universidad de León

TESIS DOCTORAL

LOS DETERMINANTES PSICOEDUCATIVOS DE LA ALFABETIZACIÓN DIGITAL EN LA EDUCACIÓN SUPERIOR REVISIÓN SISTEMÁTICA, ESTUDIOS DE VALIDACIÓN, MULTIVARIADOS Y DE MEDIACIÓN CAUSAL

THE PSYCHOEDUCATIONAL DETERMINANTS OF DIGITAL LITERACY IN HIGHER EDUCATION A SYSTEMATIC REVIEW, VALIDATION, MULTIVARIATE AND CAUSAL MEDIATION STUDIES

Programa de Doctorado en Psicología Educativa y Ciencias de la Educación
Realizada por Dña. Nieves Gutiérrez Ángel
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Escuela de Doctorado de la Universidad de León

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A mi madre

Agradecimientos

Llegados a este momento, me toca dar la gracias a todas las personas que me han acompañado en este camino:

Al Doctor Jesús Nicasio García Sánchez por su disponibilidad desde el minuto uno, por aceptar esta propuesta, por guiarme y enseñarme que en este mundo académico nunca se deja de aprender.
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PRESENTACIÓN

La tesis doctoral que se presenta, ha sido realizada en la Universidad de León dentro del Programa de Doctorado en Psicología Educativa y Ciencias de la Educación tal y como se establece en el Real decreto 99/2011, de 28 de enero, por el que se regulan las enseñanzas oficiales de doctorado, y el Reglamento de las Enseñanzas Oficiales de Doctorado y del Título de Doctor de la Universidad de León.

De acuerdo con este reglamento, también se han desarrollado las distintas acciones formativas de carácter obligatorio para poder autorizarse la defensa de la tesis, con el objetivo de favorecer la capacitación docente e investigadora de los estudiantes. Estas actividades, incluyen la participación en al menos tres seminarios de doctorandos y congresos internacionales, la celebración de un mínimo de doce reuniones con los directores de tesis y cinco con el equipo de investigación, el desarrollo de diferentes tipos de actividades de gestión y evaluación de la investigación científica, la realización de una movilidad o colaboración externa con un grupo o grupos de investigación nacionales o internacionales, y la publicación de un mínimo de tres manuscritos en revistas de alta calidad, donde uno o más de ellos debe estar indexado en JCR y otros dos en bases de datos conocidas como SCImago, In-RECS, Google Scholar Metrics, Scopus, Dialnet Métricas o SPI.

Concretamente, en relación a estas actividades, el autor de la tesis ha participado en un total de 5 congresos internacionales y 23 Planes Anuales de Evaluación de la Actividad Investigadora/Seminarios de Doctorandos, siendo aprobados todos los méritos presentados en dichas evaluaciones por los miembros de la Comisión Académica del Programa de Doctorado.

Entre dichos méritos, se hayan certificadas su asistencia a un gran número de reuniones con los directores de tesis y miembros del equipo de investigación; el desarrollo de todo tipo de actividades de gestión y evaluación de la investigación científica tales como ser revisora de artículos de revistas indexadas en el JCR, distintos cursos de metodología dela investigación, o la participación en proyectos de investigación. Así como Estancias de Investigación.

Con el permiso del Comité Científico del Programa de Doctorado y del Director de Tesis el doctorando realizó una estancia de investigación de tres meses en el Instituto Politécnico de Educación (Coímbra, Portugal), dónde continuó desempeñando tareas propias del trabajo de investigación para el que fue contratado.

Por último, con relación a la publicación de un mínimo de tres artículos científicos en revistas de alto nivel, la presente tesis incluye 8 manuscritos, 1 de los cuales han sido publicados en Frontiers in Psychology (revista indexada en Q1 en JCR, con factor de impacto: 4.232), 1 publicado en International Journal of Environmental Research and Public Health (revista indexada en Q1 en JCR, con factor de impacto: 4.614), 1 publicado en Sustainability (revista indexada en Q1 en SJR, con factor de impacto: 3.889), y otros 5 capítulos en libro en Editorial Dykinson (SPI Q1).

A continuación, se presenta la tesis cuya estructura responde a los siguientes apartados: introducción, marco teórico, metodología, resultados, discusión, conclusiones, limitaciones y prospectiva. Por su parte, en la introducción se presenta el estado del arte, estableciendo la hipótesis y los objetivos, constituyendo el marco teórico la revisión de antecedentes empíricos que sustentan los estudios e investigación desarrollada. El apartado de metodología aborda una descripción detallada del instrumento empleado para alcanzar los objetivos planteados. Los resultados muestran los hallazgos obtenidos con relación a la revisión sistemática efectuada, y los beneficios, satisfacción y limitaciones. Por último, las conclusiones generales de la tesis doctoral se aportan tanto en inglés como en español, en respuesta al carácter internacional del trabajo, y se presentan junto a las limitaciones de los resultados obtenidos y prospectiva futura. Se incluye un apartado con los manuscritos de las publicaciones que conforman el trabajo, otro con las referencias, un abstract/resumen de la tesis, y anexos

RESUMEN

Introducción

La educación puede impartirse en cualquier área curricular, y las TIC se postulan como un recurso que puede asegurar su implementación. Por tanto, es fundamental hablar de alfabetización digital, entendida como una competencia multiárea en relación con el uso de la tecnología digital, que implica acciones como la capacidad de un sujeto para analizar, componer y originar contenidos digitales, resolver problemas digitales, comunicarse e interactuar con otros de una manera segura y apropiada

Contribuciones

En el primer capítulo se realiza una revisión sistemática del estado de la cuestión, analizando los estudios empíricos en el ámbito universitario. El cual analiza la evidencia empírica que arrojan los estudios internacionales de 2010 a 2021 relacionados con la alfabetización digital de los estudiantes universitarios, incluidos aquellos que cursan carreras afines al ámbito educativo (Gutiérrez-Ángel et al., 2022a).

El segundo capítulo analiza el uso que los jóvenes españoles hacen de Internet y de los dispositivos digitales fuera de la escuela, el tiempo que los usan y sus actitudes hacia el uso de los dispositivos digitales. E identifica los efectos del uso de Internet y los dispositivos digitales en las redes sociales y las relaciones interpersonales (Gutiérrez-Ángel et al., 2022b).

El tercer capítulo parte de la hipótesis de que la mejora de la competencia digital tiene un impacto positivo en el uso que se hace de las TIC y también en su correlación con el desarrollo sostenible. Fruto de estas aportaciones surge el tercer estudio en el que se analizan los recursos, el disfrute y las experiencias digitales, y la alfabetización y las competencias digitales en los países de España, Portugal, Brasil y Colombia (Gutiérrez-Ángel et al., 2022c).

Conclusiones

En conclusión, esta tesis doctoral muestra que la alfabetización digital es un elemento inherente a la sociedad actual. En lo cual debe estar vinculado al desarrollo de la

sustentabilidad de los países a través de su formación y educación. Las principales aportaciones de esta tesis doctoral muestran la relevancia del tratamiento de esta temática desde la formación inicial de los futuros docentes, así como en colectivos como el de los adolescentes, en cuanto al uso de Internet y de los dispositivos digitales fuera de la escuela. , el tiempo que los usan y sus actitudes hacia el uso de dispositivos digitales, los recursos digitales disponibles, el disfrute y las experiencias digitales, y la alfabetización y habilidades digitales en los países de España, Portugal, Brasil y Colombia.

ABSTRACT

Background

Education can be imparted in any curricular area, and ICTs are postulated as a resource that can ensure their implementation. Therefore, it is essential to speak of digital literacy, understood as a multi-area competence in relation to the use of digital technology, which implies actions such as the ability of a subject to analyze, compose and originate digital content, solve digital issues, communicate and interact with others in a safe and appropriate manner

Contributions

In the first chapter, a systematic review of the state of the matter is carried out, analyzing the empirical studies in the university field. Which analyzes the empirical evidence provided by international studies from 2010 to 2021 related to the digital literacy of university students, including those who pursue careers related to the educational field (Gutiérrez-Ángel et al., 2022a).

The second chapter analyzes the use that young Spanish people make of the Internet and digital devices outside of school, the time they use them and their attitudes towards the use of digital devices. And it identifies the effects of the use of the Internet and digital devices on social networks and interpersonal relationships (Gutiérrez-Ángel et al., 2022b).

The third chapter starts from the hypothesis that the improvement of digital competence has a positive impact on the use made of ICT and also on its correlation with sustainable development. As a result of these contributions, the third study emerges in which it analyzes the resources, enjoyment and digital experiences, and literacy and digital skills in the countries of Spain, Portugal, Brazil and Colombia (Gutiérrez-Ángel et al., 2022c).

Conclusions

In conclusion, this doctoral thesis shows that digital literacy is an inherent element of today's society. In which it must be linked to the development of the sustainability of the countries through their training and education. The main contributions of this doctoral thesis show the relevance of the treatment of this subject from the initial training of future teachers, as well as in groups such as adolescents, in terms of the use of the Internet, and digital devices outside of school. , the time they use them and their attitudes towards the use of digital devices, the digital resources available, the enjoyment and digital experiences, and digital literacy and skills in the countries of Spain, Portugal, Brazil and Colombia.

INTRODUCCIÓN

Desde que Zurkowski (1974) definiera por primera vez el concepto de alfabetización digital como una destreza para analizar, situar y examinar la información son muchas las aportaciones que han surgido después, las cuales han pretendido aunar estas destrezas al acceso, evaluación y manejo de la información a la hora de aprender de manera digital a leer, a escribir, o el uso efectivo de las tecnologías a nivel personal, social y profesional. En la actualidad podemos afirmar que nos referimos a un concepto con diversas vertientes: entre las que se encuentran la vertiente tecnológica, la vertiente informativa y multimedia, y la vertiente comunicativa. Y se corresponde, por tanto, con un proceso completo y de alfabetizaciones múltiples, que implica procesos técnico-procesales, cognitivos y socioemocionales (Lim & Newby, 2021; Valverde et al.,2022).

En definitiva, la alfabetización digital o *digital literacy*, se refiere a una competencia genérica básica, necesaria para el desempeño eficiente y adaptado en esta sociedad de la información que permite el desarrollo de distintas competencias transversales y metacognitivas las cuales confieren al alumnado autonomía en su formación, a través de su capacidad para crear y utilizar de manera eficaz los contenidos digitales, organizarlos y canalizarlos y utilizar los medios de comunicación a través de distintos canales (Arango-Morales et al., 2020; Moreno et al., 2021; Pangrazio et al., 2021).

A este hecho hemos de sumarle la situación social y mundial actual, en la que la digitalización de todos de sus ámbitos: informativo, comunicativo, educativo, social han transformado nuestra forma de aprender, de acceder a la información, e incluso de vivir (López-Meneses et al., 2020). En esta tesis doctoral nos centramos en el terreno educativo, y en la necesidad de detenernos en reflexionar acerca de qué uso hacen nuestros alumnos y cuál es su nivel en cuanto a las competencias que necesitan en la sociedad actual, y en segundo lugar, si estamos formando un perfil de futuros docentes capaz de formar un alumnado que utilice las tecnologías de la información y la comunicación como algo inherente a su propio desarrollo personal y social. Indistintamente del nivel educativo al que hagamos alusión, en la actualidad la competencia digital se ha consolidado como una destreza que debe adquirir cualquier estudiante, junto con los conocimientos, habilidades y actitudes que configuran a un

ciudadano digitalmente competente inseparable de las necesidades sociales y educativas de la sociedad en la que vivimos (Brata et al., 2022; Indah et al., 2022; Recio et al., 2020;).

Este es el foco de esta Tesis Doctoral, que persigue analizar variables psicológicas y educativas de la digital *literacy across disciplines* (lectura/escritura digitales como competencia genérica/transversal) tanto en estudiantes universitarios como en estudiantes de secundaria. Para ello se plantean las siguientes preguntas de investigación:

1. ¿Qué variables psicoeducativas y de aprendizaje claves evidencian los estudios empíricos internacionales sobre *digital literacy across disciplines* en *pre-service teachers education,* pre y post pandemia?

2. ¿Qué uso hacen los jóvenes españoles de Internet y de los dispositivos digitales fuera la escuela?, ¿cuánto tiempo los usan y cuáles son sus actitudes hacia el uso de los dispositivos digitales? ¿cuáles son los efectos del uso de Internet y los dispositivos digitales en las redes sociales y las relaciones interpersonales?

3. ¿Qué papel causal mediador determina el origen y la cultura en los recursos, el disfrute y las experiencias digitales, y la alfabetización y habilidades digitales en los países de España, Portugal , Brasil y Colombia?

Para dar respuesta a las tres preguntas de investigación se diseñan los siguientes objetivos:

1) Identificar los factores psicoeducativos claves evidenciados por los estudios empíricos internacionales de los últimos años en relación con la *digital literacy across disciplines* en universitarios y *pre-service teachers education.*

2) Describir los efectos del uso de internet y los dispositivos digitales fuera la escuela en adolescentes españoles, así como su actitud ante los mismos, y los efectos del uso de Internet y los dispositivos digitales y las relaciones interpersonales.

3) Contrastar modelos de medida (AFC) y de estructura (SEM), para comprobar el papel causal mediador determinante de variables como la cultura, la lengua, o el país de origen.

4) Identificar la influencia de variables como la edad, el género, la experiencia, los recursos digitales personales disponibles, y las características sociales.

Para ellos se plantean las siguientes hipótesis de trabajo:

H1. Se observarán diferencias relevantes de las aportaciones en evidencias empíricas de los estudios internacionales pre- post pandemia; y por ámbitos culturales

diferentes (hispano-latino, anglosajón, luso), edad, género, experiencia y recursos digitales personales.

H2 Se identificarán patrones psicoeducativos diferenciales aportados por las variables psicológicas en relación con la *digital literacy across disciplines* en relación con resultados académicos y de aprendizaje.

H3 Las variables psicológicas juegan un papel relevante mediador en la relación causal entre las competencias digitales de alfabetización a través del contenido y los resultados académicos, de aprendizaje y de adaptación.

MARCO TEÓRICO

2.1 Estudio de revisión

2.1.1. Artículo 1

Gutiérrez-Ángel, N., Sánchez-García, J. N., Mercader-Rubio, I., García-Martín, J., & Brito-Costa, S. (2022a). Digital literacy in the university setting: A literature review of empirical studies between 2010 and 2021. *Frontiers in Psychology, 13.* https://doi.org/10.3389/fpsyg.2022.896800

El primer estudio: una revisión sistemática acerca de la literatura específica publicada en los últimos cinco años sobre la alfabetización digital de los estudiantes universitarios. Lamisma, cuenta con cuatro fases, siguiendo el modelo de Miller et al. (2017) y Scott et al.(2018):

FASE 1: Términos de búsqueda: Diagrama de términos de búsqueda en las Bases de datos siguientes Web of Science, Scopus, Psycinfo, Psicodoc, ERIC, y Dialnet; u otras relevantes, así como terceros estudios que se identifiquen a partir de los encontrados en las publicaciones de esas bases. Para ello se partirá de un diagrama de términos y ejes temáticos que guiarán la búsqueda.

FASE 2: Proceso de selección a partir de los criterios de inclusión y exclusión. Se aplicarán como criterios: año de publicación comprendido entre los años 2015 y 2021, a disposición el texto completo, e idioma de publicación inglés, portugués o español. Además, se emplearán algunas de las indicaciones aportadas por Cooper & Hedges (1994) y Cooper (2009) tales como: revistas revisadas por pares, y referencia bases de datos e índices de citas.

