Vivat Academia. Revista de Comunicación. 2022, nº 155, 1-16
ISSN: 1575-2844 http://doi.org/10.15178/va.2022.155.e1391

RESEARCH

Received: 01/07/2021 --- **Accepted**: 16/09/2021 --- **Published**: 03/01/2022

AN EXPLORATORY STUDY ON THE IMPACT OF NEUROMARKETING ON VIRTUAL LEARNING ENVIRONMENTS

Un estudio exploratorio sobre el impacto del neuromarketing en entornos virtuales de aprendizaje

Luis Manuel Cerdá Suárez: International University of La Rioja. Spain.
luis.cerda@unir.net

Carmen Cristófol Rodriguez: International University of La Rioja. Spain.
carmen.cristofol@unir.net

How to cite this article:

Cerdá Suárez, L. M. y Cristófol Rodriguez, C. (2022). An exploratory study on the impact of neuromarketing on virtual learning environments. *Vivat Academia. Revista de Comunicación,* 155, 1-16. http://doi.org/10.15178/va.2022.155.e1391

ABSTRACT

Neuromarketing is an essential topic in the current technological world, and it has experienced explosive growth in the last years as a tool for communication. Nowadays, neuromarketing subjects have greatly improved when classroom teaching is supported by adequate laboratory courses and experiments, following the 'learning by doing' paradigm, which provides students with a deeper understanding of theoretical lessons. However, many postgraduate programs do not teach their students about the use and applications of neuromarketing. It is believed that developments in neuromarketing will likely change the traditional practices in the classroom. The objective of this paper is to propose a mix of consumer-based technologies to develop a neuromarketing project into a laboratory activity. These technologies can make neuromarketing more appealing to students by enhancing the attractiveness of business administration curricula. This neuromarketing exploration project has been evaluated successfully based on the results and responses to questionnaires: students and experts rated the neuromarketing laboratory activity highly. Students found the laboratory activity learning in the neuromarketing exploration project to be very good or excellent. Moreover, the students obtained good academic outcomes. Within the specific context of a virtual private university, this work was oriented to design a neuromarketing workshop to develop certain generic competencies for improving educational processes at universities. The

findings of this research will be relevant in decisions of educational policy, but also on the pedagogical theory and practice in the scope of this study.

KEYWORDS: Knowledge management -Neuromarketing – teaching innovation – business process – Higher Education – virtual learning – learning-by-doing.

RESUMEN

El neuromarketing es un tópico fundamental en el mundo tecnológico actual y ha experimentado un crecimiento explosivo en los últimos años como herramienta de la comunicación. Últimamente, las asignaturas de neuromarketing han mejorado mucho cuando la enseñanza está respaldada por cursos y experimentos de laboratorio siguiendo el paradigma de "aprender haciendo", que proporciona a los estudiantes una comprensión más profunda de su aprendizaje. Sin embargo, muchos programas educativos no enseñan a los estudiantes sobre el uso y las aplicaciones del neuromarketing. Bajo el supuesto de que los avances en neuromarketing cambiarán las prácticas tradicionales en el aula, el objetivo de este trabajo es proponer una combinación de tecnologías para convertir un proyecto de neuromarketing en una actividad de laboratorio, haciendo que este sea más atractivo para los estudiantes al mejorar la aplicación de los planes de estudio en postgrados de administración de empresas. Este proyecto ha sido evaluado con éxito sobre la base de respuestas a cuestionarios de estudiantes y expertos que calificaron positivamente la actividad de laboratorio, encontrando el aprendizaje como muy bueno y/o excelente, alcanzándose además buenos resultados académicas. En el contexto específico de una universidad privada virtual, este trabajo se orientó al diseño de un taller de neuromarketing para desarrollar determinadas competencias genéricas en la mejora de los procesos educativos en las universidades. Los hallazgos de esta investigación resultan relevantes en las decisiones de política educativa, pero también en la teoría y práctica pedagógica en el ámbito de este estudio.

PALABRAS CLAVE: Gestión del conocimiento – Neuromarketing – Innovación docente – Procesos de negocio – Educación Superior – Enseñanza virtual – Aprender haciendo.

