Educación XX1
ISSN: 1139-613X · e-ISSN: 2174-5374

Influence of problematic video games use and technological access on academic performance: characterization of adolescent profiles

Influencia del uso problemático de videojuegos y el acceso tecnológico en el rendimiento académico: caracterización de perfiles adolescentes

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How to reference this article:

García-Gil, M.A., Sánchez Casado, J. I., Ferreira, J.A., & Fajardo-Bullón, F. (2025). Influence of problematic video games use and technological access on academic performance: characterization of adolescent profiles. *Educación XX1, 28*(2), 45-68. https://doi.org/10.5944/educxx1.39651

Date received: 23/01/2024
Date accepted: 19/09/2024
Published online: 20/06/2025

ABSTRACT

In the current context, where technology has become omnipresent in the student's daily life, it is essential to understand how the digital divide and Problematic Video Game Use (PVU) can influence their academic performance (AP). This research aims to examine the relationship between access to technological resources (mobile phone, computer, Internet access, daily Internet connection time, and problematic video games use) and AP. To do this, a sample of 1,448 students from Extremadura was selected, of which 51.1% were women and 48.9% were men, with an average age of 14.5 years (*SD* = 1.57). A sociodemographic questionnaire was used with the grade record from the previous course recorded in the Rayuela Platform. In addition, the Video Game Related Experiences Questionnaire (CERV in Spanish) was used. The results obtained in the 5 groups categorized through a two-stage cluster indicate that more than five hours of connection have a negative impact on the general AP, but when there is a connection between 1 and 3 hours, with access problems to devices and/ or digital resources, a worse AP is obtained, being more significant in Mathematics. In conclusion, a double digital divide opens up regarding the control of connectivity time, and regarding the lack of access to digital resources in the family environment, which significantly limits the academic success of this ad hoc student profile.

Keywords: ICT, problematic use of video games, adolescents, academic performance, cluster, Spain

RESUMEN

En el contexto actual, donde la tecnología se ha vuelto omnipresente en la vida cotidiana del alumnado, resulta fundamental comprender cómo la brecha digital y el Uso Problemático de Videojuegos (UPV) pueden influir en su rendimiento académico (RA). La presente investigación tiene como objetivo examinar la relación entre el acceso a los recursos tecnológicos (móvil, ordenador, acceso a Internet, tiempo de conexión diario a Internet y uso problemático de videojuegos) y el RA. Para ello, se seleccionó una muestra de 1448 estudiantes de Extremadura, de los que el 51.1% eran mujeres y un 48.9% hombres, con una edad media de 14.5 años (*DT* = 1.57). Se empleó un cuestionario sociodemográfico junto con el registro de calificaciones del curso anterior consignado en la Plataforma Rayuela. Además, se utilizó el Cuestionario de Experiencias Relacionadas con los Videojuegos (CERV). Los resultados obtenidos en los 5 grupos categorizados mediante un clúster bietápico indican que más de cinco horas de conexión inciden negativamente en el RA general, pero cuando existe una conexión entre 1 y 3 horas, con problemas de acceso a los dispositivos y/o recursos digitales, se obtiene un peor RA, siendo más significativo en Matemáticas. En conclusión, se abre una doble brecha digital respecto al control del tiempo de conectividad, y respecto a la falta de acceso a los recursos digitales en el entorno familiar, lo que limita sensiblemente el éxito escolar de este perfil de estudiante ad hoc.

Palabras clave: TIC, uso problemático de videojuegos, adolescentes, rendimiento académico, clúster, España

INTRODUCTION

Access to Information and Communication Technologies (ICT), number of hours of use, and Problematic Video Games Use (PVU)

Currently, technology plays an increasingly important role in our lives. If we consult the report 'El uso de las tecnologías por los menores en España' (2022) by the National Observatory of Technology and Society, 98% of children between 10 and 15 years old have been using the Internet regularly since the 2020 pandemic. However, during the last two years, there has been an increase in computer use in this same age group, reaching 95%. Another interesting fact is that seven out of ten children have a mobile phone, but it is mostly used by women (72%).

Therefore, ICTs have brought about significant changes in the way we relate, communicate and entertain ourselves (Bozzola et al., 2022). Similarly, the Spanish Survey on ICT Equipment and Use reveals that the use of computers (95.2%), mobile phones (68.7%), and the Internet (93.9%) among minors is very widespread (Instituto Nacional de Estadística [INE], 2022). In turn, the use of video games among young people has experienced a notable increase in recent years, as highlighted by Díaz et al. (2023).