FASE 3: Análisis de la calidad metodológica e indicadores basados en la evidencia científica. Para ello se aplicarán las pautas establecidas por Risko et al. (2008) y Torgerson (2007), incluyendo el MQQn (Risko et al., 2008), el cual se compone de siete indicadores para analizar la calidad de los estudios y efectividad (Acosta & Garza, 2011),los cuales son: la alineación de la teoría, los hallazgos, la confiabilidad y validez, detalles descriptivos de los participantes y del estudio, muestra y consistencia de los hallazgos y conclusiones con los datos (Risko et al., 2008). Alternativamente, se revisarán los

indicadores basados en la evidencia, junto con los tamaños del efecto de los estudios (Canedo et al., 2017; Díaz & García, 2016).

FASE 4: Confiabilidad y resultados. En esta fase se establecerá la confiabilidad tanto para los criterios de selección como para los criterios de codificación. Tanto a lo largo de cada fase, como para comprobar la replicabilidad de los resultados obtenidos. Igualmente, los resultados implicarán un análisis cualitativo de los estudios identificando los argumentos nucleares y las evidencias que aportan de forma articulada para dar respuesta a la pregunta de investigación. Todo el proceso será documentado y graficado según la Declaración PRISMA (Moher et al., 2009). Del mismo modo, se hará un estudio de los focos claves que aportan los diversos estudios, para explicitar los hallazgos relevantes y evidencias que aportan al respecto.

Este primer estudio de revisión sistemática permitirá identificar las herramientas, habilidades, procesos, estrategias, competencias y dominios en que se desenvuelve la competencia general de alfabetización digital a través de las asignaturas o currículum o contenido o disciplinas y que serán la base para la construcción y adaptación de instrumentos y escalas para la realización del segundo y tercer estudios.

2.1.2. Artículos 2 y 3

Gutiérrez Ángel, N., Mercader Rubio, I., Trigueros Ramos, R., Oropesa Ruiz, N. F., García-Sánchez, J. N., & García Martín, J. (2022b). Digital Competence, Use, Actions and Time Dedicated to Digital Devices: Repercussions on the Interpersonal Relationships of Spanish Adolescents. I*nternational Journal of Environmental Research and Public Health, 19*(16), 10358. https://doi.org/10.3390/ijerph191610358

Gutiérrez-Ángel, N., García-Sánchez, J.-N., Mercader-Rubio, I., García-Martín, J. & Brito-Costa, S. (2022c). Digital Competence, Validation and Differential Patterns between Spanish and Portuguese Areas as Assessed from the Latest PISA Report as a Pathway to Sustainable Education and Social Concerns. Sustainability, 14, 12721. https://doi.org/10.3390/su141912721

En el segundo y tercer estudio se llevará a cabo la validación de instrumentos, descriptivos multivariados y de mediación causal y estructurales; tomando como muestra

a alumnado de educación secundaria cuyo rango de edad estará comprendido entre los 14 y los 15 años aproximadamente, con la finalidad de conocer el papel el uso y la actitud ante los dispositivos digitales y su influencia en las relaciones interpersonales.

- Se aportará un análisis de validación de los instrumentos, primero un análisis factorial exploratorio (EFA) con el SPSS v26 para la identificación de la validez de constructo, fiabilidad por consistencia interna, etc.; y el uso de hojas de cálculo para los cálculos de fiabilidad compuesta y omega de McDonald, validez convergente y discriminante, ello a partir de las matrices de patrón del EFA. Igualmente, mediante el AMOS v26 se hará un análisis factorial confirmatorio del modelo de medida implementado (CFA); y el uso de macros y *pluggins* (ej., gazkination) pertinentes para las confirmaciones de ajustes del modelo (RMSEA, TLI, CFI…).
- Se harán análisis multivariados para la identificación de patrones psicoeducativos y variables relevantes de la competencia de alfabetización digital. Ello podrá realizarse, o bien mediante modelos MLG; o mediante análisis de cluster o de análisis de patrones latentes PLA (SPSS v26; MPlus 8.5; R; u otros).
- Se probarán otras relaciones causales. Además, podrán probarse el contraste del ajuste de modelos estructurales SEM a través del AMOS v26, MPlus 8.5, R u otros para comprobar la posible existencia de diferencias atendiendo al país de origen, cultura o lengua hablada.

METODOLOGÍA

3.1 Estudio de revisión sistemática

3.1.1 Procedimiento de búsqueda

Para responder al primer objetivo, se llevó a cabo una revisión sistemática del estado de la cuestión analizando los estudios empíricos en el ámbito universitario. El cual analiza la evidencia empírica que arrojan los estudios internacionales de 2010 a 2021 relacionados con la alfabetización digital de los estudiantes universitarios, incluidos aquellos que cursan carreras afines al ámbito educativo. Al respecto, son diversas las Universidades que han optado por incluir en sus metodologías herramientas digitales transversales en las diferentes asignaturas y grados (across the currículum), siendo las más comúnmente empleadas las *Virtual Learning* (VL), *Virtual Learning Environment* (VLE) y los *Social Media* (SM), las cuales pretenden aumentar la conciencia de logro en los estudiantes de cara a la obtención de sus metas educativas (Hilliger et al., 2020; Lacka et al., 2021; Nichols & LeBlanc, 2020; Waheed et al., 2020). Por lo tanto, en la actualidad, las TIC están plenamente integradas en el currículum educativo de la enseñanza universitaria de los diferentes programas y grados (Aslan, 2021; Halliger & Wang, 2020; Lacka et al., 2021) siendo relevante para la formación de futuros profesionales de la educación (*Pre-service teachers education*) o los profesores en activo y las enormes posibilidades de despliegue con las nuevas herramientas digitales (García-Martín & García, 2017; 2020a; 2020b; Howard et al., 2021) y en ámbitos culturales muy diferentes (Joaquín et al., 2020), con cambios profundos a partir de la generalización de la pandemia por COVID-2019 (Hargittai et al., 2020; Horesh & Brown, 2020; Joaquin et al., 2020; Kardelis et al., 2021).

A partir del mismo, se encuentran diferencias relevantes en los aportes en evidencia empírica de estudios internacionales pre-post-pandemia; y extraídos de diversos orígenes culturales (español-latino, portugués, finlandés, etc.), género y recursos digitales personales (Gutiérrez-Ángel et al., 2022a). Sin embargo, la mayor proliferación científica en cuanto a esta temática toma como muestra a los adolescentes, y en el hecho de que los dispositivos digitales e internet han dado lugar a nuevas oportunidades para el ocio y el entretenimiento, y han supuesto nuevos mecanismos de pensamiento, de estudio, de comunicación y de ocio, modificando en el desarrollo social, emocional y cognitivo de los adolescentes (Monteiro & Leite, 2021; Valencia-Ortiz et al., 2020; Varga-Atkins, 2020).

3.1.2. Selección de los estudios. Criterios de inclusión y exclusión

Los criterios seguidos para garantizar la calidad metodológica de los estudios seleccionados se basaron en la Declaración PRISMA (Moher et al., 2009), un conjunto de ítems mínimos basados en la evidencia para el desarrollo de revisiones sistemáticas y metaanálisis.

Inicialmente, se obtuvieron 45645 artículos de la búsqueda. Después de eliminar los duplicados, analizar el título y el resumen, obtuvimos un total de 22 trabajos que cumplían los siguientes criterios de inclusión: las publicaciones debían ser una investigación empírica sobre la alfabetización digital en estudiantes universitarios relacionadas con el ámbito educativo (futuros docentes).

3.1.3 Codificación de los estudios

Para codificar la información detallada en los 22 artículos seleccionados los resultados se agruparon en diferentes temas: En primer lugar, encontramos estudios que hacían referencia a la competencia digital y otros temas educativos. Dentro de ellos encontramos una serie de competencias que se enfatizan como la escritura digital y leyendo. Investigaciones desarrolladas a partir de medios digitales, como bases de datos, web, o aplicaciones destinadas al tratamiento de datos digitales la alfabetización se señaló como pedagogías emergentes y innovación. El diseño digital de contenidos y materiales y las habilidades para editarlos, publicarlos o compartirlos, y las competencias relacionados con las matemáticas y su alfabetización digital, formaron parte de alfabetización digital. En segundo lugar, encontramos estudios relacionados con la competencia digital y el uso y empleo de Internet, redes sociales, web 2.0, y el tratamiento de los riesgos digitales y su relación con alfabetización digital. En tercer lugar, encontramos trabajos que además de centrarse en lo digital alfabetización, también centrada en diferentes constructos psicológicos como la motivación, el compromiso, las actitudes o la satisfacción (ver tabla 1)

Tabla 1. Resumen de la búsqueda del artículo 1

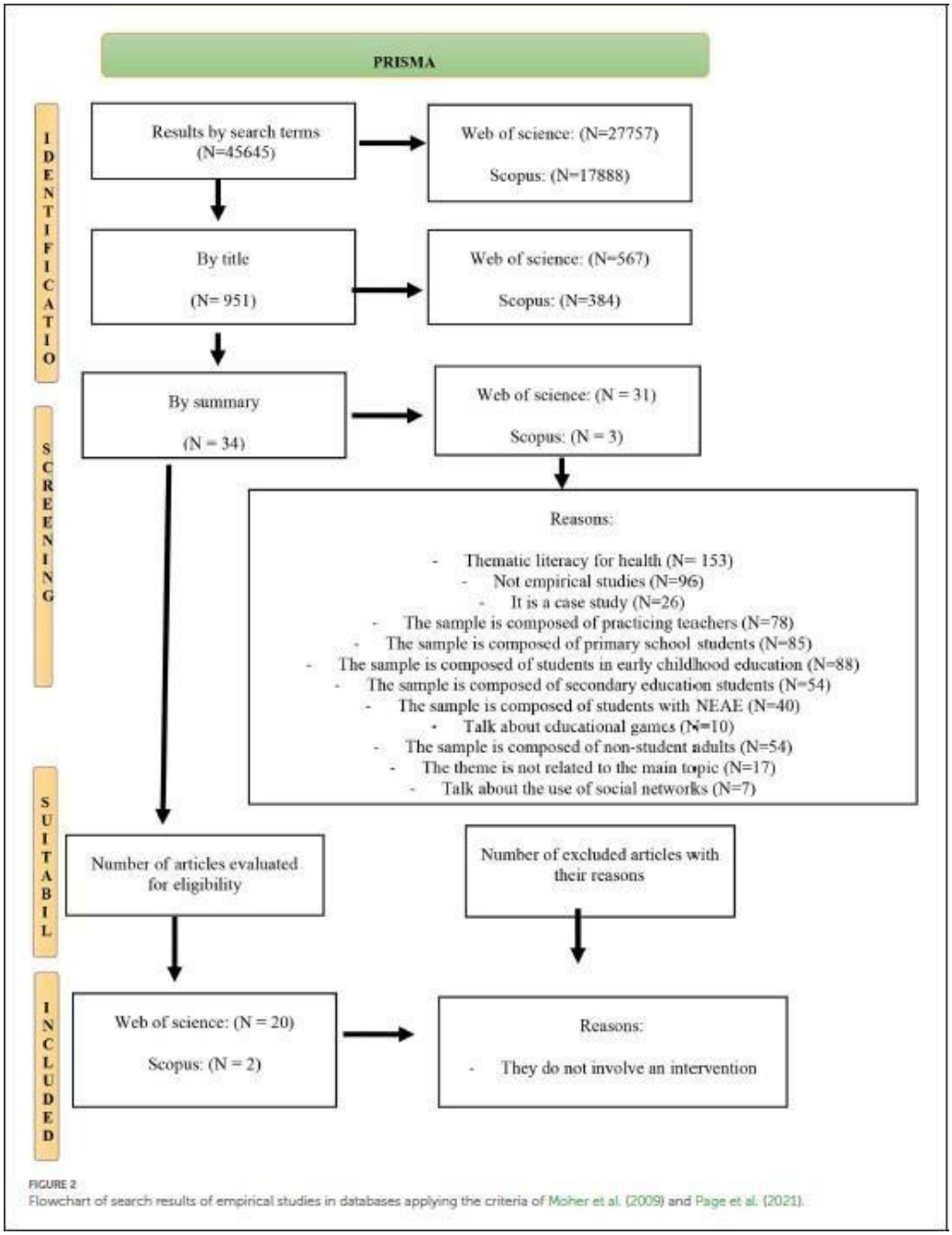

FIGURE 2
Flowchart of search results of empirical studies in databases applying the criteria of Moher et al. (2009) and Page et al. (2021).

3.1.4 Análisis estadístico

Los análisis de validación de los instrumentos, primero un análisis factorial exploratorio (EFA) con el SPSS v26 para la identificación de la validez de constructo, fiabilidad por consistencia interna, etc.; y el uso de hojas de cálculo para los cálculos de fiabilidad compuesta y omega de McDonald, validez convergente y discriminante, ello a partir de las matrices de patrón del EFA. Igualmente, mediante el AMOS v26 se hará un análisis factorial confirmatorio del modelo de

medida implementado (CFA); y el uso de macros y pluggins (ej., gazkination) pertinentes para las confirmaciones de ajustes del modelo (RMSEA, TLI, CFI…).

3.2.1 Muestra

Tanto en el estudio 2 y 3 los estudiantes fueron tomados a partir de los participantes en el Informe PISA 2018.

En el caso del estudio 2 la muestra está compuesta por 35943 alumnos de Educación Secundaria Obligatoria de diferentes institutos españoles que participaron en el Informe PISA 2018. La edad media de la muestra es de 15.83 años, con una desviación estándar SD = .28. En cuanto al género, el 50% En t. J. Medio Ambiente. Res. Salud Pública 2022, 19.10358 3 de 9 (N = 17987) son hombres y el 50% (N = 17956) son mujeres. En cuanto a la nacionalidad, 90.7% (N = 31901) eran de nacionalidad española y el 9.3%(N = 3253) eran de nacionalidad diferente a la española. Finalmente, el 82.9% (N = 29129) no había repetido curso y el 11.8% (N = 6814) había repetido alguna vez.
En el caso del estudio 3, la muestra está compuesta por 54323 participantes, de los cuales el 17.8% (N = 10619) pertenecen a Brasil, el 59.8% pertenecen a España (N = 35943), el 9.9% pertenecen a Portugal (N = 5932) y el 12.5% pertenecen a Colombia (N = 7522).La edad media de la muestra es de 15.83 años (SD = .28).

3.2.2 Instrumento

Los instrumentos utilizados en el segundo y tercer estudio son las pruebas de ubicación referentes al Informe PISA 2018, de que sólo aquellos ítems referidos a cuestiones de carácter sociodemográfico y aquellos relacionados con la frecuencia de uso de las TIC fuera de la escuela y el uso de Internet, la frecuencia de se eligió dicho uso, y la actitud hacia el uso de dispositivos digitales. Del total de artículos en el informe PISA, elegimos solo los relacionados con el tiempo de uso de los dispositivos digitales, el acciones llevadas a cabo a través de tales dispositivos, y las actitudes hacia ellos.

Son los países de la OCDE los que publican un informe (*International Student Assessment Program,* PISA) de estadísticas para establecer la dirección de la economía, la industria y la educación en tales países. En el campo educativo, investigan y presentan información relacionada al contenido matemático, científico y de resolución de

problemas, pero también están investigando varios tipos de conocimientos de los estudiantes, como las tecnologías de la información y la comunicación (TIC). Además, corresponde, por tanto, a un gran evento internacional trienal encuesta educativa, realizada por la Organización para la Cooperación y el Desarrollo Económicos (OCDE), que evalúa el rendimiento académico de los jóvenes de 15 años cada tres años. Por tanto, es una escala de categorías, muy utilizada en la investigación en el campo de la psicología. para medir preferencias, actitudes o creencias, a través de las cuales la muestra da una respuesta basado en un conjunto de categorías específicas distribuidas en orden de frecuencia o cantidad. En esto caso, en la escala de Likert utilizada, el valor de cero correspondía a nada de acuerdo, y el valor de cinco a totalmente de acuerdo.

