University Students' Perceptions of the Use of Technologies in Educational Activities and Mental Effort Invested

Percepciones del alumnado universitario sobre el uso de tecnologías en actividades educativas y esfuerzo mental invertido

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ABSTRACT

Different generations (digital natives, resident students, generation Y, X, or Z) show a preference towards technologies and the digital world. This "ex-post-facto" study is presented to learn the preferences that university students have regarding the use of different resources for various educational activities, as well as the investment of mental effort and perceived ease of learning concerning different means and technological resources. The sampling used is non-probabilistic, conventional, and intentional. 2,148 university students from different scientific fields of twelve Spanish public universities participate in it. To do this, an "ad hoc" instrument is designed whose data show high reliability and validity indices. The results indicate that students tend to have different perceptions regarding the various means and resources presented, in terms of the level of mental effort needed, along with the degree of easiness to learn through them. In this sense, the casuistry of the results is discussed and compared with the theory of mental effort proposed by Salomon (1981). The findings can be explained by the result of the interaction of three elements: the symbolic systems mobilized to elaborate messages, the message, and the technology that packages, formalizes, and transmits them. In the same way, it concludes by discussing the applicability of the results for the improvement of the digital competence of the students.

Keywords: technologies; school activities; students; higher education; mental effort.

RESUMEN

Las diferentes generaciones (nativos digitales, estudiantes residentes, generación Y, X o Z) muestran una preferencia hacia las tecnologías y el mundo digital. Este estudio "ex post-facto" se presenta bajo el objetivo de conocer las preferencias que estudiantes universitarios tienen respecto a la utilización de diferentes recursos para diversas actividades educativas, así como la inversión de esfuerzo mental y percepción de facilidad que tienen para aprender respecto a diferentes medios y recursos tecnológicos. El muestreo empleado es no probabilístico, convencional e intencional. En él participan 2.148 estudiantes universitarios de diferentes ramas científicas de doce universidades públicas españolas. Para ello, se diseña un instrumento "ad hoc" cuyos datos arrojan altos índices de fiabilidad y validez. Los resultados apuntan que los estudiantes tienden a tener percepciones distintas respecto a los diversos medios y recursos presentados, en lo que se refiere al nivel de esfuerzo mental, así como la facilidad para aprender mediante ellos. En ese sentido, se discute la casuística de los resultados y comparan con la teoría del esfuerzo mental propuesta por Salomón (1981). Los hallazgos pueden ser explicados por el resultado de la interacción de tres elementos: los sistemas simbólicos movilizados para elaborar mensajes, el mensaje y la tecnología que los empaqueta, formaliza y transmite. De la misma forma, se concluye debatiendo la aplicabilidad de los resultados para la mejora de la competencia digital del alumnado.

Palabras clave: tecnologías; actividades educativas; estudiantes; educación superior; esfuerzo mental.

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INTRODUCTION

Since the radical expansion of the classifications "digital natives", "resident learners", "generation Y", "generation X" or "generation Z", what underlies is an almost natural technological mastery in these generations, and an absolute preference for all things digital over analogue. All of this is a consequence of a high exposure to information and communication technologies (ICTs). This leads different authors to point out a series of characteristics of these generations such as: they are digitally literate (they are able to intuitively use a variety of IT devices and surf the Internet, they are comfortable with technology, they are visually literate and are more likely to use the Internet for inquiry/research than a library, tend to be always connected, consider themselves multitaskers, feel the need for immediacy, learn by doing rather than being told what to do, prefer structured rather than ambiguous materials, and show a preference for images over text (Lai & Hong, 2015, Cabero-Almenara et al., 2020).

Other authors defend the idea that they are rather terms used for advertising and journalistic purposes, but that they have failed to be endorsed by scientific research (Creighton, 2018; Granada, 2019; Desmurget, 2020), and it has been their redundancy that the phrase digital native has become embedded in the imaginary of digital society (Mas, 2017). As Creighton (2018) notes "many of the studies that supported the concept of "digital natives" and/or "digital immigrants" were based solely on anecdotal data and opinions" (p. 134). Granada (2019) criticises the position of these authors by pointing to their approaches as lacking scientific rigour and with a certain reductionism, by conceiving of "digital native generations as a uniform whole, without other considerations such as educational, cultural, geographical, familial or economic" (p. 32). More specifically, Creighton (2018), after reviewing 127 articles published between 1991 and 2014, notes that the terminology digital natives and migrants is problematic because there is scant (if any) empirical evidence included to support the claims made about digital natives and digital immigrants in higher education, and there is no research-based evidence that we should focus on age as a determining factor in identifying competent and experienced ICT students (Creighton, 2018).