However, following the same authors, it is necessary to understand how an intensive use can lead to significant problems (Díaz et al., 2023). In this paper, Problematic Video Game Use, with its acronym 'PVU', refers to a pattern of maladaptive behaviour associated with the excessive and uncontrolled use of video games. It involves a loss of control over time spent playing, interference with daily activities, impairment in social, academic or occupational functioning, and symptoms of dependence (Griffiths, 2018). Nevertheless, there is also scientific evidence that the use of video games can have a positive effect on well-being, which can have positive effects on academic profiles (Halbrook et al., 2019). To assess this construct, Chamarro et al. (2014) developed the Video Game Related Experiences Questionnaire (CERV in Spanish). Thus, the World Health Organisation (World Health Organisation [WHO], 2018) has recognised this phenomenon by including 'Gaming Disorder' in its International Classification of Diseases (ICD-11). This disorder encompasses both online and offline gaming, highlighting the importance of addressing the negative effects of PVU on people's health and well-being. All of this raises a relevant question at the adolescent education stage: *Are there differences in PVU depending on whether students own a mobile phone, or computer, have access to the Internet at home, and finally, are they influenced by how many hours they 'go online' daily?*

In this direction, studies published in Spain by González et al. (2021) reveal that access to ICTs can exceed six hours a day, being an average of five hours a day. These authors show that the most widely used device is the mobile phone, where

a high number of hours of use could impact the health of young people. On the other hand, Shinetsetseg et al. (2022) indicate that problematic internet and mobile phone use is directly associated with public health problems, such as the use of tobacco, alcohol, cannabis or other drugs, low AP, poor family relationships, and intensive computer use.

Regarding video games, Gómez-Gonzalvo et al. (2020) showed that there are around 15.8 million video game players in Spain, with 75.94% playing weekly. According to their study, a moderate daily time is recommended to prevent PVU which can affect different areas of life. These data show that the abuse of new technologies is growing due to the notorious use of video games among young people (Díaz et al., 2023). Regarding this issue, young people's preferred means of accessing video games have been changing over time. A decade ago, computers and video game consoles were the most widely used media (Gómez-Gonzalvo et al., 2020); meanwhile, a study by US consultancy The NDP Group (2023) indicates that mobile devices are the most prevalent medium among teenagers today, even more so than computers and consoles. This research concludes that 65% of children prefer to play games on mobile phones, compared to 23% who choose computers and 12% who prefer consoles. Such findings reflect the increasing use of and access to mobile phones among the adolescent population. In this regard, researchers argue that access to mobile phones significantly influences video game use among children and adolescents (The NDP Group, 2023), thus encouraging problematic use which can include psychosocial and behavioural symptoms (Chamarro et al., 2014; Joshi et al., 2023).

Therefore, easy and frequent access to ICT, such as mobile phones (Yu & Cho, 2016) and computers (Rehbein et al., 2010), may encourage excessive and unhealthy use of video games (Griffiths, 2018; Machimbarrena et al., 2023); particularly, since the expansion of device functions, the availability of online games and access to other attractive entertainment products, aspects already highlighted by Ruiz-Palmero et al. (2016). Thus, the constant availability of devices increases the likelihood of PVU patterns (Griffiths, 2018), where more online time spent may be associated with a higher risk of developing PVU in adolescents (González et al., 2021; Mora-Salgueiro et al., 2022).

Distinctive profiles in Compulsory Secondary Education (ESO) and Baccalaureate students according to technological access

We cannot ignore the fact that access to digital resources is a fundamental issue for adolescents to avoid social exclusion (Fundación Foessa, 2022). The Organisation for Economic Co-operation and Development (OECD) warned in early 2000 that such access to ICTs, particularly the Internet and computers, could lead

to a digital divide among the new generations (OECD, 2002). These predictions have been confirmed in our country twenty years later, where digital disconnection is considered a new 21st century analphabetism, highlighting Internet access and access to at least one computer as a fundamental condition for not falling behind the rest of the community (Fundación Foessa, 2022). According to the OECD report 'Empowering Young Children in the Digital Age' the digital divide among children can be addressed from an early age (OECD, 2023).

This digital divide can be addressed by 3 types: 1. The first digital divide refers to inequalities in access to digital technologies. 2.- The second digital divide refers to the competencies for the use of digital technologies by minors. 3.- Finally, a third social divide, which is emerging, relates to differences in off-line returns to the use of digital technologies between individuals, despite similar access and usage patterns. The main idea is that digital technologies make it easier to connect and thus make better use of social capital. However, this third digital divide is less relevant in the context of minors because of the compensation of their participation in the education system, which minimises this risk. Alderete and Formichella indicated in 2016 that unequal access to technologies affects AP, with higher achievement among students who use ICT. However, García-Martín and Cantón-Mayo, three years later, in 2019, commented on the complexity of such a relationship, because it will depend on the training received and the way it is used. This debate highlights the uncertainty as to whether greater access to ICT and more time spent using the Internet among secondary school students necessarily translates into an improvement in AP (Giménez-Gualdo et al., 2014).

Access to ICTs, number of Internet hours connexion and UPV in AP

Access to ICTs and their relationship with adolescent AP is a relevant issue in today's digitalised society. Previous studies, such as the one by Martínez-Garrido in 2018, pointed out this close relationship in our country. The new proposals for the integration of ICT in the educational context require reflection and analysis of their consequences on the academic progress of Secondary and Bachelor students (García-Martín & Cantón-Mayo, 2019). The OECD (2023) highlights the importance of empowering adolescents in this challenge of digital evolution, considering that ICT use modulates academic success, especially about the frequency of use as a work resource.