En concreto, para el tercer estudio se empleó un tipo de encuesta enfocada en recursos digitales (ST012Q05-08, cuatro ítems preguntando cuántos teléfonos móviles, cuántas computadoras, cuántas tabletas y cuántos muchos lectores de libros electrónicos que los participantes tenían en casa), alfabetización digital (ST158, siete ítems) y habilidades digitales (ST166, cinco ítems referentes a habilidades digitales con el correo electrónico). El otro tipo, en por otro lado, centrado en la disponibilidad digital (IC001 e IC009, 11 + 11 ítems referentes tanto a los recursos en el hogar como a los recursos en la escuela) y el disfrute con herramientas digitales y experiencias (IC013-016, veintiún ítems).

El análisis de consistencia interna de las escalas indica un índice de Cronbach estandarizado. alfa para recursos digitales de = 0.658, = 0.752 para alfabetización digital y = 0.572 para habilidades digitales. Para la parte de encuesta se logra un alfa estandarizado de 0.91, y para digital preparación, el alfa es = 0.82.

El análisis factorial exploratorio EFA identificó los tres factores esperados en la encuesta relacionadas con las habilidades digitales, la alfabetización y los recursos, como lo confirma el factor confirmatorio análisis CFA, y se presenta en los resultados. El compuesto u omega de MacDonald la fiabilidad da coeficientes de .71, .76 y .65. La validez de constructo, evidenciada por la varianza media extraída AVE o validez convergente, da coeficientes cercanos a 0,50, y la validez discriminante (raíz cuadrada de la AVE) da puntuaciones superiores a la intercorrelaciones entre las variables latentes o factores (siendo .192 el más alto), con coeficientes entre .60 y .70. La medida KMO de la adecuación del muestreo y el método de Bartlett la esfericidad del muestreo dan resultados significativos ($p < .001$), al igual que la prueba de bondad de ajuste. La varianza total explicada por los tres factores es del 42.5%. En relación con la encuesta

sobre disponibilidad y disfrute digital, lo más interesante es el análisis del disfrute de experiencias digitales. Si bien se encuentran resultados comparables a las variables anteriores con la EFA, se presenta un análisis CFA adicional en los resultados.

3.2.3 Procedimiento

Los resultados han sido recogidos y procesados de la base de datos correspondiente a la respuestas de las pruebas de nivel del Informe PISA 2018. Dicha base de datos está disponible en el sitio web del Ministerio de Educación y Formación Profesional y el INEE (Instituto Nacional de Evaluación Educativa).

3.2.4 Análisis de datos

En el segundo estudio se utilizaron los programas de análisis estadístico SPSS versión 26 y AMOS versión 22 se utilizaron para realizar varios análisis con el fin de analizar las relaciones entre los variables de estudio, como análisis descriptivos y de frecuencia, correlaciones bivariadas y un modelo de estructuras estructurales. Además, los análisis de confianza y descriptivos (medias y desviación estándar). Para el modelo de estructuras, el método de máxima verosimilitud y un bootstrapping de 6000iteraciones fueron cambiadas. Los índices de ajuste que se tienen en cuenta para juzgarla validez factorial del modelo propuesto son los siguientes: 2/gl, ajuste incremental (IFI),índice de ajuste comparativo (CFI), índice de Tucker Lewis (TLI), raíz media estandarizada residual cuadrático (SRMR) y el error cuadrático medio de aproximación (RMSEA) más su intervalo de confianza (IC) al 90%. Así, los índices de ajuste son: 2/gl,valores entre 2y 3; SI YO, CFI y TLI, valores superiores a .95; SRMR, valores por debajode .06; y RMSEA, con valores por debajo de .83.

En el tercer estudio, el primer paso fue descargar los datos en formato SPSS de la última muestreo realizado por PISA en diferentes países de la OCDE y colaboradores. A partir de estos conjuntos de datos, se extrajeron datos para España, Portugal, Brasil y Colombia; esto permitió una comparación entre países con diferentes orígenes culturales y geográficos (Ibérica Península y América Latina) y todos los países iberoamericanos, que comparten la misma dos idiomas: portugués, en Portugal y Brasil, y español, en España y Colombia, con tradiciones culturales, lingüísticas, históricas y geográficas comparables, en formas divergentes aspectos (dos lenguas, dos áreas geográficas) y en aspectos coincidentes (lengua y área geográfica). Esto permitió realizar un análisis descriptivo y comparativo para identificar patrones diferenciales en competencias

digitales.

Una vez que se tuvieron las matrices de conjuntos de datos para cada país y para los cuatro países seleccionados, reunidos, se hicieron tabulaciones cruzadas para describir las muestras por género, país, idioma y área geográfica. En segundo lugar, se procedió a los análisis de validez de constructo de las encuestas para los dos tipos de encuestas: (i) sobre recursos digitales, alfabetización digital y habilidades digitales (estos datos están disponibles para los cuatro países); y (ii) sobre la disponibilidad y disfrute de dispositivos, herramientas y experiencias digitales (estos datos solo están disponibles para Brasil) y España).

Se calculó la consistencia interna de las diferentes partes de la encuesta con el módulo IBM Corp SSPS 26.0 Scales, que proporciona el estándar de Cronbach alfas. Además, se realizó un análisis de validez de constructo; por un lado, un Se realizó un análisis factorial exploratorio (AFE), utilizando el método de máxima verosimilitud, lo cual se recomienda cuando existen interrelaciones entre los factores o latentes variables Rotación oblimin directa, la adecuación del muestreo KMO y la esfericidad de Bartlett se calcularon las medidas; la prueba de bondad de ajuste Chi2 y la varianza total explicada se midió cada variable latente y por conjunto; se consideraron las gráficas de cargas confirmar visualmente las variables latentes extraídas; y el número de variables latentes, el También se consideró la matriz de correlación entre las variables latentes y la matriz patrón. Además, se calcularon las puntuaciones de los factores para cada participante, utilizándolas puntuaciones de Bartlett. Todos estos análisis se realizaron con SPSS v26. Con los coeficientes lambda o factorial pesos de la matriz patrón, a través de Excel, calculamos la confiabilidad compuesta o Macdonald's omega, que se esperaba que fuera 0,70 o superior; la varianza media extraída AVE o CV de validez convergente, que se esperaba fuera de 0,50 o superior; y el discriminante validez DV (raíz cuadrada del AVE), cuyos coeficientes deben ser superiores a los intercorrelaciones entre las variables latentes. La validez convergente y discriminante fueron considerado una buena medida de la validez de constructo de una escala o encuesta en este caso. También se realizó análisis factorial confirmatorio con AMOS v26 (modelos de medición) sobre la base de las matrices de patrones, utilizando los complementos de Pattern Matrix Model de Gazkin Builder (http://statwiki.gaskination.com/index.php/Plugins, consultado el 1 de junio de 2022).

Se realizaron varios CFA, por país y en forma conjunta, lo que también permitió considerar la invariancia del modelo de medida. Para ilustrar su idoneidad, Los

coeficientes TLI y CFI están por encima de .90, y las puntuaciones más altas se consideran evidencia de una buen ajuste del modelo a los datos junto con el RMSEA, que tiene que estar por debajo de .080. Cuando este ajuste se confirma con diferentes muestras, es evidencia de la invariancia de la modelo de medición. Por otro lado, los patrones diferenciales entre países fueron identificados. Para este propósito, el módulo del modelo lineal general Se utilizó GLM de SPSS v26. Esto permitió extraer las diferencias entre países en las diferentes variables dependientes de la competencia digital analizadas para este estudio. Esto se llevó a cabo en tres pasos: la prueba multivariada, que fue significativa para ambos tipos de variables (ST e IC); pruebas de efectos entre sujetos; y pruebas post hoc para el caso de las variables ST (los cuatro países) ya que losCI solo están disponibles para dos países, Brasil y España Se proporcionaron puntuaciones medias y sus desviaciones estándar, significación estadística y tamaño del efecto o significancia práctica. Para el tamaño del efecto, indicado por el estadístico eta-cuadrado (2), se considera la regla de Cohen (1988) = .01–.06 (pequeño efecto); > .06–.14 (efecto medio); > .14 (efecto grande).

RESULTADOS

4.1 Estudio de revisión sistemática

4.1.1. Descripción de los estudios incluidos en la revisión

En primer lugar, encontramos estudios que hacían referencia a la competencia digital y otras cuestiones educativas. Dentro de ellas encontramos una serie de competencias que se enfatizan como la escritura y lectura digital. Se señalaron como pedagogías emergentes de innovación educativa las investigaciones desarrolladas a partir de medios digitales, como bases de datos, web o aplicaciones destinadas al tratamiento de la alfabetización digital. El diseño digital de contenidos y materiales y las habilidades para editarlos, publicarlos o compartirlos, y las competencias relacionadas con las matemáticas y su alfabetización digital, formaban parte de la alfabetización digital.

En segundo lugar, encontramos estudios relacionados con la competencia digital y el uso y empleo de Internet, las redes sociales, la web 2.0, y el tratamiento de los riesgos digitales y su relación con la alfabetización digital. Aplicaron las historias digitales como herramienta para el desarrollo de la actividad, pero también la evaluación de la competencia. En la investigación realizada por Lerdpornkulrat et al. (2019), se evidencia que con el uso de la rúbrica, el docente les dio un ejemplo del trabajo y les pidió a todos que practicaran evaluando y calificando este trabajo. De esta forma, pudieron comprobar si entendieron cómo utilizar una rúbrica. Luego usaron la rúbrica para autoevaluar su trabajo. Después de recibir comentarios, ambos grupos de estudiantes revisaron y volvieron a enviar sus proyectos terminados. Independientemente del entorno y del programa o aplicación empleada, podemos clasificar la duración de estas intervenciones en dos grandes grupos: las que tuvieron una duración <1 semestre, En tercer lugar, encontramos trabajos que además de centrarse en la alfabetización digital, también se centraban en distintos constructos psicológicos como la motivación, el compromiso, las actitudes o la satisfacción.

En cuanto a la literatura instruccional, encontramos una gran cantidad de resultados sobre programas o cursos de formación masiva en los que la alfabetización digital fue el foco. Los ejemplos incluyen un curso ofrecido en el que los estudiantes pueden inscribirse o módulos que se imparten durante la enseñanza de una materia. También encontramos investigaciones sobre intervenciones que se habían realizado a través de diferentes asignaturas del programa de estudio de donde se tomó la muestra. y los que tuvieron una intervención cuya duración osciló entre un semestre y un año académico.

En cuanto a los recursos materiales, todos los estudios utilizaron algún tipo de documentación (digital o no) con instrucciones sobre el desarrollo de las actividades, en las que se indicaba a los alumnos qué hacer y los pasos a seguir. En este caso, el escenario de desarrollo fue tanto online como presencial, a partir de diferentes actividades impartidas a través de talleres o seminarios para su desarrollo. En este caso, las muestras se tomaron ad hoc de un alumnado específico que la investigadora decidió intencionadamente en base a una experiencia previa de intervención con ellos (Ata & Yildirim, 2019; Ball, 2019; Campbell & Kapp, 2020; Domingo Coscolla et al., 2020; Tomczyk et al., 2020; Vinokurova et al., 2021).

En cuanto a los instrumentos utilizados, cabe señalar que la mayoría de ellos utilizaron formularios de encuesta como instrumento de evaluación, ya sea por parte del investigador o por parte de los estudiantes. Además, suele utilizarse como recurso para recoger información de carácter personal y sobre la propia experiencia a lo largo de la intervención. También hay que destacar que en muchos de los resultados encontrados se utilizó este formulario de forma digital o virtual, abandonando los antiguos formularios en papel (Ball, 2019; Campbell & Kapp, 2020; Carl & Strydom, 2017; Elliott et al., 2018; Kajee & Balfour, 2011; Lerdpornkulrat et al., 2019; Robertson et al., 2012).

TABLE 1 Summary of the results found.

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Alfonzo and Batson (2014)	*N* = 20 university doctoral students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 2. A teacher and a librarian	Digital literacy/ digital research/research software/ sdigital databases/self-efficacy	Digital search—apa standards—applications Resource management	Activation of previous knowledge-scaffolding Self-instructions Collaborative/ individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Ata and Yildirim (2019)	*N* = 295 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/internet/ social media/perception/ digital reading/digital writing/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/ individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Ball (2019)	Do not specify	Do not specify	Pre-post intervention	Do not specify	Specialized personnel	Digital literacy/digital writing/digital material/creation/editing//media literacy/cybersecurity/ self-efficacy	BA Writing and Publishing Program. emphasis on writing, researching, evaluating and reviewing articles in a digital environment	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Botturi (2019)	*N* = 26 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/access to information/digital content creation/content sharing/self-efficacy	Specific face-to-face program of 2 credits DML education course with 12 2-h sessions	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Visualization
Campbell and Kapp (2020)	*N* = 4 university students (future teachers)	Do not specify	Pre-post intervention	Do not specify	N Teachers = 1	Digital literacy/self-efficacy/motivation	Training course Graduate Certificate in Education (PGCE)	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation	

R	i	Selection	Colloquium
e	e		Planning-ReinforcementReview
v	w		Selection

(Continued)

TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Carl and Strydom (2017)	$N = 11$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	*N Teachers = 1*	Digital literacy/E-portfolio/self-efficacy/motivation	Digital content design—digital material design	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Domingo-Coscolla et al. (2020)	$N = 11$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 11	Digital literacy/diversity/innovation/self-efficacy/motivation	FIMTD project	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Elliott et al. (2018)	$N = 48$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Support staff—library staff	Digital literacy/digital writing/digital material/self-efficacy	Module focused on theories of learning and development—sociological module focused on educational inequalities	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Elphick (2018)	$N = 949$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/attitude/motivation/and self-efficacy	Use of iPad in education on a day-to-day basis	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

10.3389/fpsyg.2022.896800

(Continued)

TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Gabriele et al. (2019)	$N = 141$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/web 2.0/gamification/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Gill et al. (2015)	$N = 11$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/pre-preparation/digital knowledge/self-efficacy	Application of practical knowledge from different subjects of the career	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Hamutoglu et al. (2019)	$N = 47$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/attitude/digital learning/self-efficacy/motivation	Training course once a week for 3 h per week	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Istenic et al. (2016)	$N = 115$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital content design/digital mathematics/self-efficacy	Creation of digital stories—design of digital content—design of digital materials	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection

(Continued)

10.3389/fpsyg.2022.896800

TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Kajee and Balfour (2011)	$N = 20$ university students (future teachers)	GE = 10 GC = 10	Pre-post intervention	Intentional sampling	N Teachers = 1	Academic Literacy/Digital Writing/Digital Research/Self-Efficacy	Self-instructional/online classes in specific labs	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Kuhn (2017)	$N = 20$ university students (future teachers)	GE = 12 GE2 = 5 GC = 3	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/digital skills/motivation/autonomy/self-efficacy	Digital Practice and PLE	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Lerdpornkulrat et al. (2019)	$N = 584$ university students (future teachers)	GE = 321 GC = 263	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/motivation/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Paige et al. (2016)	$N = 31$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital content design/digital mathematics	Creation of digital stories—design of digital content—design of digital materials	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Slowmation—digital narratives—round tables—interviews—oral evaluations
Pequeño et al. (2017)	$N = 54$ university students (future teachers)	GE = 31 GC = 24	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital narrative/self-efficacy	Application of practical knowledge from different subjects of the career	Activation of previous knowledge-Scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

(Continued)

10.3389/fpsyg.2022.896800

TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Robertson et al. (2012)	$N = 150$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 2	Digital literacy/new pedagogies/multiliteracy/selfs-tories—thoughtful writing efficacy	Creation of digital	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific aid Colloquium Planning-Reinforcement Review Selection -Sharing
Sharp (2018)	$N = 51$ university students (future teachers)	GE = 20 GE2 = 20 GC = 11	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/digital skills/motivation/autonomy/self-efficacy	Creation of a blog, —asynchronous discussion, —wiki, —microblog	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Tomczyk et al. (2020)	$N = 227$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital inclusion/digital risks/digital content/self-efficacy	SELI Platform	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Vinokurova et al. (2021)	Do not specify	Do not specify	Do not specify	Do not specify	Do not specify	Digital literacy/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual	Colloquium Planning-Reinforcement Review Selection

emulation

Visualization

TABLE 2 Summary of the interventions found.