The separation between the supposed natives and immigrants has been established on the basis of the age of the subjects, but a series of objections can be raised to such a discriminatory variable; among them is that, if such digital competence were true on the basis of having been born in a specific time period, all these people would maintain similar characteristics of technological mastery. The reality is that this is not the case, since a variety of studies, both in different contexts and at different educational levels, do not find this to be the case (Romero-Rodríguez et al., 2019; Engeness, 2021; Furenes et al., 2021) and if the "natives" are competent in the level of instrumental handling of technologies, in terms of handling them for educational and training use, it is rather elementary.

It is true that they invest a large number of hours with technologies, but the number of them they handle is rather limited, as well as the diversity of functions to which they allocate them (Lai & Hong, 2015; Castellanos et al., 2017; López-Gil & Bernal, 2019). As Castellanos et al. (2017) found after the research carried out, students surf daily, use email, and handle certain technologies such as office automation packages in a basic way; however, they are not as familiar with the use of current tools, such as blogs or social bookmarking. Hence, it is often the students themselves who demand more training in digital skills (López-Gil & Bernal, 2019; Starkey, 2020).

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There is also the myth that is more directly related to the aims of our work, which could be called the screen myth, and which refers to the fact that "digital natives" prefer to receive information through screens of different devices rather than other types of resources. Again, the research shows that a number of factors need to be considered. Thus, Parodi et al. (2019) suggest that students' choice of resource for receiving information depends on the function they have to perform. In other words, if the information in the school context is sought to make contact with a topic, they prefer the screen. However, if the function is to learn information for, for example, an exam, they prefer printed documents. Therefore, readers' use of the medium is different depending on the function it serves: entertainment, information seeking, study or interpretation (Delgado et al., 2018).

In this sense, the objective of the present research is to know the preferences that university students have regarding the use of different resources for various educational activities, as well as the investment of mental effort and perception of ease of learning that they have, with respect to different media and technological resources, this study is presented. To do so, we present the theoretical background that guided our research and describe our methodology, as well as a description of the data collection instrument and how the data were analysed. In addition, we present the interpretation and discussion of the results, with the aim of shedding light on the students' perceptions of the use of technologies in different educational activities and their mental effort.

STUDENTS' PERCEPTIONS OF THE USE OF TECHNOLOGICAL MEDIA AND RESOURCES FOR DIFFERENT ACTIVITIES

The perception of the use of technologies is marked by beliefs about their potential.

Gergen (1996) mentioned some time ago, are bearers of meaning and constitute an enduring scheme of interpretations that develop during the personal history of each individual and, once formed, influence the way in which they give meaning to and act in their social world.

Delgado et al. (2018) pointed out three essential elements in the predominance of digital reading over paper reading: time frame, genre and year of publication. In their research, these authors point out that reading in digital format is an inevitable part of our daily lives and an integral part of the educational sphere, although they state the need to favour paper reading over digital reading, complementing it with digital devices.

In this aspect of identifying the preferred medium for reading, we can highlight the work done by Kazanci (2015) with 792 students from eight different departments of the Faculty of Education, the results indicated that the majority of students still prefer traditional printed paper rather than digital screen for their reading activities, a preference that did not change over the six-year interval in which data was collected.

Meanwhile, Farinosi et al. (2016) point out that the choice of medium is not radically determined by the historical moment of the student's birth, but also depends on functionality, "the use of pencil or keyboard depends on the task: students prefer to write longer texts digitally, while pen and paper are considered more useful for creative tasks and meta-communication" (p. 411). In a recent study, Parodi et al. (2019) analysed the reading habits declared by Chilean university students in human sciences and economic and administrative sciences. The results showed that 84% would prefer to read on paper.

The arguments mobilised to explain this type of choice go in different directions. Kutcher (2018) points out that screen reading interferes with in-depth learning for three reasons: "1) screens lack a tactile experience, 2) hypertext is distracting and difficult to navigate, and 3) superficial reading becomes the norm" (p. 32), noting that "digital distractions are found right at the machine" (p. 33). Already in a traditional study Mangen et al. (2013) found that students who read print texts scored significantly better on the reading comprehension test than students who read the texts digitally.

The cognitive interaction that students make on the different media and technological resources is also determined by the mental effort they invest in processing their information, and the perceived ease with which they learn with them (Cabero-Almenara et al., 2020).

