore & Frith, 2011), hence, it is an extremely sensitive learning-phase.

#### 1.2. Reading competence

The Organization for Economic Cooperation and Development (OECD) conceives reading as the bases for a full and active life in all aspects of contemporary society: economical, political, in community and cultural. OECD states that without reading competence, human beings cannot become emancipated neither develop in the western society (OECD, 2005; 2010; 2016a).

The information society demands new ways of literacy. Reading is no longer conceived as a school practice focusing on cognitive processes, decoding symbols and reading comprehension. Reading is a multidimensional concept that is developed throughout our lives; objectives are set by the reader in a specific sociocultural context.

Therefore, reading includes "a wide range of knowledge, social practices, values and attitudes related to the social use of written texts in each community" (Cassany & Castellà, 2010: 354).

Generation Z is inserted in a reading culture with access to new resources and new formats for learning, recreation, communication, and interaction with society. Kalantzis, Cope, Chan and Dalley-Trim (2016), as well as other authors (Lanham, 1995; Knobel & Lankshear, 2014; Plester & Wood, 2009; Van-Deursen & Van-Dijk, 2010), propose that literacy be a construction process with meaning by using multimodal symbols –oral, written, visual, gesture, touching and spatial– which may be combined or alternated to naturally represent reality.

Cerrillo-Torremocha (2005) suggests that given the characteristics of this new century (changes in communication, globalization, multiculturalism, new formats and textual genre...) at least two types of readers could be considered. The first uses reading

for its cognitive, cultural, social and emotional development; this reader demonstrates communication skills and moves with ease between what is "physical" and "digital" depending on the purpose and sociocultural context, to be defined as reader. However, there is another who, despite having contact with written codes, due to a variety of reasons, does not use it for their integral development; rather this person prefers information in graphic formats, short texts, normally writes and reads to communicate and be informed, such people can be considered the neo-illiterates of the 21st century, "illiterates who can read," but cannot construct meanings by means of said practice (Salinas, 1967).

Young people who read using a digital platform, but who have inadequate reading competence, may be considered the new, 21st century illiterates. Even if they are in continual contact with information sources, they fail to develop maximum cognitive potential. This will have a negative impact on a country's economic and social growth. Describing Generation Z digital reading practice and reading literacy proficiency, which are currently at a secondary level, provide opportunities for improvement. However, of the factors studied, the educational sector is the most influential. This coincides with the PISA results.

#### 1.3. Digital reading

The term "digital literacy" refers to a combination of texts and other multimedia resources that are only available within an electronic context (Knobel & Lankshear, 2014; 2011; 2010). Not all texts that are read on screens are considered digital. These texts must meet at least two characteristics: integration of different reading modalities patterns –oral, written, visual, gesture, touch screen and spatial– and with a different connection forms between the texts, such as, hyperlinks (MECD, 2010).

Plester and Wood (2009) consider the concept of literacy ampler than just written communication since it includes formats which allow ideas to be communicated through other means, whether visual, spatial, audio or a combination of all including videogames. Generation Z does not usually establish major differences between one format and another.

Digital texts not only constitute another classification, but as Nicholas (2011) describes, they are changing the way we read and think. This author argues, like McLuhan (1964) that the environment constitutes the thinking process and therefore, modifies it with multiple tools, how one participates in society and for example, the teaching-learning processes, communication, trade, etc.

McKenna, Conradi, Lawrence, Jang and Meyer (2012) propose a taxonomy to evaluate reading practice that takes into account academic or recreational purposes, including social media, and the reading format, digital or print. However, in this study, social media is not classified as being for recreational purposes since young adults use it to communicate and belong to a social group (Colás-Bravo, González-Ramírez, & de-Pablos-Pons, 2013).

#### 1.4. Purpose and objectives

The purpose of this research is to describe digital reading practice in Dominican teenagers between 14 and 17 years of age and its relation with their reading literacy proficiency level. This study focuses on two contexts, public and private schools. It also proposes ideas regarding the use of the ICTs in the Latin American and Caribbean educational systems.

#### 2. Material and methods

This research is descriptive and correlational since it first describes digital reading among young adults between 14 and 17 years of age. Moreover, public schools were compared with private schools regarding the proficiency level of reading literacy.