In this direction, the concern becomes evident, not only at a strictly psycho-educational level, but also at a social level, because academic success conditions the individual development of the adolescent, where the connection to the digital world (number of hours of Internet access 'sensu stricto') can support AP, but at the same time, can constitute a threat to it (García-Gil et al., 2022). Technological

resources, such as video games, continue to receive attention due to their impact on entertainment, business, and gamification-based educational methodologies (Roa et al., 2021). However, the frequent use of technological devices by adolescents can lead to problematic use, disrupting their daily routines and academic agenda (Sánchez & Benítez, 2022a). It has also been linked to lower AP, mental health difficulties (García-Gil et al., 2023), and aggressive behaviour (Bushman, 2016). Other studies show how moderate video game use can bring benefits to students, improving their concentration, improvements in cognitive states, visual attention, spatial skills and perception, ability to take initiative, as well as executive functions (Blair, 2017).

The present study

The present study takes the first digital divide as a reference, choosing the variables highlighted by the OECD (2002, 2023) and FOESSA (2022): having a computer, having access to the Internet at home, and daily Internet connection time, which previous research claims as necessary for future studies (Zhang et al., 2018). In turn, due to the wide reach of mobile phones in our country, the condition of having or not having a mobile phone is added as a complementary variable to those already proposed. In addition to these highly relevant variables, the authors of this research also wanted to analyse another condition of current interest: Problematic Video Game Use (PVU).

Aims and hypotheses of the study

O.1.— To examine whether there are differences in PVU depending on whether students have a mobile phone, computer, Internet access at home, and the number of hours they spend connected to the Internet daily. -H1. Students who own a mobile phone are more likely to have a higher PVU than those who do not have access to a mobile phone. -H2: Pupils who own a computer are more likely to have higher PVU than those who do not have access to a computer. H3: Students who have access to the Internet at home are likely to have higher PVU scores than those who do not. -H4: Students who spend more time online each day are likely to have higher PVU than those who spend less time online.

O.2.— To assess the presence of correlations between the dimensions of the Video Game Related Experiences Questionnaire (QERV; CERV in Spanish) and AP. H1. There will be a negative and significant correlation between the *psychological dependence* and *avoidance dimension* of the CERV and the AP. H2. There will be a

negative and significant correlation between the negative consequences dimension of the CERV and the AP.

O.3.— To explore using a two-stage cluster whether there are distinctive profiles among Secondary and Bachelor students, based on their PVU and their access or not to a computer, a mobile phone, the Internet at home, and the number of hours of daily connection to the Internet. - H1: There will be different profiles among students depending on the variables set out in aim two.

O.4.—To analyse the relationship between the profiles obtained in aim two and the AP in Mathematics and Language. - H1: There will be significant differences in Mathematics AP depending on the profile obtained in O.2. H2. There will be significant differences in Language and Literature AP depending on the profile obtained in O.2.

METHOD

Participants

A sample of 1448 compulsory secondary education (ESO in Spanish) and bachelor students (high school; Bachillerato in Spanish) was selected, including 740 females (51.10%) and 708 males (48.90%), with an average age of 14.5 years (*SD* = 1.57), from 8 schools in the provinces of Cáceres and Badajoz (Extremadura; Spain). We used non-probabilistic purposive sampling for the selection of participants. 51.8% of the students were located in rural environments, while the remaining 48.2% were located in urban environments. 53.7% of the selected students came from public schools, while 46.3% came from a state-subsidised school; 22% belonged to 1st ESO, 21.8% to 2nd ESO, 20% to 3rd ESO, 21.9% to 4th ESO and 14% to high school. The students surveyed answered satisfactorily all the questions.

Instruments

Firstly, an ad hoc questionnaire was drafted to collect data related to participants' Internet access. This questionnaire included specific questions that provided key information regarding: whether they had a mobile phone 'Do you have a mobile phone?', a computer at home 'Do you have a computer or laptop at home?', whether they had Internet access at home 'Do you have Internet access at home?', with a binary answer (yes/no), and how many hours they spent online each day 'How much time do you spend online?' with the response options: *Less than 1 hour, Between 1 and 3 hours, Between 3 and 5 hours, and More than 5 hours.*

To measure AP, the average grade obtained in the compulsory areas of Mathematics and Language and Literature in the 2018-2019 academic year was taken. These grades were indicated by the students themselves in the Rayuela Platform through the anonymous questionnaire, in accordance with previous studies (Fajardo-Bullón et al., 2017; García-Martín & Cantón-Mayo, 2019). Confidentiality and anonymity were ensured, in full compliance with current data protection and children's rights regulations, which would not have been possible if the data had been provided by the educational centres. This variable has been used in several studies as a representative and valid measure of AP (Fajardo-Bullón et al., 2017; García-Martín & Cantón-Mayo, 2019; Martínez-Garrido, 2018). In addition, the PISA report, which is based on the assessment of three subjects in Compulsory Secondary Education (ESO): Mathematics, Language and Literature, and Science, was used as a reference for the selection of the subjects to be assessed. In our study, Mathematics and Language and Literature were specifically chosen because of their compulsory presence in all the ESO and Bachillerato grades analysed. This choice was made in order to avoid external variables, such as the weight of the subject in the Baccalaureate Assessment for University Entrance (EBAU) or each student's choice of pathway.