THE INVESTMENT OF MENTAL EFFORT IN INFORMATION PROCESSING

The mental or cognitive effort that a person invests in learning is a key variable for this. A key author to explain the investment of mental effort that people make when interacting with a technology was Salomon, who formulated his theory of mental effort or AIME theory ("Amount of Invested Mental Effort") (Salomon, 1981), a theory that, according to Valencia et al. (2018), aims to explain the information processing that we carry out with technologies and the variables that influence it.

Almost anything worth doing requires effort, so it is not surprising that effort has played such a central role in the way researchers, theorists, instructors and even students think about learning and student achievement. Self-perception involves individuals experiencing an interest in their learning (self-regulated learning) and setting learning goals to maintain their intentional engagement (Peel, 2020). In this work, the authors of the target articles explore the importance of effort for students' self-regulated learning within multiple domains. To further support the advancement of effort research, we distinguish between objective effort as a direct causal agent of learning gains and effort as a learner perception.

Thus, at least two types of perceptions have an impact on AIME: a) perceptions of the source of the information, and b) perceptions of self-efficacy for task performance.

Different studies (Cabero-Almenara et al., 1995; Dunlosky et al., 2020) show how effort exerted has a direct impact on the quantitative and qualitative level that subjects acquire from the mediated information presented. At the same time, we have also found that processing varies from one medium to another, depending on the attitudes and predispositions that subjects have towards them. And, finally, it is not only the attitude towards the specific medium that has an influence, but also the attitude towards the content transmitted. In general terms, the learning we achieve with a medium depends on the effort we make with it, and this depends directly on the attitudes and perceptions we have towards it and towards the contents transmitted. To corroborate his theory, Salomon (1983) carried out his research by comparing the mental effort invested with two media towards which we tend to have different attitudes: television and books.

Perceptions that through different research and with different technologies have been shown to be a significant variable to explain the interaction established with ICT (Colomo et al., 2020; Ferrero & Cantón, 2020; Salas-Rueda, 2020; Engeness, 2021).

Mental effort is directly related to the cognitive load that the subject puts into action when processing information from any medium and technological resource

(Feldon et al., 2019). And, at the same time, on the motivation that a person will have for the development of any activity (Paas et al., 2005; López-Cortés et al., 2021).

METHODOLOGY

Research objectives

The objectives of the research are stated in the following terms:

- To find out the preferences that university students have regarding the use of different resources for various educational activities.
- To find out the investment of mental effort that university students indicate they will invest with different media and resources to understand and capture information.
- To find out how easy it is for university students to learn with respect to different media and technological resources.
- To analyse the possible relationships between the investments of mental effort that students indicate they will invest in understanding and capturing information, through different media and resources and for different activities, and their perceived ease of learning with these media and resources.
- To analyse whether there are differences in the predilection for different media and resources for the development of different activities according to the students' branch of knowledge.

Sample

The study carried out is of the "ex post-facto" type (Mateo, 2004), with a non-probabilistic, conventional and intentional sample.

The research sample consisted of 2148 university students from 12 Spanish public universities (Figure 1), who were studying for degrees in different areas of science (table 1). Of these, 430 were men (20%) and 1748 women (80%). The vast majority of them were aged between 21 and 25 (f=958, 44.6%), followed by those aged under 20 (f=938, 43.7%), with a similarity between those aged "between 26 and 30" and "over 30" (f=126, 5.9%). Consequently, 88.3% were under 25 years of age.