#### 2.1. Participants

The student population enrolled in secondary school in the Dominican Republic includes 574,574 students. 78% of these attend public schools, and 2% are at semiofficial centers while the remaining 20% attend private schools. 382 students participated in this research; they were enrolled in their fourth year of secondary school (10th grade) at both public and private. Participants were from the provinces of Santo Domingo and Santiago and ranged between 13 and 18 years of age (M=15.15; D.T.=.85).41% were males (n=156), and 59% were females (n=226). 71% attended public schools and 29% private ones. The stratified sample has been selected based on a percent distribution of the population and their traits using a non-probabilistic quota method. The reliability level was established at 95% (Z= $\pm$ 1.96) and a margin for error of  $\pm$ 5. 13 schools were selected, of which 8 were public and 5 private. Students were selected randomly in each school using a drawing.

#### 2.2. Instruments

Both instruments used were presented to expert opinions and pilot trial.

#### 2.2.1. Reading practice scales

Reading frequency was evaluated using a scale based on various surveys (CERLALC-UNESCO, 2011, 2014; MECD, 2010), the taxonomy proposed by McKenna, Conradi, Lawrence, Jang and Meyer (2012) and the recommendation of Colás-Bravo and others (2013) regarding the use of social networks. The general scale features 24 items. These were distributed depending on the reading format -digital and print- and the purposes: academic, recreational, for communication and participation. A Likert scale was used, with a range between 1 and 5, where 1 corresponds to "never" and 5 is "always" and a dichotomic question about textbook format preference: digital or printed copy. To facilitate the analysis, answers were grouped into three categories: low (1 and 2), intermediate (3) and high (4 and 5). Only the complete sub-scale for digital reading (14 items) is reported and two items for the academic printed format, use of textbooks and dictionaries that allow a comparison in the format preference.

Figure 1 shows the final path diagram of the Confirmatory Factor Analysis (CFA) using SPSS



Figure 1. Final diagram of the confirmatory factorial analysis (modified).

Amos V.24. Three latent variables were considered together with their respective items (observable variables): recreational, academic and participation. Twelve factors constituted the digital subscale.

The model adjustment was determined by the maximum likelihood method. Firstly, four latent variables were
tested: recreational, academic, social network and participation. During the first adjustment, the "social network" variable was eliminated.

Some of the factors have a weak effect on the latent variable that was taken into account during the results analysis. However, the model proves to be an adequate adjustment:  $\chi^2(51, n=364)$  102.17,  $\chi^2/gl.=2.00$  thus explaining 93% of the data variance. Other indexes have also proven the adequate adjustment: GFI (Goodness of Fit Index) = .96 and the AGFI = .94, the CIF=.93 and the RMEA=.051 [.037 - .066]. The measurement of errors obtained fall within the expected range. The social desirability bias and possible comprehension errors in the items due to students' low proficiency level of reading literacy proved in the Pilot Trial was avoided by using the Pitcher and collaborators (2007) interview technique. Evidence of the responses was requested and based on these, the questionnaire with the participant's responses is either confirmed or corrected. The reliability of the instrument was evaluated with Cronbach's Alpha: academic  $\alpha = .65$ ; recreational  $\alpha = .51$  and participation  $\alpha = .65$ . All were considered acceptable.

# 2.2.2. Reading competence assessment (CoLeP Test)

The reading literacy proficiency level is distributed into five levels by an "ad hoc" test, based on a text liberated by PISA, which uses the Rasch model. The value of the parameter and all other technical specifications were extracted from OECD (2000; 2002; 2012) technical reports and incorporated into a correction handbook designed for this study. For each level, an 80% correct answer cutoff was established.

The test allows performance in three activities to be identified: location, integration and evaluation. Five different texts are presented; three are continuous –descriptive, expository argumentative– and two discontinuous – exposition and diagrams. After validation from experts and a pilot trial, the final version was constituted to include 22 items. An acceptable reliability of  $\alpha$ =.81 was obtained. Each text has four to five questions. Thirteen multiple-choice questions, six open-ended and three double-entry tables were provided. Once the instrument was applied, an analysis was performed to determine abnormal cases; in other words, those that failed to meet the condition of the Rasch model. 4.5% of the sample (n=18) was eliminated, which is within the range considered reasonable and valid.

#### 2.3. Procedure

A Reading Competence Assessment Test (CoLeP from the abbreviation in Spanish) and Reading Practice Scales (EPL) were integrated into a single answer booklet to facilitate its use in the classroom. The pilot trial established an application range between 40 to 90 minutes. Students were offered all sorts of information about the research and accepted their participation as volunteers. As the group tests concluded (CoLeP and EPL), each student was given a number for the individual verification interview. The interview location varied for each school depending on the availability of space. During the interview, students were asked for permission to be recorded. 8% (n=31) refused permission, but they were interviewed. Data were processed using SPSS V.21 statistical software. Before the analysis, data were subject to various tests such as: detecting atypical cases for each variable and establishing its impact, examining lost cases, diagnosing randomness of absent data, verifying the normality of each variable, verifying the uniformity of the variance and verifying the linearity of the relations. The analyzed sample was constituted with 364 subjects. The data analysis began with descriptive statistics. ANOVA allowed us to determine whether there was a significant difference among the sectors depending on digital reading practices and the Pearson Correlation Coefficient, the link between them and reading proficiency.