The Video Game Related Experiences Questionnaire (CERV in Spanish) (Chamarro et al., 2014) measures the PVU. It is composed of 17 questions with four response options on a Likert scale from 1 (almost never) to 4 (almost always). It presents two factors: the first one is called 'psychological dependence and avoidance'. It consists of 8 items assessing the following constructs: worry, denial, avoidance, and desire to gamble (α=.841). The second factor is called 'negative consequences. It consists of 9 items assessing the following constructs: increased tolerance, reduced activities, and negative effects (α= .768), with good overall scale reliability (α=.89). The results of the questionnaire were satisfactory, demonstrating good overall reliability in this study (α= .89).

Procedure

First of all, a request was made to the Provincial Delegation of Education of the Regional Government of Extremadura in the provinces of Cáceres and Badajoz in order to collect the number of schools and students enrolled in ESO and Bachillerato (Bachelor in English). Eight schools were randomly selected from the total list of existing schools. The 8 schools agreed to participate in the study. Once the centre had been selected and allowed to be present at their facilities, the questionnaires were handed out in paper format to all the pupils in each of the 8 selected centres. If there was more than one group per year (e.g. a, b and c), one was chosen at random. Beforehand, parents and students were asked for

permission and informed about the aims of the research. They were assured of the privacy of the data collected and their exclusive use in the context of the research. The questionnaires were collected in person, depending on the time available at each school, and lasted approximately 10-15 minutes. During the completion of the questionnaires, at least one researcher was present to answer any questions together with a teacher from the school. The questionnaires were collected in 2018 with a criterion of voluntariness and confidentiality following the ethical principles of the American Psychological Association (APA, 2017).

Statistical analysis

This study developed a descriptive, correlational, cross-sectional design. Because the study variable was quantitative, continuous, and met the requirements of normality (Kolmogorov-Smirnov > .05) and homoscedasticity (Levene > .05), parametric tests were performed. Furthermore, these tests were applied in accordance with the Central Limit Theorem (CLT), which suggests their use in large samples, as in this case with 1448 adolescents (Pek et al., 2018). To analyse the first, second and third hypotheses of aim one, the student's t-test for independent samples was used. Subsequently, to study differences in PVU as a function of daily Internet connection time, a robust one-factor ANOVA was implemented. This technique was applied for hypothesis 4 of aim one, using Welch's method, which is suitable for working with heterogeneous variances. Post hoc multiple comparisons were performed using the Games Howell procedure.

Secondly, for hypothesis 1 of aim two, a two-stage clustering was used. This analysis offers an automated methodology to determine the optimal number of clusters, including both categorical and continuous variables (Rubio-Hurtado & Vilà-Baños, 2017). Categorical variables were included in the cluster such as 'having or not having a mobile phone', 'having or not having Internet at home', 'having or not having a computer (laptop or fixed) at home' and 'daily Internet connection time', from less than 1 per day to more than 5 hours per day. PVU was incorporated as a continuous quantitative variable. The model obtained satisfies the principles of independence and normality for the continuous variable, as well as for categorical qualitative variables that have a multinomial distribution. Even if these assumptions were not met in principle there are no problems because as Rubio-Hurtado and Vilà-Baños (2017, p.20) "Internal empirical checks indicate that this procedure is quite robust, even when these conditions are not met". The log-likelihood measure was applied to assess the distance between clusters, and the Bayesian Schwartz criterion (BIC) was used to identify the number of clusters. To avoid ordering effects, a random assignment of cases was performed. The results showed a satisfactory model consisting of 5 clusters.

Finally, for the analysis of Hypothesis 1 of aim three, a one-factor cluster ANOVA on AR was performed.

RESULTS

The descriptive statistics of the sample are shown below (see Table 1) and the statistical analyses previously described are carried out for each of the hypotheses of the study.

Table 1
Frequency of Internet use and access to technological resources among adolescents

		n	***%***
Having a mobile phone	Yes	1414	97.7 %
	No	34	2.3 %
Having a computer at home	Yes	1362	94.1 %
	No	86	5.9 %
Internet access at home	Yes	1408	97.2 %
	No	40	2.8 %
Internet connection time	Less than 1 hour	166	11.5 %
	Between 1 and 3h.	552	38.3 %
	Between 3 and 5h.	393	27.3 %
	More than 5 hours	331	23 %

The first study hypothesis explored PVU scores in relation to having (M = 24.86) or not having a mobile phone (M = 25.08). The results of Student's t-test for independent samples showed no significant difference in UPV according to mobile phone ownership or not (t_{1445} = -0.170, p = 0.865, d = 0.224).

Likewise, the results showed no significant differences (t_{1445} = 1.39, p = 0.165; d = 0.219) between those who had Internet at home and those who did not.

Finally, the results on having a computer at home and its influence on PVU showed that there is no significant difference in PVU (t_{1444} = 0.204, p = 0.838, d = 0.02).

However, the results of the study indicate that daily time spent on the Internet had a significant effect on PVU. Welch's robust one-factor ANOVA showed statistically significant differences in PVU as a function of Internet connection time

($F_{3, 578}$ = 6.367, p < .001, η2= 0.015). Post hoc multiple comparisons were performed using the Games Howell procedure (see Table 2).