UM ESTUDO EXPLORATÓRIO SOBRE O IMPACTO DO NEUROMARKETING EM ENTORNOS VIRTUAIS DE APRENDIZADO

RESUMO

O neuromarketing é um tópico fundamental no mundo tecnológico atual e tem acontecido um crescimento explosivo nos últimos anos como ferramenta de comunicação. Ultimamente as matérias de neuromarketing tem melhorado muito quando o processo de ensino está respaldado por cursos e experiências laboratoriais seguindo o paradigma de aprender fazendo, que proporciona aos estudantes uma

compreensão mais aprofundada do seu próprio aprendizado. Porém, muitos programas educativos não ensinam aos estudantes sobre o uso e as aplicações do neuromarketing. Sob a suposição de que os avanços no neuromarketing mudaram as práticas tradicionais na aula, o objetivo deste trabalho é propor uma combinação de tecnologias para transformar um projeto de neuromarketing em uma prática de laboratório, fazendo que este seja mais atrativo para os estudantes ao melhorar a aplicação dos planos de estudo em pós graduações de administração de empresas.
Este projeto tem sido avaliado com sucesso sobre a base de respostas de questionários de estudantes e experts que qualificaram positivamente a atividade de laboratório, encontrando o aprendizado como muito bom e/o excelente, atingindo além disso bons resultados acadêmicos. No contexto específico de uma universidade privada virtual, este trabalho se orientou a criação de um workshop de neuromarketing para desenvolver determinadas competências genéricas orientadas a melhora dos processos de pesquisa. As descobertas desta pesquisa resultam relevantes nas decisões da política educativa, mas também na teoria e prática pedagógica no âmbito deste estudo.

PALAVRAS CHAVE
Gestão do conhecimento – Neuromarketing – Inovação pedagógica – Processos de negócio – Educação Superior – Ensino virtual – Aprender fazendo.

Translation by **Paula González** (Universidad Católica Andrés Bello, Venezuela)

1. INTRODUCTION

Neuromarketing is not a traditional discipline but can be understood as a combination of disciplines that involve knowledge and tools of marketing, business administration, psychology, sociology, engineering, and technology, among other relevant disciplines. Furthermore, neuromarketing offers applications that develop the way the individual is supervised, the way the environment is evaluated, and the approach in which the customer experience is improved (Cerdá, 2016). For these reasons and as an approach, this discipline has attracted enormous attention in recent years in many business processes and products derived from engineering and business areas, through design and optical and magnetic devices, displays, and medical technologies; all of them, tools that facilitate their use in laboratory experiments (Casado-Aranda et al., 2019; Kaklauskas et al., 2020).

Neuromarketing as a discipline offers a relevant way of learning to see the opportunities that arise when various fields of social sciences, technology, and engineering converge (Asrar-ul-Haq et al., 2017; Cerdá, 2016). Every year hundreds of articles are published in this field with developments in new technologies; both in virtual versions and formats, as well as printed ones. In this sense, it should be appreciated that the exchange of concepts, tools, and their application and teaching in courses of various disciplines and relevant areas can facilitate greater access to technology and science in particular (Avinash et al., 2018).

However, learning courses and seminars based on the application of neuromarketing are not yet abundant or developed. Teaching neuromarketing to undergraduate social sciences students can often make use of hands-on educational labs, but recipients of these courses often argue that neuromarketing experiments are delicate, limited in availability, and costly to maintain (Salehzadeh, et al., 2020). Therefore, the knowledge about the best practices in neuromarketing is not very widespread; Thus, current higher education still faces fundamental issues to evaluate in this area (Chihiro Watanabe et al., 2019; Papanastasiou et al., 2020).

Various academic studies in the field have highlighted the relevance of making use of practical experiences to integrate neuromarketing into the academic curriculum. For this reason, experiments and previous experiences with laboratory activity facilitate the introduction of practical modules, as an important impulse of business and social sciences education (Chen, 2016; Seligman et al., 2009). Going deeper into the foregoing, the practical development of a higher training course in neuromarketing, using experimental instruments and devices in a laboratory, has been valued positively in the literature. Specifically, this has been studied for courses with a significant number of tasks and activities, in which students can verify and practice all theoretical concepts and methods through the development of courses and seminars (Blömeke and Olsen, 2019).