#### 3. Analysis and results

77% (n=282) of Dominican students in their fourth year of secondary school (10th grade) are below Level 3 in the CoLeP Test. In other words, they fail to have the reading competence skills that the society of today demands. 9% (n=33) fail to reach minimal levels, while 45% (n=164) fall within Level 1 and 23% (n=85) at Level 2.

There is a significant difference based on the schooling sector, F (5, 13.25) = 15.7, p=.000. Figure 2 shows that 84% of the students in the public sector lack minimal proficiency reading proficiency while in the private sector, only 25% are lacking such proficiency. Private school students have the highest reading proficiency. There are no significant differences between males and females F (5, 1.63)=1.35, p=.240.

Almost all students, 97% stated that they use the Internet, 86% accessing it from home. The most commonly used tool is a cell phone. There is greater use in the public sector (61%) than in the private sector (45%); in this

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latter sector, there are a significant number of students who use a tablet (18%). Only three students with reading competency below minimal levels stated they had no connection; two were from the public sector and one from the private.

There were no significant differences between the public and private sectors with regards to academic digital reading frequency, F(1, .439)=.361, p=.548 nor in the use of social networks, F(1, .378)=1.92, p=.166; but there was a difference in recreational use, F(1, 18.41)=21.51, p=.000 and



Figure 2. Percentage distribution of Reading Literacy Proficiency Level by educational sector.

instrumental use, F(1, 38.12) = 66.1, p = .000. Table 1 shows the private sector in which 29% had high recreational reading practice, while in the public sector, this was only 12%. 50% use the Internet for instrumental activities while in the public sector, it was only 14%.

Table 2 shows that consulting websites is the most frequent Internet activity by students, and for academic purposes, well above consulting texts in a printed format. The purchase power factor has been ruled out, as the Ministry of Education in the Dominican Republic (MINERD) provides free books at public centers. Likewise, there is a significant difference in the preferred use of the digital dictionary over the printed version. It is noteworthy that videos are viewed extensively as complementary to teaching expositions. Despite the ample use of the Internet for academic purposes, more than half (52%) continued to prefer a printed textbook.

There were no significant differences between the public and private sector when it came to downloading files for recreational purposes. However, there were significant differences between the two types of centers for reading Blogs or books at the .05 level, with the private sector showing greater frequency.

This differential between sectors for the instrumental use of the Internet could be influenced by user purchasing power and the parameter ( $\lambda$ ) of the items in the sub-scale. For example, consulting billboards ( $\lambda$ =.77) and on-line shopping ( $\lambda$ =.84) are two items with increased weight in the sub-scale for digital reading (Figure 1); this leads one to presuppose a certain amount of affordability. On the other hand, using a virtual learning platform ( $\lambda$ =.66) had no direct dependence on the user, but rather, the educational context. Virtual learning is not available in the public sector while it is in private educational centers. Lastly, the use of email ( $\lambda$ =.67) shows no significant difference between sectors (Table 2), which usually depends on the user and the Internet access.

Depending on the educational sector, there are significant differences at the Reading Literacy Proficiency level with this factor showing the strongest positive relationship. No relationship was found between digital academic reading and student reading proficiency level ( $r_p$ =.-032). The weak yet positive relationship between recreational and instrumental reading might probably be due to the significant differences of these uses and the reading competence of the reader as per sectors (Figure 3).

#### 4. Discussion and conclusions

The Dominican Republic's Generation Z living in urban areas, including the marginal areas, have access to the Internet thanks to a number of devices with a strong trend favoring handheld devices. This datum coincides with the World Bank,

the vvorid Bank, which established the number of people with cell phones was 82% in 2016. The most frequent use is for recreational and