Table 2

Comparison of PVU average values according to Daily Internet Connection Time

	M	*DT*	*Comparación*	*DM*	*p*	*IC 95%*
G1	23.21	7.08	***G1-G2***	-1.47	0.088	[-3.09, 0.14]
G2	24.68	7.03	***G1-G3***	-1.38	0.179	[-3.13, 0.37]
G3	24.59	7.87	***G1-G4***	-3.19	< .001**	[-5.1, -1.28]
G4	26.40	9	***G2-G3***	0.1	0.997	[-1.18, 1.38]
			G2-G4	-1.72	0.017*	[-3.21, -0.22]
			G3-G4	-1.81	0.023*	[-3.45, -0.18]

Note. G1=Less than 1 hour; G2= Between 1 and 3h. G3= Between 3 and 5h. G4=More than 5 hours. *M* = Mean, *SD* = Standard Deviation, *MD* = Mean Difference, *p* = p-value adjusted by Games Howell, *p < .05, **p < .01.

Statistically significant differences were observed between those who logged on for less than 1 hour and those who logged on for more than 5 hours; between those who logged on for 1-3 hours and those who logged on for more than 5 hours; and between those who logged on for 3-5 hours and those who logged on for more than 5 hours. Those who logged on for more than 5 hours had a higher PVU score compared to the other 3 groups.

For the second aim, a correlational analysis was carried out using Pearson's correlation (because the assumption of normality in the data is met), between the students' AP in each of the studied subjects (Language and Mathematics) and both dimensions of the CERV. An inverse and significant relationship was found between psychological dependence and avoidance and AP in both, the Spanish Language and Literature (with a bilateral significance level of .01 and r = -0.115) and Mathematics (with a bilateral significance level of .01 and r = -.078). Likewise, in the negative consequences dimension, r =- .159 was obtained in the case of Spanish Language and Literature and r =- .109 in Mathematics, both with a bilateral significance level of .01.

For the third aim, a two-stage clustering was performed. The model obtained from five clusters is satisfactory/good, with a cluster goodness of fit value of .6 out of 1. To corroborate these findings, a modified version of the test was carried out, in which the subjects were rearranged in the matrix, and the results were equally satisfactory (Rubio-Hurtado & Vilà-Baños, 2017). In this model, the weight of the variables is varied: the data collected in the two-stage cluster point to Internet

connection time as the most influential in the formation of clusters 1 out of 1 (χ_{12} = 3809.47, p < .001), followed by having a computer at home (χ_4 = 915.94, p < .001) with a predictor of .8 out of 1, having access to the Internet (χ_4 = 330.48, p < .001) with an influence of .6 out of 1, having a mobile phone (χ_4 = 282.26, p < .001) with a significance of .4 out of 1, and finally, the PVU with an influence of .2 out of 1. The characteristics of each of the 5 groups of students obtained are described below:

Cluster 1: In this group of 511 adolescents (35.5%), all individuals own a mobile phone, a computer, have access to the Internet at home, and go online between 1 and 3 hours per day. The average UPV in this group is 24.72. This grouping will be referred to as '*Adolescents with Digital Resources with Medium connection and Moderate use of Video Games*'.

Cluster 2: This group is made up of 129 teenagers (9%), all of whom have a mobile phone, computer, Internet connection at home and connect to the Internet less than 1 hour a day. The average in PVU in this group is 23.36. This cluster will be called '*Adolescents with Digital Resources, Low Connection and Moderate use of Video Games*'.

Cluster 3: This cluster consists of 141 adolescents (9.8%). 78.7% have a mobile phone, 44% have a computer, 75.2% have Internet access at home and connect to the Internet between 1 and 3 hours per day. The average PVU in this group is 24.72. This cluster will be called '*Adolescents with Less digital resources with Medium connection and Moderate use of Video Games*'.

Cluster 4: This group includes 362 adolescents (25.1%), with digital resources such as mobile phone, computer and Internet connection at home, using the Internet between 3 and 5 hours per day. The PVU in this cluster is moderate with an average of 24.54. This cluster will be referred to as '*Adolescents with Digital Resources and High Connection, and Moderate use of Video Games*'.

Cluster 5: This group consists of 297 adolescents (20.6%). The students have a mobile phone, computer, Internet access at home, and connect to the Internet for more than 5 hours a day. The average PVU in this group is 26.29. This cluster will be called '*Adolescents with Digital Resources and Maximum connection, as well as High use of Video Games*'.

The following table 3 shows the analysis comparing the means of AP in Mathematics for the different clusters obtained. In addition, Table 4 compares the means of the AP in Language between the same clusters mentioned above.

Table 3

Comparison of AP Mathematics means between the different types of clusters

	M	*DT*	*Comparación*	*DM*	*p*	*IC 95%*
1	6.97	2.05	***1-2***	-0.16	0.932	[-0.72, 0.39]
2	7.13	1.98	***1-3***	1.39	< .001**	[0.85, 1.92]
3	5.58	2.27	***1-4***	0.16	0.785	[-0.22, 0.55]
4	6.81	1.98	***1-5***	0.68	< .001**	[0.27, 1.09]
5	6.30	2.09	***2-3***	1.55	< .001**	[0.87, 2.24]
			2-4	0.32	0.545	[-0.25, 0.90]
			2-5	0.84	< .001**	[0.25, 1.44]
			3-4	-1.23	< .001**	[-1.79, -0.67]
			3-5	-0.71	.007**	[-0.13, -1.28]
			4-5	0.52	< .011**	[0.08, 0.96]

Note. *M*=Mean, *SD*= Standard deviation, *DM*=Mean difference, *p*=p-value adjusted by Games Howell, **p*<.05, ***p*<.01.