In other words, the neuromarketing course and module labs configure an important academic environment for students and facilitate their in-depth training, particularly in the field of higher education. This is important in hands-on learning in a laboratory: thus, it has been frequently reported that cognitive participation in learning is a validated indicator of achievement and proactive behavior in education; especially, in disciplines typical of the field of engineering and business (Dirican, 2015; Golnar-Nik et al., 2019).

In the specific context of a virtual private university, this work is aimed at developing certain generic competencies to improve educational processes in universities. The outline of this document is as follows: the first section refers to the introduction and the motivations related to this research. Second, the literature on didactic strategies and approaches to experiential learning in Higher Education, aimed at promoting neuromarketing projects in teaching and learning processes, is reviewed. Third, this article describes a systematic method for implementing these practices in the classroom: in this context, a systematic methodology for collecting and analyzing data is presented. Fourth, a discussion of the results takes place. Finally, the last section is dedicated to the conclusions, implications in the classroom, and future research. The findings of this research will be relevant in educational policy decisions, but also pedagogical theory and practice in the scope of this study.

2. OBJECTIVES

The laboratory activity is one of the most relevant experiences for undergraduate students, as it allows them to observe and explore applications of fundamental theories and connect theory and practice, developing a solid and deep understanding of theoretical lessons. Several research pieces have pointed out the relevance of using practical experience to integrate neuromarketing in the laboratory into undergraduate curricula.

For example, in a relevant study on this topic of study, students used their collective knowledge to use devices in neuromarketing; all this, to develop new modular experiments. Pedagogical methods were also used to introduce students to the field of laboratory research (Zhang, et al., 2020). Additionally, laboratory instruction, particularly in a discipline such as neuromarketing, can help students develop experimental skills and the ability to work in a team (Tshewang et al., 2016). This type of dynamic instruction also facilitates the introduction of systematic study plans, which can effectively help students to achieve a holistic and meaningful understanding; all this, with the application of a knowledge map and the integrated teaching of neuromarketing and laboratory practices in the curriculum (Folwarczny et al., 2019).

Various authors have integrated practical physical devices through a group of interrelated neuromarketing learning modules. Going deeper into this, authors such as Wang and Hsu (2014) described in their work an undergraduate course of discovery of neuromarketing practices enriched with some modules of this discipline and practical experiments (Siddiqui et al., 2019). All these projects stand out, especially because they are in favor of introducing practical modules of experimental neuromarketing in the classroom context, as a practical way to improve learning.

Most of the literature cited in this study has confirmed that including laboratory courses in teaching can lead to a better understanding and clearer conceptualization of concepts and instruments for courses in various disciplines and relevant areas; and, at the same time, it offers greater accessibility to learning neuromarketing as an academic discipline. As mentioned above, during the laboratory activities in the learning of this discipline -and to involve students with improved learning experiences- it is appropriate to pay more attention to the processes, rather than the mere result of the use of technology in classrooms (Luiz et al., 2020).

This study emphasizes the teaching support that neuromarketing activities can provide, and presents a case study project that is carried out in laboratory activity in neuromarketing courses (Moghadam & Seyyedsalehi, 2018). The main objective of the neuromarketing exploration projects course has been to contribute to the development of understanding skills of neuromarketing in the creation and testing of effective activities in students, in the context of learning in their own classrooms. In this sense, in line with recent studies, the purpose of the study cited here has been to

explore the planning, design, development, analysis, and evaluation activities that students encountered when implementing their projects in a laboratory environment (Granziera and Perera, 2019).

In this study, the experimental activity in a laboratory is an important resource for students, because it provides alternative methods to solve problems or dilemmas through the design, criticism, and evaluation of specific situations (Jang, 2019). That is, this method incorporates the concept of "learning by doing", since students are responsible for planning and implementing their ideas and solutions; at the same time, it invites students to search for information, design, and test different solutions (Gutiérrez, 2019).

As the academic literature reveals on these aspects, activities like these could help students to better build knowledge, especially in fields where the behavior and response of the real elements in the experiment are very important (Mañas-Viniegra et al., 2020). In this study and as will be seen below, the laboratory course in the experimental module covers processing, together with evaluation from the examination of the mechanical properties of the used instruments.