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Alfonzo and Batson (2014)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 4 days	Greater use of digital tools than before training	Has a sparse sample
Ata and Yildirim (2019)	Does not specify	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	An academic year	Increasing digital competence	It should apply more evaluation tools
Ball (2019)	Dashboard—training modules—Wikipedia guidelines and rules	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	An academic year	Increasing digital competence	Does not indicate the method
Botturi (2019)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher	4 months	Increasing digital competence	Has a sparse sample
Campbell and Kapp (2020)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	5 months	Increasing digital competence	Has a sparse sample
Carl and Strydom (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	Do not specify	Great interest and motivation on the part of the participants	Does not use standardized instruments
Domingo-Coscolla et al. (2020)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher	Do not specify	Increasing digital competence	Has a sparse sample/does not indicate duration
Elliott et al. (2018)	Weekly Lectures-seminars-online resources-library	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	An academic year	Increased digital expertise and dominance	Has a sparse sample
Elphick (2018)	Conferences and seminars	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	One semester	Increased digital expertise and dominance	Does not use standardized instruments

(Continued)

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TABLE 2 (Continued)

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Gabriele et al. (2019)	Power point presentations—introductory videos of the software- brochures—applications created *ad hoc*	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	10 months	Increasing digital competence	Has a sparse sample
Gill et al. (2015)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 3 years	Practical knowledge of the application of ICT as a learning tool	Has a sparse sample
Hamutoglu et al. (2019)	Texts/documents—EDMODO	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	5 weeks	Increasing digital competence	Has a sparse sample
Istenic et al. (2016)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An educational technology course in the academic year 2011–2012	Creation of digital content for the teaching of mathematics	Does not use standardized instruments
Kajee and Balfour (2011)	Texts/documents—computer applications-Laboratory with computers–standalone server—printer	Teacher—Researcher through 40 workstations	Developer of each activity through 40 workstations	Small group/face-to-face	Researcher Specific laboratory	Two semesters of 14 weeks duration	GE improvements greater than GC	Has a sparse sample
Kuhn (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An academic year	GE1 and GE2 improvements greater than GC	Has a sparse sample
Lerdpornkulrat et al. (2019)	Power point presentations—introductory videos of the software-brochures	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	13 sessions	Increased self-efficacy in relation to standards and expectations	It should apply more evaluation tools

(Continued)

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TABLE 2 (Continued)

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Paige et al. (2016)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	Do not specify	Creation of digital content for the teaching of mathematics	Does not use standardized instruments
Pequeño et al. (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An academic year	GE improvements greater than GC	Has a sparse sample
Robertson et al. (2012)	Texts/documents—computer applications—Photo Story 3 program	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 3 years: 10 months	New learning and means of expression	Has a sparse sample
Sharp (2018)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	Two semesters	GE1 and GE2 improvements greater than GC	Has a sparse sample
Tomczyk et al. (2020)	Texts/documents—SELI platform	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	Do not specify	Increasing digital competence	Does not indicate the process
Vinokurova et al. (2021)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	Do not specify	Increasing digital competence	Omits data for possible replicability

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4.2. Análisis de la Competencia Digital, uso, acciones y tiempo dedicado a dispositivosdigitales: repercusiones en lo interpersonal relaciones de los adolescentes españoles

4.2.1. Tiempo de uso y acciones a través de dispositivos

En cuanto a las acciones relacionadas con el uso de las TIC en las que los participantes dedicaron más tiempo, los resultados muestran que algunas acciones se realizan en mayor medida que otras. Así, en cuanto a los juegos online, el 35.9% nunca o casi nunca juega juegos de un solo jugador, el 41.8% utiliza juegos online colaborativos,o el 52.4% juega a juegos online a través de redes sociales. Por otro lado, en cuanto a las tareas académicas, nunca o casi nunca utilizan las redes sociales para comunicarse con otros alumnos sobre las tareas escolares, con un 41.7 %, subir contenidos a la web del colegio, con un 44.1 %,o consultar la web del colegio, con un 44.4 %. En cuanto al uso de determinados dispositivos digitales, entre las tareas que solo reconocen como realizadas a través de dispositivos móviles una o dos veces al mes se encuentran descargar una app, con un 33.1%, o enviar deberes y comunicarse con los profesores, con un 34.7%. Además, reconocen utilizar dispositivos digitales una o dos veces por semana para enviar correos electrónicos, con un 30.9 %, leer noticias en Internet, con un 25.2 %, obtener información práctica en Internet, con un 27.6 %, navegar por Internet para hacer tareas, con 36.3%, o navegar por Internet para buscar explicaciones de los deberes, con un 29.3%. Por otro lado, reportaron uso diario de chat en línea, con 77.3%, uso de redes sociales, con 67.9%,navegación en Internet por diversión, con 52.4% y descarga de música, películas o juegos, con 26.9%.

4.2.2. Actitudes hacia el uso de dispositivos digitales

En este caso, las declaraciones tenían como objetivo conocer los gustos y actitudes personales de los participantes hacia los dispositivos digitales. Así, el 49.9% de los participantes manifestó que le gusta compartir contenidos digitales. Además, les gusta utilizar diferentes dispositivos digitales en su día a día según el 53.1%. También coinciden en que les hace mucha ilusión descubrir nuevos dispositivos o aplicaciones, con un 38.6 %.Además, reconoce usarlos para hacer amigos, con un 38.1%.

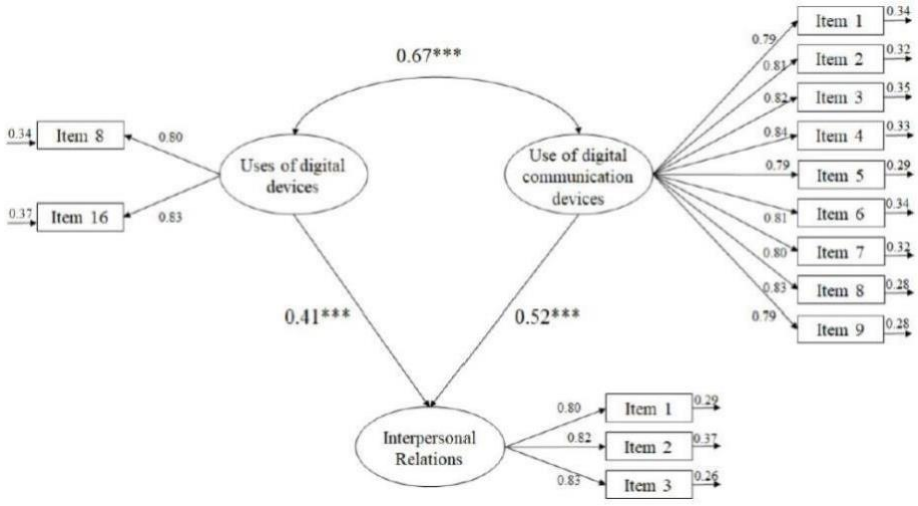
4.2.3. Influencia de los Usos de Dispositivos Digitales en las Relaciones

Como se puede observar en la Tabla 2, las correlaciones entre las variables de estudio fueron positivas, reflejando la reciprocidad entre las variables de estudio. Por otro lado, el análisis de confiabilidad a través del alfa de Cronbach mostró que cada uno de los tres factores tuvo puntuaciones superiores a .70.

Tabla 2. Descripción del uso de los dispositivos digitales

communicate with other students	41.7% (N = 1859)
upload content to the school's website	44.1% (N = 12,466)
download an app	33.1% (N = 9968)
submit assignments and communicate with teachers	34.7% (N = 9898)
send emails	30.9% (N = 9363)
read news on the Internet	27.6% (N = 8444)
get practical information on the Internet	27.6% (N = 8444)
surf the Internet to do homework	36.3% (N = 10,565)
browse the Internet to find explanations of duties	29.3% (N = 8380)

Figura 1. Modelo SEM sobre las relaciones interpersonales

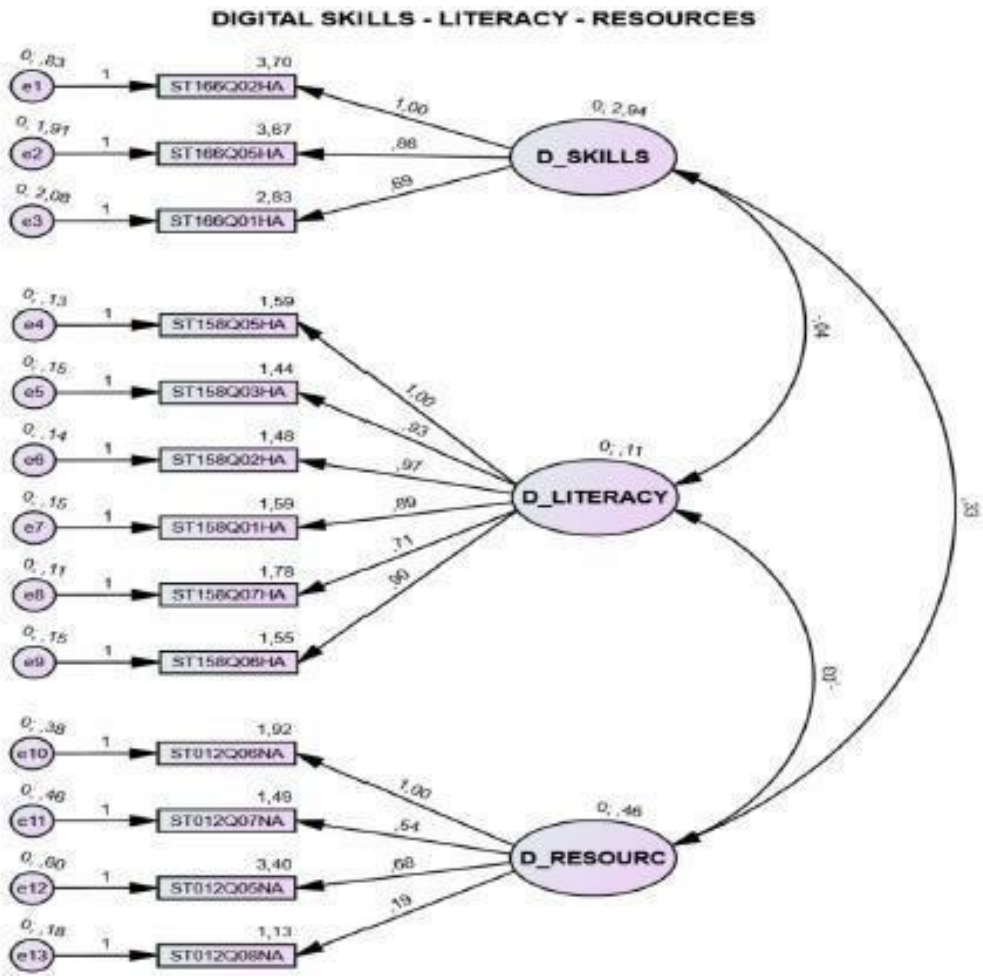


4.3. Análisis de la Competencia digital, validación y patrones diferenciales entre áreas españolas y portuguesas según la evaluación del último informe PISA como camino hacia la educación sostenible y las preocupaciones sociales

4.3.1 Habilidades digitales, alfabetización y recursos

Se obtiene un buen ajuste del modelo a los datos. Los coeficientes para la muestra española son buenos: NFI = .951; TLI = .929; CFI = .951; RMSEA = .037.La invariancia del modelo también se confirma para la muestra brasileña: NFI = .959; TLI= .943; CFI = .961; RMSEA = .040. Ver el gráfico de Brasil (ver Figura 1).

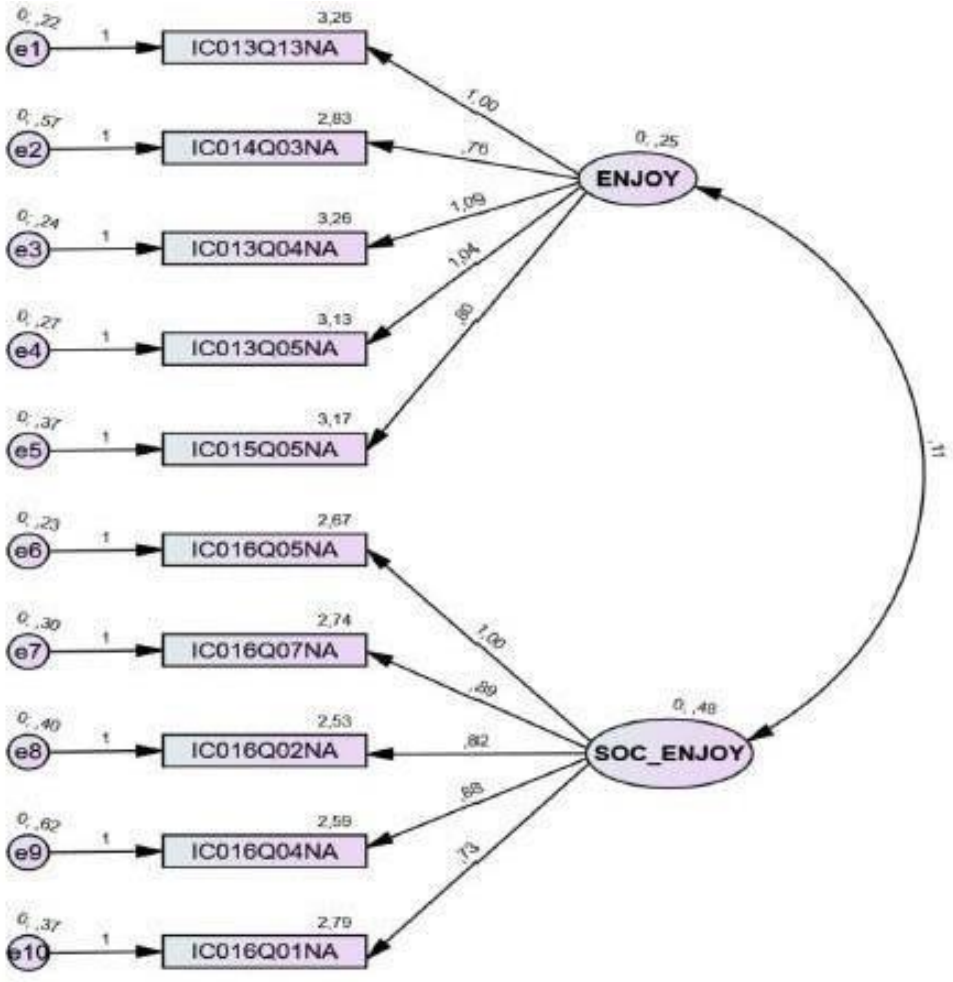
Figura 2. Modelo SEM sobre la competencia digital



4.3.2 Disfrute digital

Se obtiene un buen ajuste del modelo a los datos. Los coeficientes para lamuestra española son buenos: NFI = .951; TLI = .929; CFI = .951; RMSEA = .037.La invariancia del modelo también se confirma para la muestra brasileña: NFI = .959; TLI = .943; CFI = .961; RMSEA = .040. Ver el gráfico de Brasil (ver Figura 1).

Figura 3. Modelo SEM sobre el disfruto en el empleo de los dispositivos digitales



4.3.3 Patrones diferenciales entre países

4.3.3.1 Patrones diferenciales entre países en recursos digitales, alfabetización digital y Habilidades digitales

Los contrastes multivariados entre las variables dependientes de la competencia digital estudiadas para los recursos digitales, la alfabetización digital y las habilidades digitales son estadísticamente significativas entre los cuatro países, y con un tamaño del efecto grande (Wilks = .523; F = 564.901; gl = 60–139.683; p < .001; 2 = .194). Al probar los efectos intrasujeto, la mayoría de las variables dependientes dan resultados estadísticamente significativos, con tamaños de efecto significativos, al igual que los contrastes post hoc, como se puede ver a continuación.