| Table 1. Internet Use by Generation Z as a Percentage of the Sample |                  |               |                |      |                   |               |                |      |  |  |  |
|---|------------------|---------------|----------------|------|-------------------|---------------|----------------|------|--|--|--|
|   | Public (n = 262) |               |                |      | Private (n = 102) |               |                |      |  |  |  |
| Sub-scales  | Low              | Medium<br>Low | Medium<br>High | High | Low               | Medium<br>Low | Medium<br>High | High |  |  |  |
| Academic  | 25               | 24            | 29             | 21   | 28                | 27            | 21             | 24   |  |  |  |
| Recreational  | 20               | 41            | 28             | 12   | 7                 | 34            | 29             | 29   |  |  |  |
| Instrumental  | 0                | 60            | 26             | 14   | 0                 | 25            | 25             | 50   |  |  |  |
| Social Networks   | 3                | 14            | 0              | 84   | 3                 | 6             | 0              | 90   |  |  |  |

social communication purposes, but there is also an elevated use for academic reasons, which would imply unprecedented cognitive development. Nevertheless. 17 years ago, Millán (2000), warned that this access would not necessarily produce the expected effects if people fail to have adequate reading levels. This is the case a high percentage of Dominican students who have below minimal requirement; the oxy-

| Table 2. Digital sub-scale factors per educational center as percentage of the sample |                          |                 |                 |                   |                 |                 |  |  |  |  |  |
|---|--------------------------|-----------------|-----------------|-------------------|-----------------|-----------------|--|--|--|--|--|
|   | Educational Centers (EC) |                 |                 |                   |                 |                 |  |  |  |  |  |
|   | P                        | ublic (n = 262  | 2)              | Private (n = 102) |                 |                 |  |  |  |  |  |
|   | Low                      | Medium          | High            | Low               | Medium          | High            |  |  |  |  |  |
| Academic  |                          |                 |                 |                   |                 |                 |  |  |  |  |  |
| Dictionaries  | 7 <sup>a</sup>           | 21 <sup>a</sup> | 71 <sup>a</sup> | 7 <sup>a</sup>    | 25 <sup>a</sup> | 69 <sup>a</sup> |  |  |  |  |  |
| Web   | 4 <sup>a</sup>           | 13 <sup>a</sup> | 83 <sup>a</sup> | 1 <sup>a</sup>    | 5 <sup>b</sup>  | 94 <sup>a</sup> |  |  |  |  |  |
| Magazines or blogs  | 24 <sup>a</sup>          | 29 <sup>a</sup> | 46 <sup>a</sup> | 22 <sup>a</sup>   | 33 <sup>a</sup> | 44 <sup>a</sup> |  |  |  |  |  |
| Videos  | 17 <sup>a</sup>          | 27 <sup>a</sup> | 55 <sup>a</sup> | 22 <sup>a</sup>   | 32 <sup>a</sup> | 46 <sup>b</sup> |  |  |  |  |  |
| Recreational  |                          |                 |                 |                   |                 |                 |  |  |  |  |  |
| Download files  | 6 <sup>a</sup>           | 18 <sup>a</sup> | 74 <sup>a</sup> | 6 <sup>a</sup>    | 12 <sup>a</sup> | 82 <sup>a</sup> |  |  |  |  |  |
| Books   | 28 <sup>a</sup>          | 28 <sup>a</sup> | 44 <sup>a</sup> | 11 <sup>b</sup>   | 27 <sup>a</sup> | 61 <sup>b</sup> |  |  |  |  |  |
| Fanfiction  | 79 <sup>a</sup>          | 8 <sup>a</sup>  | 12 <sup>a</sup> | 59 <sup>b</sup>   | 16 <sup>b</sup> | 24 <sup>b</sup> |  |  |  |  |  |
| Magazines or blogs  | 36 <sup>a</sup>          | 32 <sup>a</sup> | 31 <sup>a</sup> | 29 <sup>a</sup>   | 28 <sup>a</sup> | 42 <sup>b</sup> |  |  |  |  |  |
| Video   | 6 <sup>a</sup>           | 21 <sup>a</sup> | 73 <sup>a</sup> | 5 <sup>a</sup>    | 8 <sup>b</sup>  | 87 <sup>b</sup> |  |  |  |  |  |
| Participate   |                          |                 |                 |                   |                 |                 |  |  |  |  |  |
| Email   | 46 <sup>a</sup>          | 23 <sup>a</sup> | 31 <sup>a</sup> | 25 <sup>b</sup>   | 35 <sup>b</sup> | 39 <sup>a</sup> |  |  |  |  |  |
| Consult   | 45 <sup>a</sup>          | 33 <sup>a</sup> | 20 <sup>a</sup> | 28 <sup>b</sup>   | 35 <sup>a</sup> | 36 <sup>b</sup> |  |  |  |  |  |
| Virtual Platform  | 65 <sup>a</sup>          | 21 <sup>a</sup> | 14 <sup>a</sup> | 41 <sup>a</sup>   | 22 <sup>a</sup> | 37 <sup>b</sup> |  |  |  |  |  |
| Virtual Shopping  | 76 <sup>a</sup>          | 15 <sup>a</sup> | 9 <sup>a</sup>  | 34 <sup>a</sup>   | 23 <sup>a</sup> | 43 <sup>b</sup> |  |  |  |  |  |
| Social Networks   | 3 <sup>a</sup>           | 14 <sup>a</sup> | 84 <sup>a</sup> | 3 <sup>a</sup>    | 6 <sup>b</sup>  | 90 <sup>b</sup> |  |  |  |  |  |
| Academic printed  |                          |                 |                 |                   |                 |                 |  |  |  |  |  |
| Text Books  | 14 <sup>a</sup>          | 40 <sup>a</sup> | 46 <sup>a</sup> | 15 <sup>a</sup>   | 34 <sup>a</sup> | 51 <sup>a</sup> |  |  |  |  |  |
| Dictionaries  | 27 <sup>a</sup>          | 34 <sup>a</sup> | 39 <sup>a</sup> | 48 <sup>a</sup>   | 30 <sup>a</sup> | 22 <sup>a</sup> |  |  |  |  |  |