3. METHODOLOGY

Besides the modules in class and on practical content, the participating students were asked to prepare a final work about a specific application of the neuromarketing modules (Karakus et al., 2015). Papers were submitted individually covering topics such as optical and mechanical properties, etc. Furthermore, expert evaluation, self-evaluation, and teacher evaluation were used; all this, so that students and teachers could make modifications during the project to have the greatest possible academic success. Interim reports were evaluated to help teachers verify work. The final evaluation was based on the complete documentation and, the findings of the project, on the laboratory activity of the course (according to the detail indicated in table 1).

In this study, the laboratory activity created a learning situation from the configuration of a comprehensive approach to teaching and learning in the classroom. The instructor designed the course based on projects, using a laboratory activity so that students could build their own knowledge and skills; all this, experiencing various learning situations. Within this framework, students could analyze previous studies, create a plan, conduct related research, and share new knowledge.

The course was based on the neuromarketing activities described here, within the curriculum of the International University of La Rioja; and provided students with the skills required in the curriculum, through the development of project-based learning. To complete this academic activity, students had to do the following:

1) define the problems and tasks of the subject;
2) research a situation and implement the project proposed by the teacher in the classroom;
3) provide feedback and review the project;
4) present the project in written and oral form; and
5) describe the findings and evaluate the work.

In this experiment, the activity was conducted over a 14-week schedule as part of a six-credit course, in which college students were enrolled. To analyze the data, this research was applied in the context of a Spanish virtual university, implementing learning styles in which the students were questioned by the professors about their opinions after the development and the results of the course, through the collection and later analysis of their perceptions about the activities carried out. In this research, two aspects of the methodological process were explicitly considered, as described below: 1) the sources; and 2) the detailed research procedure.

In the first place and regarding the sources, a triangulation methodology was implemented in two lines of application: 1) bibliographic review of the presented topics; and 2) a survey of student opinion, collected in a structured questionnaire from disciplinary fields such as Neuromarketing and Business Administration (or Business, in general).

According to the conditions of this exploratory research, the informants were selected from a virtual university because these experiences can reveal some significant insights to obtain relevant findings on these topics; in particular, the greatest difficulty inherent in laboratory experiments in this area. A scale previously designed from the academic literature was applied, with the evident purpose of measuring applied teaching styles to students; in this specific case, in the context of the International University of La Rioja (UNIR, Spain). The participants filled out an online questionnaire related to their experiences and particular learning situations as a way of approaching the learning context; Previously, several in-depth interviews were applied on the target (although for expository reasons, in this work only quantitative results are evidenced), and teachers with experience in Higher Education analyzed the validity of the tool described here.

Second, the students were selected from a census. An equally random design was implemented, in terms of the approach of a transactional versus transformational teaching style to be implemented by the teachers, regarding the laboratory experiment. The students completed the questionnaire after the course, which comprised of two different sections to collect the information: Part I: "Teacher performance in the classroom"; and Part II: "Identification and classification data". In Part I of the questionnaire, the measurement scale required evaluations on a Likert scale from 1 to 7; while Part II of the

questionnaire was measured with nominal, ordinal, and ratio variables (the latter, for a variable such as age, measured in years).

Table 1. *Research methodology*

PHASE	ANALYSIS	METHODOLOGY	TECHNIQUE
Validation	Bibliography Apparent validity	Literature review	Documentary analysis
	Reliability Construct validity	Qualitative and quantitative research (analysis of global reliability and factor validity)	Descriptive analysis of the variables and content analysis Cronbach's alpha, item-total correlation Exploratory/confirmatory factor exploratory and confirmatory factor analysis, T-test

Source: Self-made

The fieldwork at the International University of La Rioja was carried out in May 2020. Table 1 shows the details of each step of the experiment, according to the designed schedule. The constructs and instruments of the neuromarketing course were first explained to the students through a conference, and then they were given instructions for the development of the experiment through the laboratory activity. The activity of the experiment consisted of two main procedures: 1) planning of the learning tasks; and 2) evaluation of the results of the experiment. At the end of the experiment, the students received feedback from various informants and other measures such as the performance scale and the neuromarketing activity assessment were administered.

4. RESULTS AND DISCUSSION

In comparative terms, Table 2 shows the profile of the students who participated in this study based on the two main teaching styles analyzed, that is, transactional versus transformational teaching style, regarding the implemented neuromarketing experiment.