Table 4

Comparison of means of AP in Language between the different cluster types

	M	*DT*	*Comparación*	*DM*	*p*	*IC 95%*
1	7.14	1.84	***1-2***	-0.24	.687	[-0.75, 0.26]
2	7.38	1.80	***1-3***	1.13	< .001**	[0.64, 1.62]
3	6.01	2.07	***1-4***	0.15	.795	[-0.21, 0.50]
4	6.99	1.82	***1-5***	0.77	< .001**	[0.39, 1.15]
5	6.37	1.98	***2-3***	1.37	< .001**	[0.75, 2]
			2-4	0.39	.263	[-0.14, 0.92]
			2-5	1.01	< .001**	[0.47, 1.56]
			3-4	-0.98	< .001**	[-1.5, -0.47]
			3-5	-0.36	.336	[-0.89, 0.17]
			4-5	0.62	< .001**	[0.22, 1.03]

Note. *M*=Mean, *SD*= Standard deviation, *DM*=Mean difference, *p*=p-value adjusted by Games Howell, **p*<.05, ***p*<.01.

To produce the figures, the mean scores obtained in the analysis were presented. In addition, a post hoc analysis was used to identify categories with no significant differences between their mean scores. These categories were represented in the figures by the inclusion of circles grouping them together. Figure 1 shows the means of AR in Mathematics as a function of cluster, while Figure 2 shows the means of AR in Language as a function of cluster.

Figure 1

Mathematics AP as a function of Cluster

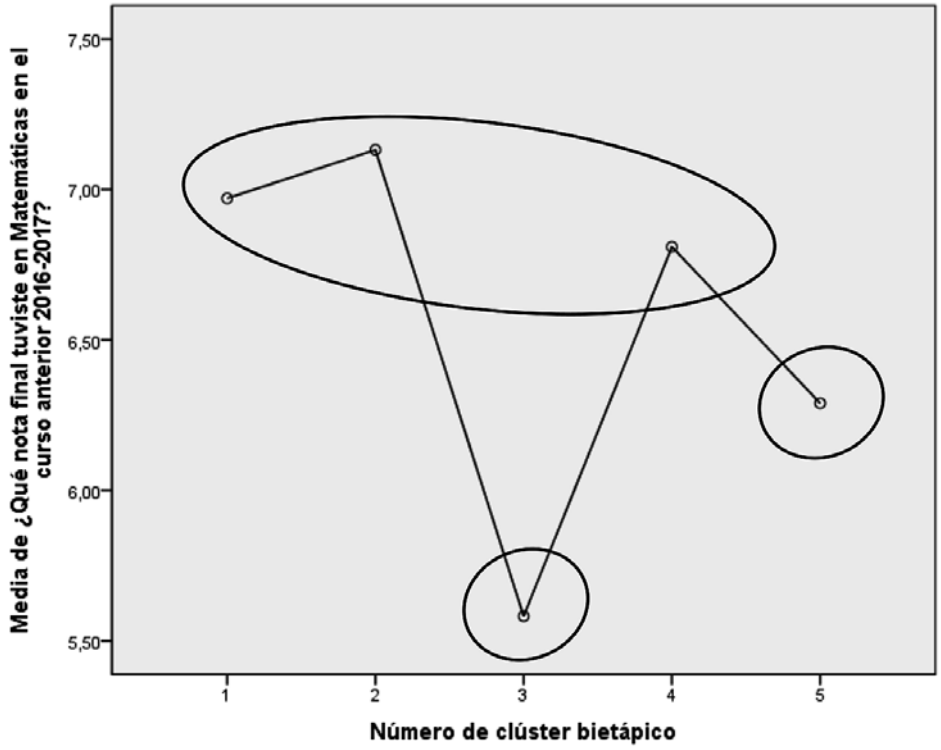
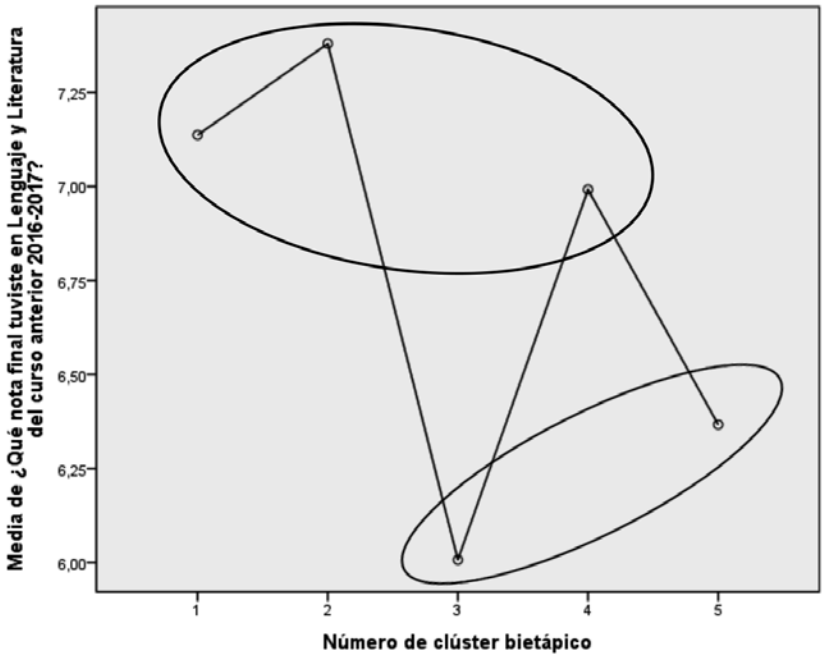