Figure 1
Number of participating students by university

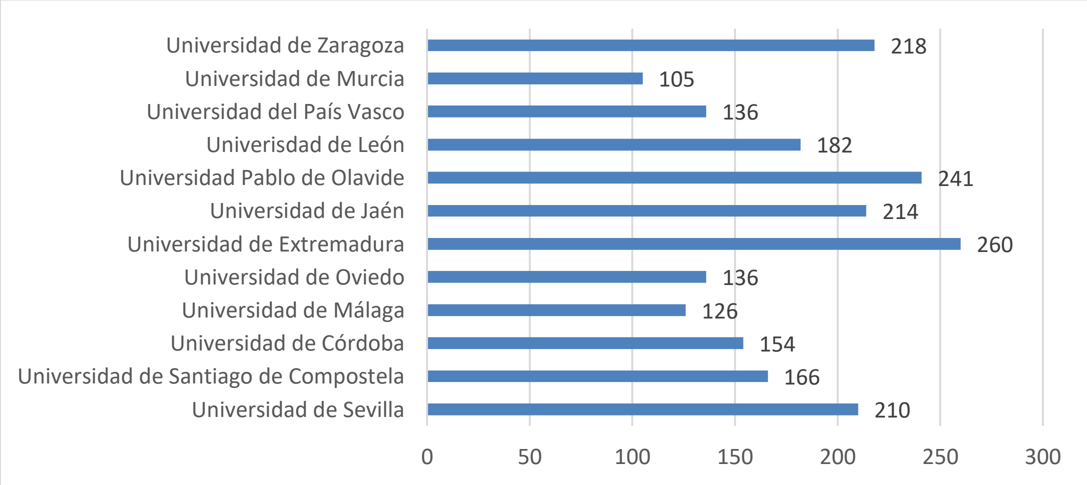

Table 1
Study areas taken by students

Areas	Frequency (f)	%
Arts and Humanities	370	17,2
Sciences	122	5,7
Health Sciences	134	6,2
Social Sciences and Legal Sciences	1334	62,1
Engineering and Architecture	188	8,8
Total	2.148	100,0

Instrument

The data collection instrument was revised "ad hoc" for the present work, although we rely on those used in their research by Fortunati and Vicent (2014), Farinosi et al. (2016) and Parodi et al. (2019). The instrument was constructed with "Google form" and can be found at the following web address: https://forms.gle/be5j5xdXqQ4GdJMc7. It was administered in the first half of the year 2021.

The instrument had different sections: a) demographic data (gender, age, university where the student was studying and branch of knowledge), b) assessment of the different resources preferred for the development of various activities, c) perception of the mental effort invested to understand the information according to different media and technological resources, and d) perception of the ease of learning according to different media and technological resources.

The reliability of the instrument was obtained by means of Cronbach's alpha, the items identified were those referring to the mental effort invested and the perception of ease of use. The following values were obtained: a) general of the two dimensions: 0.897; b) mental effort dimension: 0.866; and c) ease of learning dimension: 0.896. The scores suggest a high level of reliability.

Regarding the reliability of the questionnaire, it is calculated by means of a confirmatory factor analysis (CFA). The CFA was verified with the theoretical proposal of the dimensions with the selected items. For this, the maximum likelihood method was selected, using the thresholds recommended by Hu and Bentler (1999): CMIN/DF (mean chi square/degree of freedom<3) = 2,562, p = <0.05; CFI (comparative fit index>0.7) = 0.952; TLI (Tucker-Lewis index>0.7) = 0.971; IFI (incremental fit index>0.7) = 0.963; RMSEA (root mean square error of approximation<0.1) = 0.062.

RESULTS

The results indicate that students tend to have different perceptions of the different media and resources presented in terms of the level of mental effort and the ease of learning through them. In this way, the research findings are explained through the interaction of three elements: the symbolic systems mobilised to elaborate messages, the message, and the technology that packages, formalises and transmits them.

One of the questions in the questionnaire was aimed at investigating the preferences that students showed for certain activities with respect to different media and technological resources; specifically, the question was: What resources do you prefer for the development of the activities? Table 2 shows the values obtained in the resources fixed computer, laptop computer and printed matter, since they are the resources with the highest reference by students. The questionnaire also took into account other resources, such as augmented/virtual reality, social networking, simulator and smartphone. These values are not shown in the table since the response percentage is less than 10%. Therefore, they are not considered significant data.

Table 2

Activities and preferred resources

Activities	Resources	f	%
Developing academic reading	Fixed computer	34	1,6
	Laptop computer	368	17,1
	Printed material	1610	75,0
Reading for entertainment	Fixed computer	28	1,3
	Laptop computer	206	9,6
	Printed material	1186	55,2
Reading for information	Fixed computer	144	6,7
	Laptop computer	1420	66,1
	Printed material	62	2,9
Preparing for an exam	Fixed computer	36	1,7
	Laptop computer	166	7,7
	Printed material	1890	88,0
Remembering information	Fixed computer	24	1,1
	Laptop computer	156	7,3
	Printed material	1592	74,1
Understanding information	Fixed computer	32	1,5
	Laptop computer	290	13,5
	Printed material	1368	63,7
Applying information	Fixed computer	112	5,2
	Laptop computer	1140	53,1
	Printed material	584	27,2
Analysing information	Fixed computer	86	4,0
	Laptop computer	946	44,0
	Printed material	812	37,8
Evaluate information	Fixed computer	102	4,7
	Laptop computer	1004	46,7
	Printed material	764	35,6