Table 2. *Total sample at the International University of La Rioja*

SAMPLE	Transactional style	Transformational style	TOTAL
Interviewee's age:			
▪ Average	25.2	31.4	28.2
▪ Standard deviation	3.42	4.32	3.83
Gender of the interviewee:			
▪ Female	55 %	45.2 %	50 %
▪ Male	45 %	54.8 %	50 %
TOTAL STUDENTS	**30**	**30**	**60**

Source: Self-made

At this point, it is convenient to highlight the presence of significant differences between students and whether or not this consideration is relevant to the study; all this, to conclude on the implications of this research. For example, in descriptive terms, it is only appreciable that, in the group where the teacher applied a transactional style in the classroom, there are more female students than men, but the opposite is observed when the teacher's transformational style was implemented. The total number of participants was 60.

Neuromarketing activity

In this study, experimental modules in neuromarketing could be configured through content design that included an interface for experiments and instructions. The students used two content categories to prepare their programs for their modules, and the first consideration in the analysis was to design dimensions to assess the state of the art on teacher performance in the classroom.

According to the methodology described in the last section, the documentary analysis identified insights and categories on this construct, according to various research works that have been analyzed for this study. Thus, the literature was reviewed according to the following procedure: first, the conceptual framework on the performance of the teacher in the classroom was analyzed and, secondly, the analysis was focused on the detail of the evaluation of the content of this experiment.

To promote a transformational style of teaching in the classroom - following what is indicated by various authors, such as Nussbaum et al. (2012) -, the participants interviewed for this work pointed out that both emotional intelligence and satisfaction are two important indicators to understand the teacher's performance in the classroom.

Scale validation and comparative analysis

To understand the results described in this work, the identification of the construct concerning academic performance is presented in this section, in terms of a quantitative approach that was the basis for obtaining information and its analysis for this research. In addition, the particular internal consistency of the performance scale (Cronbach's Alpha) and the general reliability of this measurement instrument were observed, which showed an Alpha value of 0.883 (all items had an approximately normal distribution).

The results of this statistical analysis showed significant empirical evidence. Additionally, a detailed analysis of Table 3 showed that the item-total correlation ranged between 0.851 and 0.917. To validate the psychometric characteristics of this scale, an exploratory factor analysis of principal components with Varimax rotation was applied, and a confirmatory factor analysis was performed to further redefine the measurement scale. For this confirmatory analysis, the adequacy of the factorial structure was observed through CFI, RMSEA, and SRMR.

The scale of the teacher's performance in the classroom was obtained in terms of the average score of the sum of the items that measure this construct. To demonstrate the importance of the particular teaching style related to the teacher's performance in the classroom, a t-test analysis was then performed comparing by type of teaching (that is, transactional versus transformational style). Regarding the average score of the scale, a significant difference was found in the teacher's performance (see Table 3: p-value <0.05).

Table 3. *Impact of the type of teaching on the performance of the teacher in the classroom*

		Averages by type of teaching style			
VARIABLE	**Average (Stand. Dev.)**	**Transformational style**	**Transactional style**	***t***	***p* < 0.05**
Performance scale	4.95 (0.87)	5.975	3.834	4.362	0.001

Source: Self-made

Regarding the Cronbach's Alpha coefficient of the neuromarketing laboratory activity, the results of the questionnaire showed that the satisfaction levels of the experts and students in this study were 0.851 and 0.917, respectively. These results demonstrated the timely reliability of the internal consistency of the survey. Furthermore, more than 75% of the students –those with scores higher than 80– found the learning of the laboratory activity very good or excellent in the neuromarketing project; also achieving good grades and high degrees of satisfaction.

According to the instrument described by various authors (Nussbaum et al., 2012), in this construct the factor loadings expressed that the values exceeded 0.850 for items specifically related to "didactic methods that I find satisfactory", "the teacher rewards us for the achievements...", "The teacher is effective in meeting the needs...", and "new ways to motivate the group." The reliability and validity of the performance scale were also tested: the Cronbach's Alpha test, the inter-correlation of the items, and the exploratory factor analysis determined the structure of a factor of this scale. These findings determined that it was possible to reduce the total number of items on this scale and present a one-factor scale on the teacher's performance in the classroom (Cerdá, 2016).