Table 2. Results of the application of the general linear model (GLM), considering country of origin as the grouping variable and the use of digital resources, digital literacy and digital skills as dependent variables.

	VARIABLES PISA	Brazil	(N = 6900)	Colombia	(N = 5567)	Spain	(N = 29,448)	Portugal	(N = 4927)	Total	(N = 46,842)	F	p	$\blacksquare^2$
		M	σ	M	σ	M	σ	M	σ	M	σ			
						DIGITAL ASSETS								
How many in your home: <Cell phones> with Internet access (e.g., smartphones)	ST012Q05NA	3.48	0.844	3.30	1.020	3.91	0.346	3.80	0.531	3.76	0.620	2392.064	0.001	0.133
How many in your home: Computers (desktop computer, portable laptop, or notebook)	ST012Q06NA	2.01	0.935	2.13	0.960	3.00	0.866	2.94	0.877	2.74	0.980	3343.393	0.001	0.176
How many in your home: <Tablet computers> (e.g., <iPad>, <BlackBerry PlayBook>)	ST012Q07NA	1.51	0.778	1.70	0.902	2.48	0.960	2.25	0.921	2.22	1.002	2744.790	0.001	0.150
How many in your home: E-book readers (e.g., <Kindle>, <Kobo>, <Bookeen>)	ST012Q08NA	1.14	0.448	1.35	0.783	1.56	0.771	1.23	0.561	1.44	0.733	867.006	0.001	0.053
						LITERACY								
Taught at school: How to use keywords when using a search engine such as <Google©>, <Yahoo©>, etc.	ST158Q01HA	1.59	0.491	1.46	0.498	1.60	0.489	1.43	0.495	1.57	0.496	273.471	0.001	0.017
Taught at school: How to decide whether to trust information from the Internet	ST158Q02HA	1.48	0.500	1.27	0.445	1.32	0.467	1.36	0.479	1.34	0.474	275.837	0.001	0.017
Taught at school: How to compare different web pages and decide what information is more relevant for your school work	ST158Q03HA	1.44	0.496	1.35	0.476	1.42	0.493	1.38	0.485	1.41	0.491	46.279	0.001	0.003
Taught at school: To understand the consequences of making information publicly available online on <Facebook>, [. . .] Taught at school: How to use the short description below the links in the list of results of a search	ST158Q04HA	1.51	0.500	1.19	0.391	1.16	0.370	1.21	0.409	1.22	0.416	1404.516	0.001	0.083
Taught at school: How to detect whether the information is subjective or biased	ST158Q05HA	1.60	0.490	1.46	0.498	1.65	0.477	1.46	0.498	1.60	0.490	394.478	0.001	0.025
Taught at school: How to detect phishing or spam emails	ST158Q06HA	1.55	0.498	1.57	0.496	1.53	0.499	1.45	0.498	1.53	0.499	53.139	0.001	0.003
	ST158Q07HA	1.79	0.408	1.61	0.489	1.64	0.480	1.45	0.497	1.64	0.481	506.613	0.001	0.031
How appropriate in reaction to this email:						DIGITAL LITERACY								
Answer the email and ask for more information about the smartphone	ST166Q01HA	2.88	1.873	2.86	1.643	3.04	1.720	3.05	1.785	2.99	1.743	28.538	0.001	0.002
How appropriate in reaction to this email: Check the sender's email address	ST166Q02HA	3.81	1.941	3.91	1.710	4.35	1.602	4.51	1.567	4.24	1.682	313.310	0.001	0.020
How appropriate in reaction to this email: Click on the link to fill out the form as soonas possible	ST166Q03HA	2.50	1.707	2.66	1.558	2.44	1.546	2.38	1.544	2.47	1.574	37.289	0.001	0.002
How appropriate in reaction to this email: Delete the email without clicking on the link	ST166Q04HA	2.56	1.735	2.94	1.631	3.19	1.789	3.34	1.807	3.09	1.781	289.295	0.001	0.018
How appropriate in reaction to this email: Check the website of the mobile phone operator to see whether [. . .]	ST166Q05HA	3.76	2.022	3.78	1.801	4.27	1.709	4.38	1.704	4.15	1.784	265.310	0.001	0.017

Note: multivariate tests: $\lambda_{W\,ks} = 0.523$; F = 564.901; gl = 60–139,683.

Table 3. Post hoc contrasts that are significant in multivariate analyses by cross-country comparisonfor both digital resources and digital literacy and digital skills, as measured by PISA results.

PISA VARIABLES		Brazil vs. Colombia	Brazil vs. Spain	Brazil vs. Portugal	Colombia vs. Spain	Colombia vs. Portugal	Spain vs. Portugal
			DIGITAL RESOURCES				
How many in your home: <Cell phones> with Internet access (e.g., smartphones)	ST012Q05NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: Computers (desktop computer, portable laptop, or notebook)	ST012Q06NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: <Tablet computers> (e.g., <iPad>, <BlackBerry PlayBook>)	ST012Q07NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: E-book readers (e.g., <Kindle>, <Kobo>, <Bookeen>)	ST012Q08NA	0.001	n.s.	0.001	0.025	0.001	0.001
			DIGITAL LLITERACY				
Taught at school: How to use keywords when using a search engine such as <Google©>, <Yahoo©>, etc.	ST158Q01HA	0.001	0.001	0.001	0.001	0.001	0.001
Taught at school: How to decide whether online information from the Internet	ST158Q02HA	0.001	0.001	0.001	0.001	0.001	0.001
Taught at school: How to compare different web pages and decide what information is more relevant for your school work	ST158Q03HA	0.001	0.020	0.001	0.001	0.018	0.001
Taught at school: To understand the consequences of making information publicly available online on <Facebook>, [. . .]	ST158Q04HA	0.001	0.001	0.001	0.001	0.028	0.001
Taught at school: How to use the short description below the links in the list of results of a search	ST158Q05HA	0.001	0.001	0.001	0.001	n.s.	0.001
Taught at school: How to detect whether the information is subjectiveor biased	ST158Q06HA	n.s.	n.s.	0.001	0.001	0.001	0.001
Taught at school: How to detect phishing or spam emails	ST158Q07HA	n.s.	0.001	0.001	0.001	0.001	0.001
			DIGITAL SKILLS				
How appropriate in reaction to this email: Answer the email and ask for more information about the smartphone	ST166Q01HA	0.001	0.001	0.001	0.001	0.001	n.s.
How appropriate in reaction to this email: Check the sender's email address	ST166Q02HA	0.018	0.001	0.001	0.001	0.001	0.001
How appropriate in reaction to this email: Click on the link to fill out the form as soon as possible	ST166Q03HA	0.001	0.001	0.001	0.001	0.001	0.001
How appropriate in reaction to this email: Delete the email without clicking on the link	ST166Q04HA	0.001	0.001	0.001	0.001	0.001	0.001
How appropriate in reaction to this email: Check the website of the mobile phone operator to see whether [. . .]	ST166Q05HA	n.s.	0.001	0.001	0.002	0.002	0.001

Note: n.s. Not statistically significat.

4.3.4 Patrones Diferenciales entre Brasil y España en las Variables Dependientes deDigital: Disponibilidad y Disfrute

Los contrastes multivariados estadísticamente significativos son evidentes con un tamaño del efecto grande (Wilks = .627; F = 311.909; gl = 42–22 030; p = .001; 2 (SE) =.373). Pruebas para intersujeto efectos proporcionan diferencias estadísticamente significativas en la mayoría de las variables.

Table 4. Results of the application of the general linear model (GLM), considering as the grouping variable the country of origin (in this case, Brazil vs. Spain; Colombia and Portugal not applicable) and as dependent variables, the availability of digital experiences and enjoyment.

	VARIABLES PISA	Brazil	(N = 4177)	Spain	(N = 17,896)	Total	(N = 22,073)	F	p	$\blacksquare^2$
		M	σ	M	σ	M	σ			
AVAILABILITY AT HOME										
Available for you to use at home: Desktop computer	IC001Q01TA	2.01	0.941	1.63	0.846	1.70	0.878	664.051	0.001	0.029
Available for you to use at home: Portable laptop, or notebook	IC001Q02TA	1.89	0.932	1.32	0.645	1.43	0.742	2180.058	0.001	0.090
Available for you to use at home: <Tablet computer> (e.g., <iPad>, <BlackBerry PlayBook>)	IC001Q03TA	2.31	0.859	1.51	0.741	1.66	0.827	3736.723	0.001	0.145
Available for you to use at home: Internet connection	IC001Q04TA	1.19	0.558	1.05	0.279	1.07	0.354	581.229	0.001	0.026
Available for you to use at home: <Video games console>, e.g., <Sony PlayStation>	IC001Q05TA	1.99	0.927	1.48	0.693	1.57	0.770	1640.505	0.001	0.069
Available for you to use at home: <Cell phone> (without Internet access)	IC001Q06TA	2.30	0.866	2.26	0.802	2.27	0.814	11.559	0.001	0.001
Available for you to use at home: <Cell phone> (with Internet access)	IC001Q07TA	1.16	0.499	1.05	0.289	1.07	0.341	332.279	0.001	0.015
Available for you to use at home: Portable music player (Mp3/Mp4 player, iPod or similar)	IC001Q08TA	2.08	0.938	1.59	0.753	1.68	0.815	1321.549	0.001	0.056
Available for you to use at home: Printer	IC001Q09TA	2.09	0.925	1.47	0.768	1.59	0.836	2024.536	0.001	0.084
Available for you to use at home: USB (memory) stick	IC001Q10TA	1.43	0.714	1.13	0.396	1.19	0.487	1348.785	0.001	0.058
Available for you to use at home: <ebook reader>, e.g., <Amazon Kindle>	IC001Q11TA	2.61	0.730	2.20	0.855	2.27	0.848	840.867	0.001	0.037
Available for you to use at school: Desktop computer	IC009Q01TA	1.99	0.837	1.64	0.820	1.71	0.834	622.875	0.001	0.027
Available for you to use at school: Portable laptop or notebook	IC009Q02TA	2.46	0.778	2.12	0.897	2.18	0.886	524.606	0.001	0.023
Available for you to use at school: <Tablet computer> (e.g., <iPad>, <BlackBerry PlayBook>)	IC009Q03TA	2.69	0.656	2.53	0.781	2.56	0.761	135.807	0.001	0.006
AVAILABILITY AT THE SCHOOL										
Available for you to use at school: Internet connected school computers	IC009Q05NA	1.98	0.840	1.35	0.648	1.47	0.731	2782.212	0.001	0.112
Available for you to use at school: Internet connection via wireless network	IC009Q06NA	2.05	0.883	1.68	0.856	1.75	0.874	649.133	0.001	0.029
Available for you to use at school: Storage space for school-related data, e.g., a folder for own documents	IC009Q07NA	2.32	0.827	1.94	0.926	2.01	0.920	604.567	0.001	0.027
Available for you to use at school: USB (memory) stick	IC009Q08TA	2.39	0.823	1.90	0.933	1.99	0.934	992.378	0.001	0.043
Available for you to use at school: <ebook reader>, e.g., <Amazon Kindle>	IC009Q09TA	2.69	0.628	2.73	0.620	2.72	0.622	11.680	0.001	0.001
Available for you to use at school: Data projector, e.g., for slide presentations	IC009Q10NA	1.86	0.881	1.33	0.684	1.43	0.755	1801.444	0.001	0.075
Available for you to use at school: Interactive Whiteboard, e.g., <Smartboard>	IC009Q11NA	2.53	0.763	1.63	0.852	1.80	0.907	3919.262	0.001	0.151
ENJOYMENT										
Agree: I forget about time when I'm using digital devices.	IC013Q01NA	2.84	0.874	2.77	0.866	2.78	0.868	23.750	0.001	0.001
Agree: The Internet is a great resource for obtaining information I am interested in (e.g., news, sports, dictionary).	IC013Q04NA	3.20	0.734	3.31	0.703	3.29	0.710	76.063	0.001	0.003
Agree: It is very useful to have Social Networks on the Internet.	IC013Q05NA	3.05	0.734	3.16	0.720	3.14	0.724	80.907	0.001	0.004
Agree: I am really excited discovering new digital devices or applications.	IC013Q11NA	2.98	0.757	2.83	0.798	2.86	0.792	115.729	0.001	0.005
Agree: I really feel bad if no Internet connection is possible.	IC013Q12NA	2.88	0.823	2.99	0.852	2.97	0.847	60.800	0.001	0.003
Agree: I like using digital devices.	IC013Q13NA	3.17	0.724	3.29	0.672	3.27	0.684	100.539	0.001	0.005
Agree: I feel comfortable using digital devices that I am less familiar with.	IC014Q03NA	2.77	0.816	2.86	0.828	2.84	0.827	44.502	0.001	0.002
Agree: If my friends and relatives want to buy new digital devices or applications, I can give them advice.	IC014Q04NA	2.93	0.751	2.95	0.793	2.95	0.785	2.073	0.150	0.000
Agree: I feel comfortable using my digital devices at home.	IC014Q06NA	3.18	0.701	3.33	0.683	3.30	0.689	168.542	0.001	0.008
Agree: When I come across problems with digital devices, I think I can solve them.	IC014Q08NA	2.89	0.753	3.00	0.759	2.98	0.759	65.799	0.001	0.003
Agree: If my friends and relatives have a problem with digital devices, I can help them.	IC014Q09NA	2.90	0.765	3.01	0.774	2.99	0.773	68.286	0.001	0.003
Agree: If I need new software, I install it by myself.	IC015Q02NA	2.93	0.816	2.78	0.901	2.81	0.887	91.312	0.001	0.004
Agree: I read information about digital devices to be independent.	IC015Q03NA	2.85	0.771	2.61	0.864	2.65	0.852	284.550	0.001	0.013
Agree: I use digital devices as I want to use them.	IC015Q05NA	2.95	0.738	3.21	0.705	3.16	0.719	473.369	0.001	0.021
Agree: If I have a problem with digital devices I start to solve it on my own.	IC015Q07NA	2.82	0.792	2.98	0.768	2.95	0.775	139.732	0.001	0.006
Agree: If I need a new application, I choose it by myself.	IC015Q09NA	3.06	0.714	3.14	0.721	3.13	0.721	44.610	0.001	0.002
Agree: To learn something new about digital devices, I like to talk about them with my friends.	IC016Q01NA	2.80	0.762	2.80	0.773	2.80	0.771	0.001	0.974	0.000
Agree: I like to exchange solutions to problems with digital devices with others on the Internet.	IC016Q02NA	2.68	0.784	2.51	0.856	2.55	0.845	134.649	0.001	0.006
Agree: I like to meet friends and play computer and video games with them.	IC016Q04NA	2.74	0.858	2.58	1.013	2.61	0.987	90.777	0.001	0.004

Table 4. *Cont.*

	VARIABLES PISA	Brazil	(N = 4177)	Spain	(N = 17,896)	Total	(N = 22,073)	F	p	η^2
Agree: I like to share information about digital devices with my friends.	IC016Q05NA	2.78	0.772	2.66	0.847	2.69	0.835	63.597	0.001	0.003
Agree: I learn a lot about digital media by discussing with my friends and relatives.	IC016Q07NA	2.81	0.768	2.73	0.826	2.75	0.816	31.977	0.001	0.001

Note: multivariate tests: $\lambda_{Wilks} = 0.627$; F = 311.909; gl = 42–22,030; $p = 0.001$; ^{2} (SE) = 0.373. W only inclu e the statist i cally significant results ($p < 0.05$) ^{2} (e ta-s uared statistic) = e stimates o size effects. The Cohen (1988) rule signals = 0.01–0.06 (small effect); > 0.06–0.14 (medium effect); > 0.14 (large effect).