Figure 2
Average Language AP as a function of Cluster



DISCUSSION AND CONCLUSIONS

The aims of the research were: (1) to examine the differences in problematic video game use according to access to computers, mobile phones, as well as Internet access and daily connection time; (2) to evaluate the presence of correlations between the dimensions of the CERV and AP; (3) to explore the existence of possible adolescent profiles according to access to digital resources, connection time and problematic video game use, and (4) to analyse the relationship between the profiles obtained and AP in Mathematics and Language.

Based on the results, no significant differences were found in the PVU score in relation to ownership of a mobile phone and access to a computer at home. Thus, the first two hypotheses of the first aim are rejected (H1. Pupils who own a mobile phone are likely to have higher PVU than those who do not have access to a mobile phone, and H2: Pupils who own a computer are likely to have higher PVU than those who do not have access to a computer). Therefore, it seems that, although there has

been an increase in adolescent screen use in recent decades (Thomas et al., 2020), problematic video game use will not be affected by having a mobile phone and/or computer available. Similarly, the results of the present study showed no significant differences in PVU scores in relation to Internet access at home (H3: Students who have Internet access at home are likely to have higher PVU scores than those who do not). However, the fourth hypothesis was confirmed (H4: Students who spend more time connected to the Internet daily are likely to have higher PVU than those who spend less time connected to the Internet). Based on the obtained results, it seems that it is the time spent online for more than 5 hours that most significantly affects the PVU. These results agree with previous studies by Mora-Salgueiro et al. (2022) who also found a positive relationship between Internet connection time and the risk of developing PVU in adolescents. In this direction, research such as Ruiz-Palmero et al. (2016) suggests that excessive use of online games or entertainment apps on mobile phones may be associated with problematic mobile phone use. This would be relevant to focus studies not so much on access to resources (mobile, computer, Internet) but on their proper use and control of their connection times. Therefore, it would be advisable to pay attention to the second digital divide proposed by the OECD (2023), by teaching skills to adolescents that allow them to control their connection time, prevent the problematic use of video games and the difficulties associated with this use in areas such as mental health and emotional well-being (Fajardo-Bullon et al., 2019; García-Gil et al., 2022).

Concerning the second aim, the existence of an inverse correlation between both scales, the CERV and the AP in Spanish Language and Literature, as well as the AP in Mathematics, was corroborated. These results agree with Herrera et al. (2019), who indicate the existence of different characteristics of the video game that could make it more or less harmful for the adolescent depending on the time of use.

Regarding the third aim, five types of student clusters were identified. The variable with the greatest weight is the number of hours of Internet connection, followed by having a computer and Internet access at home, with PVU being the variable with the least weight in the classification. Therefore, it seems that, although access to resources is essential, the number of hours spent on the Internet per day carries the most weight when category students. In the same way as the OECD (2023), we find a group that could be related to the first digital divide among the clusters. The so-called '*Adolescents with fewer digital resources, with medium connection and moderate use of video games*' (cluster 3) are particularly characterised by having fewer digital resources than the rest. In turn, we obtain another group that could be related to the second digital divide, the group called '*Teenagers with Resources, with Maximum connection and High use of Video Games*' (cluster 5) which is characterised by those who misuse the Internet with

an excessive number of hours of connection and high scores in PVU. In this regard, the model is adequate allowing us to confirm the study hypothesis (H1: There will be different profiles among students depending on their PVU, their access or not to a computer, a mobile phone, the Internet at home and the number of hours of daily connection to the Internet). This classification of adolescents allows us to understand the significance of looking at the studied variables in a grouped way. It is vital to highlight the weight of the number of hours of daily Internet connection as a key variable when classifying students. In previous studies, this variable has already been considered relevant for the well-being of Spanish children, especially when the threshold of 5 hours of connection per day is exceeded (Fajardo-Bullon et al., 2019). However, it had not yet been analysed jointly in a cluster with problematic video game use. In this way, thanks to the analysis carried out, we will be able to preventively attend to groups of students who may have difficulties depending on the presence of the variables studied, paying special attention to the number of hours online per day.

Finally, with regard to objective four, the two hypotheses put forward (H1: There are significant differences in Mathematics AP according to the profile obtained in O.3. There are significant differences in Language AP as a function of the profile obtained in O.3.) According to the graphs in this study, Cluster 3 '*Teenagers with fewer digital resources, with medium connection and moderate use of video games*' and Cluster 5 '*Teenagers with digital resources, with maximum connection and high use of video games*' are the ones with the worst scores in Mathematics and Language AP compared to the rest. The results show that adolescents either with fewer digital resources or with a high Internet connection (more than 5 hours) are the most disadvantaged in AP. However, clusters with moderate Internet use obtain better scores in AP. These results coincide with those obtained in the study by López-Agudo and Mancenaro-Gutiérrez (2020), which show the positive effect of moderate ICT use on Mathematics AP, and other previous studies that indicate that the video games use, does not in itself imply a decrease in AP at school, although it may affect adolescents' attention (Drummond & Sauer, 2015).