Create other resources	Fixed computer	168	7,8
	Laptop computer	1452	67,6
	Printed material	128	6,0

As can be seen, two are the resources where students mostly showed their choice:

- Printed material: developing academic reading, reading for entertainment (f=1610, 75%), reading for information search (f=1186, 55.2%), (f=1420, 66.1%), preparing for an exam (f=1890, 88%), remembering information (f=1592, 74.1%) and understanding information (f=1368, 63.7%).
- Laptop: applying information (f=1140, 53.1%), analysing information (f=812, 37.8%), evaluating information (f=1004, 46.7%) and creating other resources (f=1452, 67.6%).

The rest of the resources were quite distant from the choices made by the students. Only in one case was there certain closeness in the answers between printed material and laptop, in analysing information, where printed material obtained 812 choices (37.8%).

The ad hoc questionnaire also asked students about the amount of mental effort they thought they invested in understanding and capturing information, based on a range of resources. Students were offered a response scale ranging from 0 (very little/not at all) to 5 (very much), while at the same time they were asked to use the response option NA (not applicable/never used). Eliminating the answers given in the latter option, the mean scores and standard deviations achieved are presented in Table 3.

Table 3
Amount of mental effort invested in different media and resources

Media & Resources	Mean	Standard Deviation
Printed material	2,78	1,723
Fixed computer	2,55	1,463
Laptop computer	3,14	1,449
Tablet	2,70	1,480
Smartphone	2,99	1,465
Video / TV	2,39	1,411
Web/Internet	3,01	1,482
Social Networking	2,38	1,542
Simulator	2,27	1,541
Augmented / Virtual Reality	2,26	1,598

Also in response to one of the objectives, students were asked how easy it was for them to learn with such media, and in this case the scale ranged from 0 (very easy) to 5 (very difficult). Again, the option NA was also offered. In this case the mean values and standard deviations achieved are shown in Table 4.

Table 4
Perceived ease of learning about different media

Media & Resources	**Mean**	**Standard Deviation**
Printed material	1,06	1,401
Fixed computer	2,04	1,355
Laptop computer	1,70	1,273
Tablet	2,15	1,343
Smartphone	2,38	1,467
Video / TV	2,08	1,449
Web/Internet	1,84	1,385
Social Networking	2,40	1,522
Simulator	2,83	1,538
Augmented / Virtual Reality	2,80	1,570

Accordingly, Table 5 below gives the rankings achieved for mental effort and perceived ease.

Table 5

Positions achieved for mental effort and perception of ease

Mental effort		**Perception of ease**	
Media – Resource	Ranking	Media – Resource	Ranking
Laptop	314	Augmented/Virtual Reality	2,80
Web/Internet	3.01	Simulator	2,83
Smartphone	2.99	Social Networking	2,40
Printed material	2.78	Smartphone	2,38
Tablet	2.70	Tablet	2,15
Fixed computer	2.55	Video / TV	2,08
Video/TV	2.39	Fixed computer	2,04
Social Networking	2.38	Web/Internet	1.84
Simulator	2.27	Laptop	1,70
Augmented reality/virtual reality	2.26	Printed material	1,06

The first thing that can be noted is that a large majority of means require subjects to invest mental effort above or slightly close to the mean of the scale. While in the case of ease only two resources are above average. We found some with slightly easier perceptions, such as printed materials and computers, both stationary and portable.

The research also sought to analyse whether the branch of study the student was studying had an impact on the investment of mental effort they would make with the different resources and on the perception of ease they would have with respect to them. For this purpose, the Kruskal-Wallis statistic was applied for both cases, the post hoc test, if the null hypothesis was rejected and the student's gender had an impact on the amount of mental effort they would invest.

For this purpose, the following hypotheses were formulated:

- Null hypothesis (H0): There are no significant differences depending on the course of study studied by the students in the amount of mental effort invested in different materials to understand and capture information, as well as in the ease they perceive with respect to the same media to learn with them with an alpha risk of error of 0.05.

- Alternative hypothesis (H1): If there are significant differences depending on the course of study taken by the students in the amount of mental effort invested in different materials to understand and capture information, as well as in the ease they perceive with respect to the same media to learn with them with an alpha risk of error of 0.05.

Table 6 shows the results achieved.