PUBLICACIONES INCLUIDAS EN LA TESIS DOCTORAL

Listado de artículos e indicadores de calidad

- Tesis doctoral presentada por Dª Nieves Gutiérrez Ángel en la modalidad de "compendio de publicaciones".
- Número de artículos publicados: 3
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Digital literacy in the university setting: A literature review of empirical studies between 2010 and 2021

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The impact of digital devices and the Internet has generated various changes at social, political, and economic levels, the repercussion of which is a great challenge characterized by the changing and globalized nature of today's society. This demands the development of new skills and new learning models in relation to information and communication technologies. Universities must respond to these social demands in the training of their future professionals. This paper aims to analyze the empirical evidence provided by international studies in the last eleven years, related to the digital literacy of university students, including those pursuing degrees related to the field of education. Our findings highlight the fact that the digital literacy that is offered in universities to graduate/postgraduate students, in addition to treating digital literacy as a central theme, also focuses on perceived and developed self-efficacy. This is done by strengthening competencies related to digital writing and reading, the use of databases, the digital design of content and materials, and the skills to edit, publish or share them on the web, or applications aimed at treating digital literacy as emerging pedagogies and educational innovation. Secondly, we found studies related to digital competencies and use of the Internet, social networks, web 2.0, or the treatment of digital risks and their relationship with digital literacy. Thirdly, we found works that, in addition to focusing on digital literacy, also focused on different psychological constructs such as motivation, commitment, attitudes, or satisfaction.

Systematic review registration: https://www.scopus.com/home.uri; https://www.recursoscientificos.fecyt.es/.

KEYWORDS

digital literacy, pre-service & teacher education, higher education, teachers', transversal competences

Introduction

The concept of digital literacy (DL) appears for the first time in the works of Zurkowski (1974), for whom it is an ability to identify, locate, and examine information. However, despite its novelty, the conceptions it encompasses have been changing (Lim and Newby, 2021). Proof of this are the contributions of Gilster (1997) who combines the idea that DL is also closely linked to skills such as access, evaluation, and management of information used in learning processes. Digital learning is understood as the set of technical-procedural, cognitive, and socio-emotional skills necessary to live, learn, and work in a digital society (Eshet-Alkalai, 2012; European Commission, 2018). It is related to reading, writing, calculation skills, and effective use of technology in personal, social, and professional areas. It is also considered inseparable from the social and educational needs of the society in which we live (Larraz, 2013; Brata et al., 2022). Therefore, we refer to a conceptthat has several aspects including the technological aspect, the informative and multimedia aspect, and the communicative aspect. It involves a complete process and multiple literacies (Gisbert and Esteve, 2011; Lázaro, 2015; Valverde et al., 2022). It requires mastery of certain competencies related to the identification of training needs, access to information in digital environments, the use of ICT tools to manage information, interpretation, and representation of information, and the evaluation of information and the transmission of information (Covello and Lei, 2010; Walsh et al., 2022).

Digital literacy in university students

In recent years, society has undergone enormous changes with the digitalization of many of its spheres at the information level, the communication level, the level of knowledge acquisition, the level of the establishment of social relations, and even the level of leisure. Thus, our habits and means of accessing, managing, and transforming information have also changed (European Union, 2013; Cantabrana and Cervera, 2015; Allen et al., 2020; López-Meneses et al., 2020).

These developments have also had a great impact on the educational field, in which we have to rethink firstly what kind of students we are training in terms of the skills they need in today's society, and secondly, whether we are training a profile of future teachers capable of training a student body that uses information and communication technologies as something inherent to their own personal and social development. In short, digital communication has changed practices related to literacy and has gained great relevance in the development of knowledge in the twenty-first century (Comisión Europea, 2012, 2013; European Commission, 2012; OECD, 2012; Unión Europea, 2013; Instituto Nacional de Tecnologías Educativas y Formación del Profesorado, 2017; Gudmundsdottir and Hatlevik, 2018; Pérez and Nagata, 2019; Fernández-de-la-Iglesia et al., 2020).

The European Commission (2013) indicates that initial teacher training (IDT) should integrate teachers' digital literacy, betting on the pedagogical use of digital tools, enabling them to use them in an effective, appropriate, and contextualized manner. This teaching competence should be characterized by having a holistic, contextualized, performance-, function-, and development-oriented character. In short, it is about incorporating and adequately using ICT as a didactic resource (Cantabrana and Cervera, 2015; Castañeda et al., 2018; Tourón et al., 2018; Chow and Wong, 2020; Vodá et al., 2022).

In this sense, according to the work of Krumsvik (2009), the CDD (*competencia digital docente de los profesores*– digital competency training for teachers) is composed of four components: basic digital skills (Bawden, 2008), didactic competence with ICT (Koehler and Mishra, 2008; Gisbert and Esteve, 2011), learning strategies, and digital training or training.

While at the Spanish level, the Common Framework of Digital Teaching Competence of the National Institute of Educational Technologies and Teacher Training (INTEF, 2017) standardizes it in five areas: information and information literacy, communication and collaboration, digital content creation, security, and problem solving (López-Meneses et al., 2020). Recently, they have been consolidated as competencies that must be acquired by any university student, along with the knowledge, skills, and attitude that make up a digitally competent citizen (Recio et al., 2020; Indah et al., 2022).

Digital literacy in future teachers

Several efforts have been made to equip future teachers with these competencies through different standards and frameworks to the level of learning acquired (Fraser et al., 2013; INTEF, 2017; UNESCO, 2018). However, how to work these competencies in initial training is still a hotly debated topic, in which special attention is paid to the promotion of experiences of a pedagogical and innovative nature to transform teaching practices, involving the integration of technologies in the classroom, as stated in the Horizon Report 2019 for the Higher Education (Educause, 2019; Le et al., 2022).

Universities are in a moment of transformation, from a teacher-focused teaching model to a model based on active learning through the use of digital technologies, giving rise to a new type of education in which the use of digital devices is intrinsic (Area, 2018; Aarsand, 2019). If digital resourcesand devices are an inescapable part of current and futureteaching practice, digital competency training for future teachers becomes extremely relevant, given that teachers need to acquire these competencies in their initial training to integrate them into their practices as future teachers. That is, the digital competence (DC) acquired during their initial training significantly predicts

the integration of technologies in future teaching practice (Nikou and Aavakare, 2021), which could range from basic digital literacy to the integration of technologies in their daily teaching practice (Gisbert et al., 2016; Alanoglu et al., 2022). Several studies have defined the different indicators that make up DC (Siddiq et al., 2017; González et al., 2018; Rodríguez-García et al., 2019; Cabero-Almenara and Palacios-Rodríguez, 2020).

This calls for a new paradigm, in which future teachers must be digitally literate, in terms of the application of active methodologies, digital competencies, and the use of innovative strategies, styles, and approaches (Garcia-Martin and Garcia-Sanchez, 2017; Gómez-García et al., 2021).

Currently, literacy workshops for future professionals are being carried out in a timely and precise manner from customized short training capsules to specific semester-long subjects in undergraduate or postgraduate studies. The training is focused on several specific aspects of digital literacy, but there is a lack of experience in imparting comprehensive digital training. In addition, there are just a few interactions with professional experts in such literacy (Ata and Yildirim, 2019; Campbell and Kapp, 2020; Domingo-Coscolla et al., 2020; Tomczyk et al., 2020; Vinokurova et al., 2021).

The present study

For the present study, we based our approach on quality and current education, in which DC was postulated as a key element for the development of students. The educational system was tasked with preparing them for their full developmentand participation in society (OECD, 2011). For this reason, digital literacy is understood as an essential requirement for development in the society in which we live, based onthe promotion of strategies related to searching, obtaining, processing, and communicating information. All these aspects have been consolidated as the dimensions of literacy in the twenty-first century (Piscitelli, 2009; Martín and Tyner, 2012). It is, therefore, necessary to understand the reality of this subject and to investigate how these practices are being developed in the context of work. And secondly, it is equally necessary to implement new interventions and lines of research that respond to this urgent need for literacy required by today's society. Therefore, we posed the following research questions: What psychoeducational and learning variables are key in digital literacy? What is the current situation internationally regarding digital literacy in all disciplines in pre-service teacher education? What are the differences in digital literacy requirements pre and post pandemic?

Objective

The objective of this study is to analyze the empirical evidence provided by international studies from 2010 to 2021 related to the digital literacy of university students, including those who are pursuing careers related to the educational field.

Relevant differences will be observed in the contributions in empirical evidence from international studies pre-post-pandemic; and drawn from diverse cultural backgrounds (Spanish-Latin, Portuguese, Finnish, etc.,), gender, and personal digital resources.

Materials and methods

The systematic review is composed of four phases, following the model of Miller et al. (2016) and Scott et al. (2018).

PHASE 1: Search terms: In this phase, we developed a schematic of search terms from Web of Science and Scopus databases. We also accessed the databases to locate specific studies that were referenced in the publications that we found in the databases during our initial search. The schematicof terms and thematic axes that were used as a starting point for scanning both databases for anything related to the descriptor "digital" and the descriptor "literacy" is presented in Figure 1.

PHASE 2: Selection process based on inclusion and exclusion criteria. The following selection criteria were applied: year of publication between 2010 and 2021, availability of full text, and language of publication in English, Portuguese, or Spanish. Once the first results were obtained, they were selected based on title, abstract, and the use of standardized instruments in their methodology. We rejected the studies that used "*ad hoc*" instruments to measure digital competence.

In addition, the selection indicators provided by Cooper and Hedges (1994) and Cooper (2009) were used, such as peer-reviewed journals, referenced databases, and citation indexes.

PHASE 3: Analysis of methodological quality and indicators based on scientific evidence. Following Torgerson (2007) and Risko et al. (2008) and taking into consideration the MQQn (Risko et al., 2008), we used seven indicators to analyze the quality and effectiveness of the studies (Acosta and Garza, 2011). These were: alignment of theory, findings, reliability and validity, descriptive details of participants and the study, sample, and consistency of findings and conclusions with the data (Risko et al., 2008). Alternatively, evidence-based indicators were also used along with study effect sizes (Díaz and García, 2016; Canedo-García et al., 2017).

PHASE 4: Reliability and outcomes. Reliability was established for both the selection criteria and the coding criteria during each phase, to evidence the replicability of the results. In addition, the results entailed a qualitative analysis of the selected studies, the central arguments, and the evidence provided in a modulated way to address the research questions.

Therefore, the procedure to be followed was documented and charted according to the PRISMA statement (Moher et al., 2009; Page et al., 2021) (see Figure 2). Likewise, an analysis was

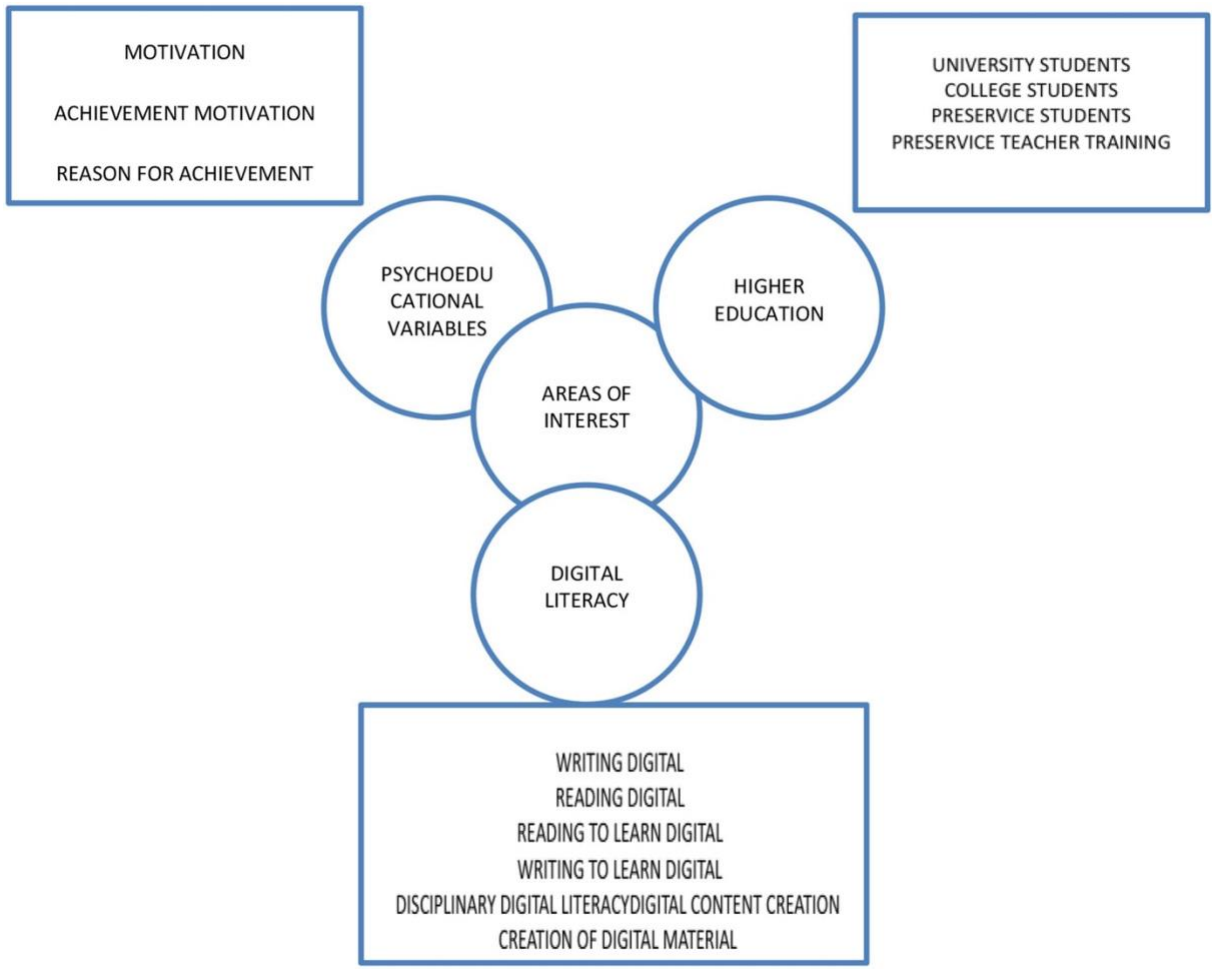

FIGURE 1
Diagram of search terms used in the systematic review.

undertaken of the key foci in the various studies to highlight the relevant findings and evidence they provided in this regard.The key focus of our work was: first, to analyze the documents related to the digital literacy of university students; second, to identify which variables affect digital literacy; and third, to undertake a comparative analysis between the different variables that were analyzed.

Results

All the selected studies had as samples university students who were pursuing some type of degree or postgraduate degree related to education, and therefore, studying to become future teachers. An intervention design was presented that corresponds to a pre-intervention, the intervention itself, and a post-intervention using techniques such as the activationof prior knowledge, instructions, emulation, and subsequent tests. We also found studies that had an experimental design assessing control groups and experimental groups (Kajee and Balfour, 2011; Kuhn, 2017; Pequeño et al., 2017; Sharp, 2018; Lerdpornkulrat et al., 2019).

In the case of those responsible for the intervention, practically in all cases, the teacher acts as such, with one or two of them taking the lead. Although the presence of specialized personnel should also be highlighted, as is the case of the work elaborated by Alfonzo and Batson (2014) and Elliott et al. (2018) in which a professional librarian also intervened. Or, in the work detailed by Ball (2019), where a consultant who is not a teacher but a professional expert in the use of digital devices and trained for such an occasion by a responsible brand (Apple) carried out the training at the center.

If we examine the constructs or competencies covered by the works selected in our search, we find that all of them, in addition to dealing with digital literacy, also focus on self-efficacy perceived and developed through digital literacy.