Based on the above, the results reveal that the performance scale was affected by the type of teaching (that is, the teacher's transformational versus transactional style). Explaining the importance of the results of this work, the findings evidenced in this research show that the scale is related to the particular teaching style. The preliminary review of the literature studied in the context of this research confirms these results and suggests that teachers who provide care to their students in a transformational style can achieve similar levels of student participation and satisfaction, with some independence of the context taken into account (Cerdá, 2016; Nussbaum et al., 2012).

To conclude the evidence of the results obtained in this case study, this research also allowed us to appreciate the positive effect of transformational teaching actions on teacher performance in the classroom, in terms of satisfaction. A total of sixty students finally completed the questionnaire with items related to relevant experiences and actions in the virtual classroom and the analysis of the results suggests that students can distinguish activities and interests according to their personal motivations, and the particular teaching style applied by the teacher in the classroom. Furthermore, the main contribution of this study reveals that experiences positively impact classroom performance and, ultimately, makes it possible to demonstrate that measuring positive experiences and actions becomes essential to improve learning; in particular, in the context of learning experiences in neuromarketing.

5. CONCLUSIONS

In laboratory activity, as the literature reveals and has been seen in this study, neuromarketing courses that use a laboratory platform and exploration projects in this area enhance the interest of students and offer knowledge that can be practically applied. The study addressed the recent implementation of an experiment in a neuromarketing course and the project even entered current study plans by incorporating laboratories, guiding students in research, and designing a set of lab activities to appreciate how the experiment improved various competencies and skills in the classroom.

Certainly, neuromarketing as a discipline has attracted attention as a product development process in matters of engineering, business administration, and business development: optical and magnetic devices, displays, and medical technologies. Recently, an orientation towards more technological approaches is generally appreciated in educational institutions based on collaborative knowledge, virtual reality, and digital devices among students. In this sense, the implementation of laboratory activities in educational institutions is an interesting issue, particularly oriented to effective action for change in education. Moreover, the implementation of experiments has generated advantages and learning opportunities for students in various institutions; However, it is evident that the applied models tend to be reported during commercial processes and referred to reengineering activities; that is, they rarely support the implementation of the processes. In the laboratory activity, a technology platform for the development of neuromarketing projects can help students to understand the concepts and application of systems based on the consumer approach.

This work aimed to describe the application of experiments related to neuromarketing at the International University of La Rioja, (UNIR, Spain). In particular, this research has identified some variables that play an active role in this educational institution, however, these findings, in particular, can also be generalized to other educational contexts.

The main contributions related to the conceptual and managerial foundations derived from this empirical study are aimed at improving various experimental activities when teachers and instructors implement various tasks in the classroom. Some indicators -such as student satisfaction and recommendations on opportunities for improvement- are of special relevance to facilitate good practices in the classroom - as can be seen from the results of this work.

Regarding the specific objectives described in this document, their findings reinforce the importance of continually reviewing certain skills handling different aspects of learning in the laboratory. As the main contribution of this work, the opportunity to understand this research as a frame of reference with application to similar contexts stands out, considering certain specific aspects -face-to-face or virtual environment...- of each particular context. In this sense, this repository of knowledge that emerges from the empirical study includes different experiences revealed by the students; all understood as findings and best practices in the university classroom. Additionally, these results contribute to reinforcing the value proposition of the universities in different aspects of the processes focused on learning, as well as of the study plans, related to the discipline of neuromarketing in particular.

Additionally, some significant aspects to consider in terms of limitations of this study are the following: in this research, with students from different countries, the difficulty in managing actors derived from different cultures and visions of all the

students involved in the International University of La Rioja, following its mission and geographical presence in the world, is appreciated.

Managing the quality of service in teaching represents, in addition to all the above, an important challenge in the management of educational organizations and institutions. The knowledge repository generated by this research will facilitate the generalization of these results and findings, serving as a reference for the extrapolation of these results to future research.