Table 6

Kruskal-Wallis scores to accept or reject H0 or H1

Dimension	Kruskal-Wallis	gl	sig
How much mental effort you invest in understanding and capturing information, according to:			
Printed material	15,424	4	0,004(**)
Fixed computer	24,498	4	0,000(**)
Laptop computer	27,132	4	0,000(**)
Tablet	8,207	4	0,084
Smartphone	7,520	4	0,111
Video / TV]	5,735	4	0,220
Web/Internet	20,880	4	0,000(**)
Social Networking	7,041	4	0,134
Simulator	2,129	4	0,712
Augmented / Virtual Reality	3,651	4	0,455
How easy is it for you to learn with such media?			
Printed material	12,801	4	0,012(**)
Fixed computer	12,476	4	0,014(**)
Laptop computer	4,665	4	0,323
Tablet	12,047	4	0,017(**)
Smartphone	1,294	4	0,862
Video / TV]	5,511	4	0,239
Web/Internet	10,808	4	0,029(*)
Social Networking	14,379	4	0,006(**)
Simulator	9,292	4	0,054(*)
Augmented / Virtual Reality	21,515	4	0,000(**)

Note: *= significant at 0,05; **=significant at 0,01

The results obtained in the case of the investment of mental effort expended allow us to reject the following H0, at p≤ 0.05 or lower for the following resources: printed material, fixed computer, laptop computer, and Web/Internet.

And for the resulting ease of learning, the means in which the H0s were rejected, at p≤ 0.05 or lower, were as follows: printed material, fixed computer, laptop, Web/Internet, Social Networking, simulator, and augmented/virtual reality.

In other words, there were significant differences between students' degree courses, perceptions of mental effort and ease of use with respect to different media and resources.

The data found suggest that there are differences in the investment of mental effort and the perception of ease of learning with different resources, depending on the branch of studies pursued by the students.

In order to analyse the differences between branches of study, we applied the rank test (Table 7) in those cases in which the H0 had been rejected.

Table 7
Rank test to analyze differences between study branches

Media - Resources	Areas	n	Mid-range
Mental effort			
Printed material	Arts and Humanities	366	1130,13
	Sciences	122	1166,30
	Health Sciences	134	1051,08
	Social Sciences and Legal Sciences	1320	1056,94
	Engineering and Architecture	188	944,64
Fixed computer	Arts and Humanities	290	962,59
	Sciences	100	953,24
	Health Sciences	114	1054,15
	Social Sciences and Legal Sciences	1132	879,52
	Engineering and Architecture	164	796,57
Laptop computer	Arts and Humanities	366	1126,81
	Sciences	122	1069,96
	Health Sciences	134	1209,07
	Social Sciences and Legal Sciences	1320	1058,14
	Engineering and Architecture	188	892,59
Web/Internet	Arts and Humanities	360	1104,05
	Sciences	122	1055,39
	Health Sciences	130	1147,70
	Social Sciences and Legal Sciences	1310	1052,28
	Engineering and Architecture	182	882,18
Ease of learning			
Printed material	Arts and Humanities	366	1030,42
	Sciences	122	963,52
	Health Sciences	134	1062,44
	Social Sciences and Legal Sciences	1322	1071,12
	Engineering and Architecture	188	1174,00
Fixed computer	Arts and Humanities	296	906,16
	Sciences	104	815,35
	Health Sciences	114	928,22
	Social Silences and Legal Sciences	1152	939,59
	Engineering and Architecture	166	830,01
Web/Internet	Arts and Humanities	350	993,10
	Sciences	120	963,28
	Health Sciences	128	1097,50
	Social Sciences and Legal Sciences	1302	1063,82
	Engineering and Architecture	180	974,90
Social Networking	Arts and Humanities	308	914,08
	Sciences	104	789,69
	Health Sciences	104	792,69
	Social Silences and Legal Sciences	1162	914,69
	Engineering and Architecture	130	972,02
	Arts and Humanities	158	480,17

Media - Resources	Areas	n	Mid-range
Augmented/Virtual Reality	Sciences	50	367,94
	Health Sciences	38	307,92
	Social Sciences and Legal Sciences	556	435,18
	Engineering and Architecture	62	415,37

Next, the Kruskal-Wallis one-factor non-parametric post hoc ANOVA test (Dunn's test) will be applied (Dinno, 2015) and then for those that were significant, Cohen's d statistic (Cohen, 1988) will be calculated to analyze the effect size.

For the sake of completeness, only those pair-wise comparisons that were significant at p≤ 0.05 or lower will be presented and these will also be the ones on which we will obtain the effect size (Table 8).