Note: Each superscript letter indicates a sub-set for the EC categories, the column proportions do not differ significantly between each other at level .05.

moron effect appears, because despite having the potential to access quality academic sources, its use fails to lead to meaningful and autonomous learning.

There is a significant gap in reading literacy proficiency levels among students who study in the public and the private sector. In turn, this deepens social-economic inequalities while at the same time undercutting opportunities for the most vulnerable sectors of society. The Matthew effect is being produced, as described by Stanovich (1986) to explain the individual differences in acquiring reading competence and the influence of the social-cultural context and one's own life history. A student with prior knowledge and one who lives in a literate culture will more efficiently incorporate what one has read while at the same time enriching one's reading experience. It is a matter of the "rich get richer." On the contrary, a student with limited prior knowledge and who is not immersed in a reading culture, even if the person reads a lot and uses ICTs, that student will be unable to efficiently incorporate the information; therefore, he/she will continue to be disadvantaged. In summary, the "poor get poorer."

The frequent use of social networks by most students, regardless of gender, coincides with the study by Colás-Bravo and others (2013) of young people from Andalusia (Spain). There is evidence of a change in how adolescents recreate, learn and communicate with no differences between social sectors. Textbooks are not the primary or



Figure 3. Relationship among the variables studied.

single source of information or culture, as youth tend to prefer multimodal contents and there are fewer who use written codes to access information. The use of videos to complement the teacher's explanations, the download of music and films confirm this fact, but even so, it is risky to understand the current generation as a standardized group in terms of preference and skill in digital practices. Age is not the best criteria as not all of them prefer nor uses such resources in a similar manner, as proven by the data. Further gualitative studies are necessary to deepen into the skill, 112

motivation and context of the Internet use by the Generation Z to confirm that the majority may consider that there are more visitors than residents, as indicated by a metaphor from White & Le-Cornu (2011).

Students' use of Internet, even for academic purposes, seems to be insufficient to develop the necessary reading or digital competence. There is a need for further studies that ponder teachers' technological and pedagogic competence, which could be the key (Fernández-Cruz & Fernández-Díaz, 2016) to undertaking more intense interventions where technologies accompany teaching and learning strategies to generate the appropriation of knowledge on behalf of students through productive, experiential and communicative learning activities (Marcelo, Yot, & Mayor, 2015).

Young people who read using a digital platform, but who have inadequate reading competence, may be considered the new, 21st century illiterates. Even if they are in continual contact with information sources, they fail to develop maximum cognitive potential. This will have a negative impact on a country's economic and social growth.

Describing Generation Z digital reading practice and reading literacy proficiency, which are currently at a secondary level, provide opportunities for improvement. However, of the factors studied, the educational sector is the most influential. This coincides with the PISA results (OECD, 2016b). Thus, the Ministry of Education must carry out interventions in those schools with the lowest proficiency of reading competence to develop critical and fully functional citizens.

The digital gap in the Dominican Republic is deeper than it is wide. ITCs provide great potential to bring students closer to the necessary knowledge for the 21st century. Nevertheless, users must have the necessary reading and digital competence. Without these, they will be sailing adrift through a sea of information.

The digital gap in the Dominican Republic is deeper than it is wide. ITCs provide great potential to bring students closer to the necessary knowledges and skills for the 21st century. Nevertheless, users must have the necessary reading and digital competence. Without these, they will be sailing adrift through a sea of information.

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