6. REFERENCES

Asrar-ul-Haq, M., Anwar, S. y Hassan, M. (2017). Impact of emotional intelligence on teacher's performance in higher education institutions of Pakistan. *Future Business Journal*, 3(2), 87-97; http://dx.doi.org/10.1016/j.fbj.2017.05.003

Avinash, T., Dikshant, L. y Seema, S. (2018). Methods of Neuromarketing and Implication of the Frontal Theta Asymmetry induced due to musical stimulus as choice modeling. *Procedia Computer Science*, 132, 55-67, https://doi.org/10.1016/j.procs.2018.05.059

Blömeke, S. y Olsen, R. V. (2019). Consistency of results regarding teacher effects across subjects, school levels, outcomes and countries. *Teaching and Teacher Education*, 77, 170-182. https://doi.org/10.1016/j.tate.2018.09.018

Casado-Aranda, L-A., Dimoka, A. y Sánchez-Fernández, J. (2019). Consumer Processing of Online Trust Signals: A Neuroimaging Study. *Journal of Interactive Marketing*, 47, 159-180. https://doi.org/10.1016/j.intmar.2019.02.006

Cerdá, L. M. (2016). Happiness in teaching: positive emotions for evaluating the relationship between leadership style and performance of the professor in the classroom. En *Proceedings of 10th annual International Technology, Education and Development Conference INTED 2016*. Valencia, March, 1396-1405. http://doi.org:10.21125/inted.2016.1305

Chen, J. (2016). Understanding teacher emotions: The development of a teacher emotion inventory. *Teaching and Teacher Education*, 55, 68–77. http://doi.org:10.1016/j.tate.2016.01.001

Chihiro Watanabe, C., Naveed, K. y Neittaanmäki, P. (2017). Co-evolution between trust in teachers and higher education toward digitally-rich learning environments. *Technology in Society*, 48, 70-96. https://doi.org:10.1016/j.techsoc.2016.11.001

Dirican, C. (2015). The Impacts of Robotics, Artificial Intelligence on Business and Economics. *Procedia - Social and Behavioral Sciences,* 195, 564-573; https://doi.org/10.1016/j.sbspro.2015.06.134

Folwarczny, M., Pawar, S., Sigurdsson, V. y Fagerstrøm, A. (2019). Using neuro-IS/consumer neuroscience tools to study healthy food choices: a review. *Procedia Computer Science*, 164, 532-537. https://doi.org/10.1016/j.procs.2019.12.216

Golnar-Nik, P., Farashi, S. y Safari, M.-S. (2019). The application of EEG power for the prediction and interpretation of consumer decision-making: A neuromarketing study. *Physiology & Behavior* 207, 90-98 https://doi.org/10.1016/j.physbeh.2019.04.025

Granziera, H. y Perera. H. N. (2019). Relations among teachers' self-efficacy beliefs, engagement, and work satisfaction: A social cognitive view. *Contemporary Educational Psychology,* 58, 75-84. http://dx.doi.org/10.1016/j.cedpsych.2019.02.003

Gutiérrez, G. (2019). Neuromarketing as an effective tool for education in sales and advertising. *Revista Latina de Comunicación Social,* 74, 1173-1189. https://dx.doi.org/10.4185/RLCS-2019-1377

Jang, H.-R. (2019). Teachers' intrinsic vs. extrinsic instructional goals predict their classroom motivating styles. *Learning and Instruction*, 60, 286-300; https://doi.org/10.1016/j.learninstruc.2017.11.001

Kaklauskas, A., Abraham, A., Dzemyda, G., Raslanas, S., Seniut, M., Ubarte, I., Kurasova, O., Binkyte-Veliene, A. y Cerkauskas, J. (2020). Emotional, affective and biometrical states analytics of a built environment. *Engineering Applications of Artificial Intelligence*. 91, 103621. https://doi.org/10.1016/j.engappai.2020.103621

Karakus, O., Howard-Jones, P. A. y Jay, T. (2015). Primary and Secondary School Teachers' Knowledge and Misconceptions about the Brain in Turkey. *Procedia - Social and Behavioral Sciences*, 174, 1933-1940. https://doi.org/10.1016/j.sbspro.2015.01.858

Luiz, I., Annukka Kim Lindell, A. K. y Ekuni, R. (2020). Neurophilia is stronger for educators than students in Brazil. *Trends in Neuroscience and Education*, 20, 100136. https://doi.org/10.1016/j.tine.2020.100136

Mañas-Viniegra, L., Núñez-Gómez, P. y Tur-Viñes, V. (2020). Neuromarketing as a strategic tool for predicting how Instagramers have an influence on the personal identity of adolescents and young people in Spain. *Heliyon*, 6, (3), e03578. https://doi: 10.1016/j.heliyon.2020.e03578