Table 8

Pair-wise comparison

Dimension - Resource – pair-wise area	Test Standard Dev.	Sig.	d
Mental effort			
Printed material			
Engineering and Architecture-Social and Legal Sciences	2,383	,017	0,181
Engineering and Architecture-Arts and Humanities	3,419	,001	0,298
Engineering and Architecture-Sciences	3,153	,002	0,364
Social Sciences and Legal Sciences - Arts and Humanities	2,049	,040	0,116
Fixed Computer			
Engineering and Architecture-Sciences	2,424	,015	0,272
Engineering and Architecture-Arts and Humanities	3,336	,001	0,286
Engineering and Architecture-Health Sciences	4,147	,000	0,493
Social and Legal Sciences-Arts and Humanities	2,478	,013	0,141
Social and Legal Sciences-Health Sciences	3,489	,000	0,351
Laptop			
Engineering and Architecture-Social and Legal Sciences	3,528	,000	0,287
Engineering and Architecture-Sciences	2,534	,011	0,322
Engineering and Architecture-Arts and Humanities	4,336	,000	0,395
Engineering and Architecture-Health Sciences	4,650	,000	0,538
Web/Internet			
Engineering and Architecture-Social and Legal Sciences	3,608	,000	0,288
Engineering and Architecture-Sciences	2,484	,013	0,313
Engineering and Architecture-Arts and Humanities	4,093	,000	0,369
Engineering and Architecture-Health Sciences	3,880	,000	0,468
Ease			
Printed material			
Engineering and Architecture-Social and Legal Sciences	1,956	,050	0,078
Engineering and Architecture-Arts and Humanities	2,920	,004	0,207
Engineering and Architecture-Sciences	2,812	,005	0,248
Fixed Computer			
Health Sciences-Engineering and Architecture	-2,227	,026	0,275
Health Sciences-Sciences	2,142	,032	0,256
Social and Legal Sciences-Engineering and Architecture	-2,297	,022	0,182

Dimension - Resource – pair-wise area	Test Standard Dev.	Sig.	d
Social and Legal Sciences-Sciences	2,054	,040	0,164
Tablet			
Health Sciences-Arts and Humanities	2,056	,040	0,284
Health Sciences-Engineering and Architecture	-2,285	,022	0,328
Health Sciences-Sciences	2,554	,011	0,343
Smartphone			
Health Sciences-Social and Legal Sciences	-2,697	,007	0,299
Health Sciences-Arts and Humanities	3,217	,001	0,375
Health Sciences-Sciences	4,321	,000	0,639
Engineering and Architecture-Arts and Humanities	2,437	,015	0,219
Engineering and Architecture-Sciences	3,739	,000	0,476
Social and Legal Sciences-Sciences	3,142	,002	0,323
Arts and Humanities-Sciences	-2,090	,037	0,245
Social Networking			
Engineering and Architecture-Social and Legal Sciences	2,671	,008	0,240
Engineering and Architecture-Sciences	2,309	,021	0,266
Engineering and Architecture-Arts and Humanities	3,152	,002	0,333
Health Sciences-Social and Legal Sciences	-2,044	,041	0,211
Health Sciences-Arts and Humanities	2,573	,010	0,297
Simulator			
Social and Legal Sciences - Arts and Humanities	3,209	,001	0,314
Social and Legal Sciences-Health Sciences	2,620	,009	0,435
Social and Legal Sciences-Engineering and Architecture	-4,074	,000	0,488
Social and Legal Sciences-Sciences	3,657	,000	0,485
Augmented reality			
Social and Legal Sciences - Arts and Humanities	4,096	,000	0,385
Social and Legal Sciences-Sciences	2,531	,011	0,368
Social and Legal Sciences-Health Sciences	2,790	,005	0,447

The results suggest that in the case of mental effort, it is the students in the "Engineering and Architecture" fields who show the greatest degree of difference with respect to students in other fields. Moreover, in all cases, it is these students who indicate that they invest less mental effort with the different resources to understand and capture the information. These differences were found in all of the means in which H0 was rejected and H1 was accepted. Significant differences were also found between those in Social and Legal Sciences and those in "Arts and Humanities" and with those in "Health Sciences" in the case of the mental effort invested with the fixed computers; in these cases, it was those in Health Sciences, followed by those in "Arts and Humanities", who indicated that they invested more effort.