On the other hand, clusters 1, 2, and 4 have similar AP scores in both subjects, Language and Literature and Mathematics. Cluster 2, however, with Internet connections of less than one hour, has higher AP scores (although not statistically significant). If we conduct an analysis by subject, Mathematics shows higher results in the clusters of adolescents who have access to digital resources, moderate scores in the use of video games and, above all, moderate daily Internet connection time. This is followed by lower scores for those clusters with resources and an Internet connection of more than 5 hours, and finally, in a differentiated way, for the group with less access to digital resources. These results could be useful to understand why, when digital resources are used in schools with moderate time connection

and video games use and accessible digital resources, Mathematics scores may improve, or, conversely, may suffer if their connection time is excessive (García-Martín & Cantón-Mayo, 2019; Islam et al., 2020; Martínez-Garrido, 2018). Regarding the subject of language, again, groups of adolescents who have access to digital resources, moderate scores in the use of video games, and mostly a moderate amount of time spent online obtain better scores. Thus, the educational approach focused on digital competence and the use of technologies can have benefits in terms of connectedness, as long as a balance and moderate use of resources is maintained (Blair, 2017). However, in contrast to Mathematics (see Figures 1 and 2), both, the cluster with fewer resources and the cluster with an excess of connection obtained similar, but lower, scores compared to the other groups. Some studies suggest that adolescents' daily Internet use is not so much focused on academic activities as on more recreational and social use (Álvarez-de-Sotomayor et al., 2022). In this sense, previous studies show how the lack of access to resources can generate a psychosocial impact on minors that can have effects on AP in Language and Mathematics (García-Gil et al., 2022). Likewise, higher scores in the PVU or in the number of hours connected to the Internet may be influencing adolescent adjustment, affecting their AP and psychosocial development (García-Gil et al., 2023; Moge & Romano, 2020).

Analysing the results, it seems that not having digital resources or having them, but not having the skills to control the excessive number of hours of connection and the PVU, may be fundamental determining factors in guaranteeing a child's good academic development. In the first case concerning access to resources, the TALIS report (2018) showed how insufficient access to the internet and the scarcity or inadequacy of digital technology for play and learning (e.g. computers, tablets, smartboards) hinder the provision of a quality environment for development, well-being and learning in school. This has recently been supported by OECD studies (2023) and furthermore in Spain by the FOESSA Foundation report (Fundación Foessa, 2022).

In the second case, related to the number of connection hours and PVU, it seems essential to have adequate digital skills that can limit the number of hours of connection. This information is in relation to previous studies that show a significant deterioration in children's development after 5 hours of daily Internet use (Fajardo-Bullon et al., 2019) or the impact that problematic video game use can have on children's mental health (Gonzálvez et al., 2016). In reference to AP, excessive daily Internet use, highlighting its non-academic use, will have a negative impact on their weekly learning time and AP (Gómez-Gonzalvo et al., 2020; Zhang et al., 2018) as well as on their mental health (Sánchez & Benítez, 2022b), which may in turn influence the child's AP (García-Gil et al., 2022).

Finally, it is important to highlight some limitations of the present study. The self-report method was used to collect information, which may be associated with social desirability bias. However, the sample size used in the research helped to mitigate this potential bias (Kraushaar & Novak, 2010). Another limitation is that the data collection is from 2019 and circumstances may have changed in recent years. Future research proposes to update these results after the Covid-19 pandemic to determine whether they are maintained or changed. In addition, it seems necessary to research in detail the type of video games that students use to extend the results (López-Agudo & Mancenaro-Gutiérrez, 2020). In turn, it would be interesting to make a series of psychoeducational recommendations both for the educational centres themselves and to train families, in these new digital needs of their adolescent children (Sánchez & Benítez, 2022a), as well as to carry out gender-differentiated studies.

Finally, this paper shows the significance of joint attention to relevant variables such as access to digital resources, problematic video game use and daily Internet connection. It also tries to show how these variables can correctly classify students in ESO and Bachillerato and thus determine their joint impact on Language and Mathematics AP. The study shows how access to resources is important for academic performance, which is why educational policies should focus on universal access to technologies for equal opportunities. In turn, in an increasingly digitalised environment, it is essential that such education policies address the second digital divide (OECD, 2023), which focuses on the adequate training and education of children in digital skills. Therefore, it is not only a question of access to digital resources, but also of the user's ability to at least control their daily connection time and manage content. In this sense, it should be ensured that the adolescent never equals or exceeds 5 hours of daily Internet connection, regardless of the devices used during the day.

ACKNOWLEDGEMENTS

Fernando Fajardo-Bullón received support for this study thanks to the Ayudas José Castillejo and the Ayudas a la Recualificación del Profesorado Universitario from the Ministerio de Universidades. Spanish Government.

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