Moghadam, S. M. y Seyyedsalehi, S. A. (2018). Nonlinear analysis and synthesis of video images using deep dynamic bottleneck neural networks for face recognition. *Neural Networks*, 105, 304-315. https://doi.org/10.1016/j.neunet.2018.05.016

Nussbaum, P. A., Herrera, A., Joshi, R. y Hargraves, R. (2012). Analysis of Viewer EEG Data to Determine Categorization of Short Video Clip. *Procedia Computer Science*, 158-163. http://doi.org: 10.1016/j.procs.2012.09.047

Papanastasiou, G., Drigas, A., Skianis, C. y Lytras, M. (2020). Brain computer interface based applications for training and rehabilitation of students with neurodevelopmental disorders. A literature review. *Heliyon,* 6(9), e04250; https://doi.org/10.1016/j.heliyon.2020.e04250

Salehzadeh, A., Calitz, A. P. y Greyling, J. (2020). Human activity recognition using deep electroencephalography learning. *Biomedical Signal Processing and Control,* 62, 102094; https://doi.org/10.1016/j.bspc.2020.102094

Seligman, M., Ernstb, R., Gillhamc, J., Reivicha, K y Linkins, M. (2009). Positive education: positive psychology and classroom interventions. *Oxford Review of Education,* 35(3), 293-311. https://doi.org/10.1080/03054980902934563

Siddiqui, N., Gorard, S. y See, B. H. (2019). Can learning beyond the classroom impact on social responsibility and academic attainment? An evaluation of the Children's University youth social action programme. *Studies in Educational Evaluation,* 61, 74-82. http://doi.org: 10.1016/j.stueduc.2019.03.004

Tshewang, R., Chandra, V. y Yeh, A. (2016). Students' and teachers' perceptions of classroom learning environment in Bhutanese eighth-grade mathematics classes. *Learning Environments Research*, 1(1), 1-20. https://doi.org/10.1007/s10984-016-9225-6

Wang, C.-C. y Hsu, M.-C. (2014). An exploratory study using inexpensive electroencephalography (EEG) to understand flow experience in computer-based instruction. *Information & Management*, 51(7), 912-923. https://doi.org/10.1016/j.im.2014.05.010

Zhang, J., Yin, Z., Chen, P. y Nichele, S. (2020). Emotion recognition using multi-modal data and machine learning techniques: A tutorial and review. *Information Fusion,* 59, 103-126. https://doi.org: 10.1016/j.inffus.2020.01.011

AUTHORS:

Luis Manuel Cerdá Suárez
International University of La Rioja. Spain. His areas of work extend into disciplines of marketing, market research, business processes, leadership and business

administration, information technology, and business management systems, in general. Furthermore, he has been a visiting professor in postdoctoral agreements with the Spanish Agency for International Development Cooperation (AECID) and has given courses and conferences in Spain, Mexico, Colombia, Ecuador, the United States, Chile, and Portugal. He has also published book chapters, books, articles in journals, and presentations at national and international conferences, actively collaborating in various scientific committees. Likewise, he has several national and international awards in recognition of his research work, accredited with a Six-year Research Period by the National Commission for the Evaluation of Research Activity, of the National Agency for Quality Assessment and Accreditation (ANECA).
ORCID ID: https://orcid.org/0000-0002-3909-8805

Carmen Cristófol Rodriguez
International University of La Rioja. Spain. Ph.D. in Communication and Bachelor of Advertising and Public Relations (UMA). She participates as MR in Teaching Innovation Projects, as an evaluator in prestigious journals, and as a member of thesis and final master's thesis tribunals. She is section editor of the *Revista Mediterránea de Comunicación*, researcher in the groups COMPUBES (*Comunicación y Públicos Específicos*) and IICCXXI (*Industrias Culturales Hoy*), both from the Universidad de Alicante. She is a member of the AEIC (section 10) and AIRRPP. She is part of the Interuniversity Doctoral Program. She has teaching experience in public and private universities and virtual and classroom teaching. For 17 years she has combined her teaching and research work with her facet as a media professional. She has a six-year research period.
ORCID ID: https://orcid.org/0000-0001-9766-6500