In the case of ease, the data were not as homogeneous as in the previous case. Although the most significant differences were found with the "Social and Legal Sciences" students, who had the highest scores in all the resources in which H0 was rejected, followed later by the "Arts and Humanities" students.

As far as effect sizes are concerned, according to Cohen's (1988) proposal, they can be considered low, except in the following cases for mental effort: Engineering and Architecture-Health Sciences (fixed computer), Engineering and Architecture-Health Sciences (laptop) and Engineering and Architecture-Health Sciences (web/internet); which can be considered moderate. And in the following cases for facility: "Health Sciences-Sciences (Smartphone), Engineering and Architecture-Sciences (Smartphone), Social and Legal Sciences-Engineering and Architecture"; and "Social and Legal Sciences-Sciences" (simulator) which can also be considered moderate.

Finally, we analyzed whether there was a relationship between the amount of mental effort that students said they would invest with different media and for different actions, and the perceived ease they had with respect to different resources and for carrying out different activities. For this we applied Spearman's correlation coefficient (Table 9).

Table 9

Spearman correlation coefficient

Resource	Correlation	Sig
Printed material	,273	,000
Fixed computer	,251	,000
Laptop computer	,288**	,000
Tablet	,213**	,000
Smartphone	,155**	,000
Video / TV	,237**	,000
Web/Internet	,366**	,000
Social Networking	,268**	,000
Simulator	,294**	,000
Augmented / Virtual Reality	,317**	,000

The results highlight two aspects: firstly, that the correlations are all significant at the level of $p \leq 0.01$; and secondly that they are all positive in consequence when one of the variables increases the other increases as well. In our case, when students indicate that they invest more mental effort with different media it is also because they perceive that they find it more difficult to learn with them. It should also be noted that the correlations obtained are not very high according to Mateo (2004).

DISCUSSION/CONCLUSION

The conclusions of our research go in different directions. The first one is that we have not found a preference for technological media and resources as much as one would expect from the comments referring to them as highly technical people. Moreover, for activities that could be considered as having a strong academic connection (academic reading, searching for information, preparing for an exam or recalling information) they prefer printed materials over other digital resources. In this aspect our findings are in line with the research of Kazanci (2015), Farinosi et al. (2016) and Parodi et al. (2019).

Similarly, different studies show that students prefer printed material for these types of questions. For example, studies such as those by Mizrachi (2015), Pálsdóttir and Einarsdóttir (2016), Baron et al. (2017) or Furenes et al. (2021) show that students prefer this type of material because it is easier to annotate; or that printed materials favour student concentration by making it easier to remember, highlight, annotate and revise the text (Delgado et al., 2018; Pálsdóttir, 2019).

At the same time, our work goes against what is indicated by different authors who consider these people to be "digital natives", as users of a great galaxy of technological resources; rather, the findings indicate very little variability of resources: printed materials and laptop. In this aspect, the results coincide with those studies that point to the low variability of the resources they use, and, furthermore, to the low use of activities to which they dedicate them (Cabero-Almenara et al., 2020; Desmurget, 2020).

It has been found that students tend to have different perceptions of the different media and resources indicated, in terms of the level of effort they would invest in understanding and capturing information, as well as the ease with which they find learning through different media. Also, and in line with other work, a direct relationship has been found between the mental effort invested by students in processing information through different media and their perception of how easy it is for them to learn. This is directly related to the theory of mental effort traditionally formulated by Salomon (1981).

Additionally, it has also been found that the students' perception of the ease and usefulness of the medium depends on the branches of study studied by the students. In our case, it is the "Engineering and Architecture" students who show a higher degree of use of the diversity of resources used. This could be due to the wide range of technologies used in these disciplines, where, for example, technologies such as augmented reality are used more and more constantly; and even to the acquisition of digital skills and the construction of a digital identity, as pointed out in their studies by Engeness (2021), Peel (2020), Rodríguez-Abitia (2020) and Starkey (2020).

Therefore, initial training plays a crucial role with regard to the use of technologies in the development of educational activities, and how these have an impact on: students' own mental efforts, the processing of information and the acquisition of digital competences for their future professional development.

Finally, the limitations of the study are presented, as well as lines of future research. Regarding the former, one of the limitations is in the use of a self-perception questionnaire. The study is based on the opinions of students regarding the use of technology. For future work, it is recommended to triangulate this data with others such as the level of digital competence or usage preferences. In addition, other data collection instruments are proposed, such as the objective questionnaire or the semi-structured interview. Likewise, future studies can focus on performing a contrast taking into account the level of digital competence of the students.

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