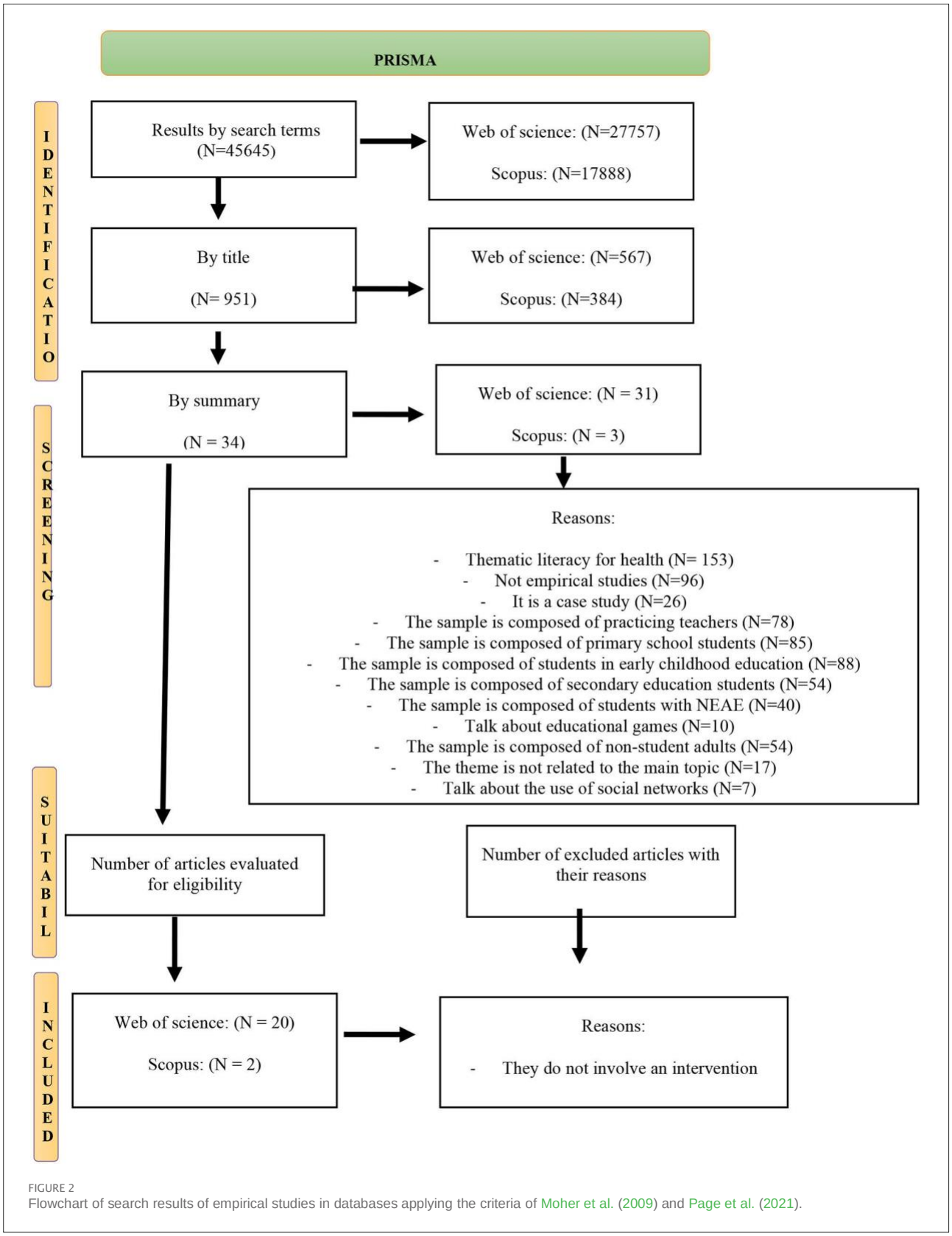

FIGURE 2
Flowchart of search results of empirical studies in databases applying the criteria of Moher et al. (2009) and Page et al. (2021).

The results of our study could be understood under different themes.

First, we found studies that referred to digital competence and other educational issues. Within them, we found a series of competencies that are emphasized such as digital writing and reading. Research developed from digital media, such as databases, web, or applications aimed at the treatment of digital literacy was noted as emerging pedagogies and educational innovation. The digital design of content and materials and the skills to edit, publish or share them, and competencies related to mathematics and its digital literacy, formed part of digital literacy.

Second, we found studies related to digital competence and the use and employment of the Internet, social networks, web 2.0, and the treatment of digital risks and their relationship with digital literacy.

Third, we found works that in addition to focusing on digital literacy, also focused on different psychological constructs such as motivation, commitment, attitudes, or satisfaction (Tables 1, 2).

Regarding instructional literature, we found a large number of results on mass training programs or courses in which digital literacy was the focus. Examples include a course offered in which students could sign up to, or modules taught during the teaching of a subject. We also found investigations on interventions that had been carried out through different subjects in the study program from where the sample was taken. In this case, the samples were taken on an *ad hoc* basis from a specific student body which the researcher intentionally decided based on a previous intervention experience with them (Ata and Yildirim, 2019; Ball, 2019; Campbell and Kapp, 2020; Domingo-Coscolla et al., 2020; Tomczyk et al., 2020; Vinokurova et al., 2021).

In terms of material resources, all the studies used some type of documentation (digital or not) with instructions onthe development of the activities, in which the students were provided with what to do and the steps to follow. In this case, the development scenario was both online and face-to-face, based on different activities given through workshops or seminars for their development.

It should also be noted that in those investigations in which the intervention itself required a specific application or program, the same was used, specifically, and even the intervention had a specific scenario since it was carried out in person in specialized laboratories where experts and specific material was available for this purpose. As an example of these specific materials, in our results, we found the use of the Photo Story 3, Dashboard, and Wikipedia, as well as the EMODO program or the SELI platform (Kajee and Balfour, 2011; Robertson et al., 2012; Ball, 2019; Hamutoglu et al., 2019; Tomczyk et al., 2020).

Regardless of the setting and the program or application employed, we can classify the duration of these interventions into two broad groups: those that had a duration of $<$1 semester, and those that had an intervention whose duration ranged from one semester to one academic year.

Regarding the instruments used, it should be noted that most of them used survey forms as an evaluation instrument, either by the researcher or by the students. In addition, it is usually used as a resource to collect information of a personal nature and about one's own experience throughout the intervention. We must also highlight the fact that in many of the results found, this form was used digitally or virtually, abandoning the old paper forms (Kajee and Balfour, 2011; Robertson et al., 2012; Carl and Strydom, 2017; Elliott et al., 2018; Ball, 2019; Lerdpornkulrat et al., 2019; Campbell and Kapp, 2020).

Regarding the use of questionnaires, scales or self-reports, we found several works that used participants' digital literacy histories as instruments. Through them, the researcher could learn first-hand about the sample's personal experience of digital literacy, the previous knowledge they possess, the digital skills they had mastered, those they lack, or those they consider they should improve. It also included the sample's vision regarding the use and employment of digital resources in teaching practice (Kajee and Balfour, 2011; Robertson et al., 2012; Pequeño et al., 2017; Elliott et al., 2018).

In the case of scales, we found two papers that employed a Likert-scale elaborated *ad hoc*. We also found studies that employed standardized scales like the Information Literacy Assessment Scale for Education (ILAS-ED), the Digital Literacy Scale, or the E-Learning Attitudes Scale.

Some of the studies we reviewed used semi-structured interviews as a means of monitoring and providing feedback to the students Table 3; (Kajee and Balfour, 2011; Alfonzo and Batson, 2014; Gill et al., 2015; Carl and Strydom, 2017; Elliott et al., 2018; Elphick, 2018; Ata and Yildirim, 2019; Campbell and Kapp, 2020).

As for the sequence through which the different interventions were developed, we found two types—first, those that divided the contents in time, as is the case of the work of Kajee and Balfour (2011), who covered a firstsemester digital writing from online classes, self-instructions and face-to-face classes in a specific laboratory, and in a secondsemester was exposed to different digital research techniques, following the same methodology. In contrast, we spotted the second type, where the same technique was followed throughout the study, as is the case of Robertson et al. (2012).They applied digital stories as a tool for the development of the activity, but also the evaluation of the competency. Inthe research carried out by Lerdpornkulrat et al. (2019), itis apparent that with the use of the rubric, the teacher gave them an example of the work and asked them all to practice evaluating and grading this work. In this way, they could checkif they understood how to use a rubric. They then used the rubric to self-assess their work. After receiving feedback, both groups of students revised and resubmitted their completed projects again.

TABLE 1 Summary of the results found.

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Alfonzo and Batson (2014)	*N* = 20 university doctoral students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 2. A teacher and a librarian	Digital literacy/ digital research/research software/ sdigital databases/self-efficacy	Digital search—apa standards—applications Resource management	Activation of previous knowledge-scaffolding Self-instructions Collaborative/ individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Ata and Yildirim (2019)	*N* = 295 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/internet/ social media/perception/ digital reading/digital writing/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/ individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Ball (2019)	Do not specify	Do not specify	Pre-post intervention	Do not specify	Specialized personnel	Digital literacy/digital writing/digital material/creation/editing// media literacy/cybersecurity/ self-efficacy	BA Writing and Publishing Program. emphasis on writing, researching, evaluating and reviewing articles in a digital environment	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Botturi (2019)	*N* = 26 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/access to information/digital content creation/content sharing/self-efficacy	Specific face-to-face program of 2 credits DML education course with 12 2-h sessions	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Campbell and Kapp (2020)	*N* = 4 university students (future teachers)	Do not specify	Pre-post intervention	Do not specify	N Teachers = 1	Digital literacy/self-efficacy/motivation	Training course Graduate Certificate in Education (PGCE)	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

(Continued)

TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Carl and Strydom (2017)	*N* = 11 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	*N Teachers = 1*	Digital literacy/E-portfolio/self-efficacy/motivation	Digital content design—digital material design	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Domingo-Coscolla et al. (2020)	*N* = 11 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 11	Digital literacy/diversity/innovation/self-efficacy/motivation	FIMTD project	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Elliott et al. (2018)	*N* = 48 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Support staff—library staff	Digital literacy/digital writing/digital material/self-efficacy	Module focused on theories of learning and development—sociological module focused on educational inequalities	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Elphick (2018)	*N* = 949 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/attitude/motivation/and self-efficacy	Use of iPad in education on a day-to-day basis	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

(Continued)

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TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Gabriele et al. (2019)	$N = 141$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/web 2.0/gamification/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Gill et al. (2015)	$N = 11$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/pre-preparation/digital knowledge/self-efficacy	Application of practical knowledge from different subjects of the career	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Hamutoglu et al. (2019)	$N = 47$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/attitude/digital learning/self-efficacy/motivation	Training course once a week for 3 h per week	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Istenic et al. (2016)	$N = 115$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital content design/digital mathematics/self-efficacy	Creation of digital stories—design of digital content—design of digital materials	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection

(Continued)

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TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Kajee and Balfour (2011)	$N = 20$ university students (future teachers)	GE = 10 GC = 10	Pre-post intervention	Intentional sampling	N Teachers = 1	Academic Literacy/Digital Writing/Digital Research/Self-Efficacy	Self-instructional/online classes in specific labs	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific grants Colloquium Planning-Reinforcement Review Selection
Kuhn (2017)	$N = 20$ university students (future teachers)	GE = 12 GE2 = 5 GC = 3	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/digital skills/motivation/autonomy/self-efficacy	Digital Practice and PLE	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Lerdpornkulrat et al. (2019)	$N = 584$ university students (future teachers)	GE = 321 GC = 263	Pre-post intervention	Intentional sampling	N Teachers = 1	Digital literacy/motivation/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Paige et al. (2016)	$N = 31$ university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital content design/digital mathematics	Creation of digital stories—design of digital content—design of digital materials	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Slowmation—digital narratives—round tables—interviews—oral evaluations
Pequeño et al. (2017)	$N = 54$ university students (future teachers)	GE = 31 GC = 24	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital narrative/self-efficacy	Application of practical knowledge from different subjects of the career	Activation of previous knowledge-Scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

(Continued)

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TABLE 1 (Continued)

Research	Participants					Construct and competence	Instructional procedure	Instructional techniques	Instructional strategies
	Sample	Groups	Design	Sampling and inclusion and exclusion criteria	Teachers				
Robertson et al. (2012)	*N* = 150 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	N Teachers = 2	Digital literacy/new pedagogies/multiliteracy/selfs-tories—thoughtful writing efficacy	Creation of digital	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Specific aid Colloquium Planning-Reinforcement Review Selection -Sharing
Sharp (2018)	*N* = 51 university students (future teachers)	GE = 20 GE2 = 20 GC = 11	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/attitude/digital skills/motivation/autonomy/self-efficacy	Creation of a blog, —asynchronous discussion, —wiki, —microblog	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Tomczyk et al. (2020)	*N* = 227 university students (future teachers)	Do not specify	Pre-post intervention	Intentional sampling	Do not specify	Digital literacy/digital inclusion/digital risks/digital content/self-efficacy	SELI Platform	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection
Vinokurova et al. (2021)	Do not specify	Do not specify	Do not specify	Do not specify	Do not specify	Digital literacy/self-efficacy	Training course	Activation of previous knowledge-scaffolding Self-instructions Collaborative/individual emulation Visualization	Colloquium Planning-Reinforcement Review Selection

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TABLE 2 Summary of the interventions found.

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Alfonzo and Batson (2014)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 4 days	Greater use of digital tools than before training	Has a sparse sample
Ata and Yildirim (2019)	Does not specify	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	An academic year	Increasing digital competence	It should apply more evaluation tools
Ball (2019)	Dashboard—training modules—Wikipedia guidelines and rules	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	An academic year	Increasing digital competence	Does not indicate the method
Botturi (2019)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher	4 months	Increasing digital competence	Has a sparse sample
Campbell and Kapp (2020)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	5 months	Increasing digital competence	Has a sparse sample
Carl and Strydom (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	Do not specify	Great interest and motivation on the part of the participants	Does not use standardized instruments
Domingo-Coscolla et al. (2020)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Great group	Researcher	Do not specify	Increasing digital competence	Has a sparse sample/does not indicate duration
Elliott et al. (2018)	Weekly Lectures-seminars-online resources-library	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	An academic year	Increased digital expertise and dominance	Has a sparse sample
Elphick (2018)	Conferences and seminars	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	One semester	Increased digital expertise and dominance	Does not use standardized instruments

(Continued)

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TABLE 2 (Continued)

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Gabriele et al. (2019)	Power point presentations—introductory videos of the software- brochures—applications created *ad hoc*	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	10 months	Increasing digital competence	Has a sparse sample
Gill et al. (2015)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 3 years	Practical knowledge of the application of ICT as a learning tool	Has a sparse sample
Hamutoglu et al. (2019)	Texts/documents—EDMODO	Teacher—Researcher	Developer of each activity	Great group	Researcher/face-to-face	5 weeks	Increasing digital competence	Has a sparse sample
Istenic et al. (2016)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An educational technology course in the academic year 2011–2012	Creation of digital content for the teaching of mathematics	Does not use standardized instruments
Kajee and Balfour (2011)	Texts/documents—computer applications-Laboratory with computers–standalone server—printer	Teacher—Researcher through 40 workstations	Developer of each activity through 40 workstations	Small group/face-to-face	Researcher Specific laboratory	Two semesters of 14 weeks duration	GE improvements greater than GC	Has a sparse sample
Kuhn (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An academic year	GE1 and GE2 improvements greater than GC	Has a sparse sample
Lerdpornkulrat et al. (2019)	Power point presentations—introductory videos of the software-brochures	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	13 sessions	Increased self-efficacy in relation to standards and expectations	It should apply more evaluation tools

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TABLE 2 (Continued)

Research	Materials	Instructor role	Student role	Student grouping	Implementation/ Context	Program duration	Intervention results	Comments
Paige et al. (2016)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	Do not specify	Creation of digital content for the teaching of mathematics	Does not use standardized instruments
Pequeño et al. (2017)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	An academic year	GE improvements greater than GC	Has a sparse sample
Robertson et al. (2012)	Texts/documents—computer applications—Photo Story 3 program	Teacher—Researcher	Developer of each activity	Small group	Researcher/virtual	For 3 years: 10 months	New learning and means of expression	Has a sparse sample
Sharp (2018)	Texts/documents—specific computer applications—material with indications	Teacher—Researcher	Developer of each activity	Small group	Researcher/face-to-face	Two semesters	GE1 and GE2 improvements greater than GC	Has a sparse sample
Tomczyk et al. (2020)	Texts/documents—SELI platform	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	Do not specify	Increasing digital competence	Does not indicate the process
Vinokurova et al. (2021)	Texts/documents—specific computer applications—material withindications	Teacher—Researcher	Developer of each activity	Great group	Researcher/virtual	Do not specify	Increasing digital competence	Omits data for possible replicability

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TABLE 3 Assessment intervention in the reviewed studies.

Research	Timetable for the implementation of each instrument	Direct comments	Task-specific performance	Overall task performance
Alfonzo and Batson (2014)	Pre-evaluation, post-evaluation and follow-up evaluation using Qual-trics software	Comparison and improvement of the results obtained through the Qual-trics software	Learning the ZOTERO platform at the end of the invention	Mastery of digital bibliographic research and ZOTERO
Ata and Yildirim (2019)	During the intervention	Does not specify	Does not specify	Carecen of digital skills to find, evaluate, create, and communicate
Ball (2019)	During the intervention	Tests throughout the development of the subject through portfolios	Feedback of the results of the questionnaires at the end of each module that showed improvements	Progressive mastery of digital skills
Botturi (2019)	Before and after the intervention	Agree with the participants on the contents and the evaluation	Yields are analyzed practice and evolution	Limited space in the curriculum
Campbell and Kapp (2020)	Before and after the intervention	Learning models and tasks to apply in the classroom	Inclusion of digital competences in curriculum design and monitoring of their development	Differences between resources in cemters and in households
Carl and Strydom (2017)	Before and after the intervention	Assessment through direct observation and class visits	Digital learning as part of teacher training	Digital writing support required
Domingo-Coscolla et al. (2020)	Before and after the intervention	Documentary analysis. Discussion groups and finally questionnaires	Digital literacy and content creation	Not all aspects of CDD are measured
Elliott et al. (2018)	Before and after the intervention	Through the delivery of weekly activities	Increased capacity to identify, select and apply digital reading	Not all students developed these skills
Elphick (2018)	Before and after the intervention	Performance is measured through direct observation and scales	Increasing the dominance of digital competence with iPads	A single discipline with a smaller number of staff and students
Gabriele et al. (2019)	Before and after the intervention	feedback on your programming experience and skills from questionnaires	Medium-high level of CT skills, combining design and programming skills	It must be applied in educational practice and not only at the laboratory level
Gill et al. (2015)	Before and after the intervention	3 stages of ict teaching capacity development in which each phase is evaluated	Practice itself as a learning tool	Minimal development where there is no real use of ICT for learning and teaching
Hamutoglu et al. (2019)	Before and after the intervention	Before and after the introduction by standardized instruments	Increased attitudes and skills	Only through EDMODO
Istenic et al. (2016)	Before and after the intervention	Describes the statement design framework and evaluation criteria for solving mathematical and digital problems	Their conceptions changed during the course of passive recipients to active producers of media content.	Control group without intervention
Kajee and Balfour (2011)	Before and after the intervention	Evaluates the results by semesters from accounts or observations	Increasing digital capacity	Large differences in terms of resources
Kuhn (2017)	Before and after the intervention	Evaluate performance through student presentations	Improving your digital skills and abilities	Scarcity of digital tools
Lerdpornkulrat et al. (2019)	Before and after the intervention	Formative assessment and feedback	Increased ability to search, evaluate, process and communicate information	Only the students of the experimental group participated in a formalized activity in the classroom
Paige et al. (2016)	Before and after the intervention	Development of conceptual and semiotic understandings.	Increasing digital literacy in content creation	It is only done with one app
Pequeño et al. (2017)	Before and after the intervention	Narrative research with digital ethnography,	Technological and social mediation	Focused solely on one degree

(Continued)

TABLE 3 (Continued)

Research	Timetable for the implementation of each instrument	Direct comments	Task-specific performance	Overall task performance
Robertson et al. (2012)	Before, during, and after the intervention	Throughout the process, personal reflections on their own experience are requested.	New understanding of literacy, particularly when digital stories are shared as part of the adult classroom experience	Only uses digital stories to gather information from the sample
Sharp (2018)	Before and after the intervention	Performance is evaluated after each practice	Increased perceived levels of confidence and importance of digital literacy	Does not indicate assessment instruments
Tomczyk et al. (2020)	Before and after the intervention	Reflections and own experiences on e-leawrning at the end of each course	Increasing digital competence	Does not indicate assessment instruments
Vinokurova et al. (2021)	Before, during, and after the intervention	Observation, analysis and pedagogical design and surveys during the intervention	Increasing professional skills, information culture and digital literacy	Insufficient digital resources

In the investigation by Elliott et al. (2018), the intervention was structured in work modules with the following sequence of sessions: they were introducedin the first session with opportunities for groupdiscussions and questions. Essential module reading was provided in weekly online study units and module workshops integrated academic reading and writing activities, such as paraphrasing and referencing, with module content.

In the study by Ball (2019), in the first year, the students took modules on publishing history, culture, markets, and media. In the second year, the intervention was based on their publishing skills, reading for writing development, and grammar and general literacy.

Hamutoglu et al. (2019) organized their intervention in different weeks, such that during the first week of the 14-week semester, the instructor oriented the students for the course and administered pre-tests. In the following week, students were provided with a session on the Edmodo platform and orientation training on the course content.

In the work of Gabriele et al. (2019), the experimental research plan (i.e., activities to be performed, methodology to be adopted) was established over 4 months followed by the organization of the reading material (power point presentations, introductory videos of the software, handouts, *ad hoc* created applications as examples).

We also found interventions that had very short time durations, but provide daily detail of the contents and interventions. Similarly, Alfonzo and Batson (2014) dedicate 1 day to the search and orientation in digital resources, 1day to the APA standards, and 3 days to develop and use a specific application.

In the research by Istenic et al. (2016), the intervention was based on six different types of tasks related to a variety of mathematical problems, including problems withredundant data, problems with multiple solutions, problems with multiple paths to the solution, problems with no solution, mathematical problems in logic, and problems with insufficient information.

In some interventions, the sequence through which they are developed is the very development of the subject of the degree course from which they are implemented, as is the case of the work of Gill et al. (2015).

In the work of Carl and Strydom (2017), students were first familiarized with the devices and then introduced to electronic portfolios, which helped them to create blogs that serve as platforms for electronic portfolios, and guided them on how to collect artifacts and how to reflect and share content.

In one work we found narrative was used as a technique so that the students could later present their work, analyze it in groups, rework it and present it again to their classmates. Kuhn (2017), Pequeño et al. (2017), and Elphick (2018) followedthis model.

Adopting a novel consultative approach, Botturi (2019) co-designed the intervention with his students in two steps: they were surveyed 4 weeks before the start of the course andasked to choose between two options: an overview of different topics/methods/experiences, or an in-depth exploration of one or two topics/methods/experiences. All respondentsindicated a preference for the first option and provided indications of the topics they wished to cover (see Tables 4,5).

The limitations of our search are listed in Table 6. At the theoretical level, we encountered studies that were not very

TABLE 4 Assessment instruments used in the instructional intervention in the reviewed studies.

Research	Questionnaires-self-reports-rating scales-semantic differential	Wallet physical/virtual	Interviews-Reports	Evaluation of the effects of the intervention	Satisfaction	Comments-Individual-Group
Alfonzo and Batson (2014)	Information literacy assessment scale for education (ILAS-ED)	Observations on student work	Does not specify	Post-evaluation of the competencies from the qualtrics software	Learning and satisfaction for participating students	Significant effects on previous methods of instruction
Ata and Yildirim (2019)	Digital literacy scale	Does not specify	Does not specify	The final evaluation confirms the mastery of digital competences	Attitudinal, cognitive and are predictors of digital literacy	Domain alto and positive perceptions of digital literacy
Ball (2019)	Article editing of at least 1,500 words of additional content to the article–500–word report detailing the choice of edits made and the approach used	Edited portfolio	Weekly blog through Pebblepad (an electronic portfolio platform), detailing and explaining the work done that week	1,090 edits in 124 articles, creating six new articles	High capacity for digital editing and publication of content	Mastery and monitoring of competencies after the training course
Botturi (2019)	*Ad hoc* elaborate Likert scale	Does not specify	Follow-up interviews	Greater digital self-efficacy	Critical assessment of obstacles to implementing DML	Ability to integrate DML
Campbell and Kapp (2020)	Questionnaires that provide background on participants' biographies, perceptions, and experiences with technology	Reflections - justification of their use of technology - narratives of the difficulties experienced	Video recording, semi-structured - focus group interview	Increasing understanding of digital learning possibilities	Complementary tool and means to participate and not as an intentional remedy	Digital non-competition is a barrier today
Carl and Strydom (2017)	*Ad hoc* elaborate Likert scale	Individual and virtual	Recorded interviews: reflection, training, professional development, and social dimensions of the e-portfolio	Integration of electronic portfolios as tools for reflection	High institutional expectations	Digital growth and development through the use of digital portfolios
Domingo-Coscolla et al. (2020)	*Ad hoc* elaborate Likert scale	Does not specify	Focus groups	Promoting digital literacy and digital content creation	Insufficient C DD proficiency	Three institutional actions on CDD to be considered in university curricula

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TABLE 4 (Continued)

Research	Questionnaires-self-reports-rating scales-semantic differential	Wallet physical/virtual	Interviews-Reports	Evaluation of the effects of the intervention	Satisfaction	Comments-Individual-Group
Elliott et al. (2018)	Essay of 3,000 words on the theories of learning—group oral presentation	Portfolio of 3,000 words. The portfolio was divided into three sections that required students to relate different phases of their personal education experiences to theory.	Semi-structured questionnaires, mainly quantitative, at the beginning and end of the academic year	Difficulties as part of the process	Students' expectations of achievement as the course progressed	Scaffolding strategies with a positive effect on digital self-efficacy
Elphick (2018)	Free text surveys—*ad hoc* elaborate Likert scale	Does not specify	Semi-structured interview with small groups	Correlations between classrooms rich in technology and digital self-efficacy	The use of iPads has a positive impact on digital behaviors and perceptions about digital skills	Digital competence as a key skill in teachers
Gabriele et al. (2019)	*Ad hoc* elaborate Likert scale	Does not specify	Tests to check the level of abstraction, parallelism, logistics, synchronization, and control	practical applicability of the intervention	Elaboration of digital material from games with Scratch Software	Increased knowledge and digital skills
Gill et al. (2015)	Interviews developed in 6 phases	Does not specify	Interviews developed in 6 phases	development is proportionate to opportunities to observe and/or use ICT for learning	Classroom experience enables and accelerates the development of digital literacy	The development of digital literacy as a key challenge for future donors
Hamutoglu et al. (2019)	E-Learning attitudes scale—digital literacy scale	Does not specify	Does not specify	Relevant results in terms of avoidance	The trend is one of the most significant predictors of digital literacy skills.	Effectiveness of treatment on participants' attitudes toward e-learning platforms
Istenic et al. (2016)	Performance analysis—analysis of written reflections—pre- and post-test scores-reflections of the participants	Does not specify	Does not specify	Increases in digital pedagogical competences	Instructional approach with digital storytelling and multi-mode design to facilitate learning	Transfer of ICT competencies and their integration into teaching
Kajee and Balfour (2011)	Digital literacy stories of the participants (collected at the beginning of the semester)	Remarks of student work—access and sufficiency	Semi-structured interviews	Digital practice as valuable and social knowledge	Influence of the social context	Digital literacy as a contribution and influence to learning

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TABLE 4 (Continued)

Research	Questionnaires-self-reports-rating scales-semantic differential	Wallet physical/virtual	Interviews-Reports	Evaluation of the effects of the intervention	Satisfaction	Comments-Individual-Group
		surveys—journal of researcher's reflections				
Kuhn (2017)	*Ad hoc* elaborate likert scale	Does not specify	Focus groups	Obtaining new literacies from digital practice	Need for support and guidance in these contents	Redesign of the PLE of the students.
Lerdpornkulrat et al. (2019)	Questionnaires developed *ad hoc*—standardized questionnaires	Rubric	Does not specify	Developing self-efficacy related to digital literacy	Increase in self-efficacy in information literacy	The rubric as an appropriate tool to measure learning outcomes related to information literacy
Paige et al. (2016)	*Ad hoc* elaborate Likert scale	Does not specify	Does not specify	experiences and reflections of the PST on Slowmation as an educational tool	Modeling of best practice evaluation tools.	Digital literacy skills development
Pequeño et al. (2017)	Transmedia narratives	Does not specify	Comments and recommendations made in the group work	Transmedia education as a process of technological mediation and social	Digital skills that students incorporate into internships design, analysis, production, and dissemination of transmedia content	Creation and dissemination of transmedia content
Robertson et al. (2012)	Personal digital story	Remarks of student work—journal of researcher's reflections	Does not specify	Digital stories as an appropriate tool for evaluation and reflection	Multi-literacy	Evidence of transformative pedagogy
Sharp (2018)	*Ad hoc* elaborate likert scale	Does not specify	Does not specify	Increasing prevalence of digital learning environments.	Greater involvement in digital practices	Collaborative digital literacy practices
Tomczyk et al. (2020)	*Ad hoc* elaborate likert scale	Does not specify	Does not specify	Need for more training	Need for more studies to identify digital gaps	Achievement Learning Autonomy Adaptation
Vinokurova et al. (2021)	Does not specify	Does not specify	Does not specify	Educational paradigm shift in terms of the content of education	Digital transformation	Increased opportunities for teachers to offer and disseminate ICTs if they have good digital literacy

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TABLE 5 Treatment fidelity.

Research	Pertinence	Meetings	Feedback	Reliability and validity assessment	Maintenance and generalization	Other controls	Feedback
Alfonzo and Batson (2014)	Horizontal relevance	Does not specify	Feedback to the student at the end of the course	Does not specify	Pre-post-follow-up evaluation	Agreement between observers collecting data	The duration of the workshops is short
Ata and Yildirim (2019)	Horizontal relevance	Does not specify	Feedback to students after the completion of each phase	Reliability Validity	Pre-post-intervention evaluation	A single researcher	Does not indicate the process or sessions
Ball (2019)	Horizontal relevance	Does not specify	Feedback to students after each module	Consistency	Pre-post-intervention evaluation	A single researcher	Does not use standardized instruments
Botturi (2019)	Horizontal relevance	Does not specify	Continuous feedback to students on each task	Consistency	Pre-post-intervention evaluation	A single researcher	Does not use records such as interviews or portfolios
Campbell and Kapp (2020)	Horizontal relevance	Does not specify	Feedback at the end of the intervention	Does not specify	Pre-post-intervention evaluation	A single researcher	Does not indicate the process or sessions
Carl and Strydom (2017)	Horizontal relevance	Does not specify	Feedback to students at the end of the course	Does not specify	Pre-post-intervention evaluation	A single researcher	Does not specify the duration
Domingo-Coscolla et al. (2020)	Horizontal relevance	Does not specify	Feedback to students at the end of the intervention	Reliability Validity	Pre-post-intervention evaluation	Agreement between observers collecting data	Does not use records such as interviews or portfolios
Elliott et al. (2018)	Horizontal relevance	Does not specify	Feedback to students after each session	Reliability Validity Consistency Exploratory factor analysis	Pre-post-intervention evaluation	Agreement between observers collecting data	Does not use standardized instruments
Elphick (2018)	Horizontal relevance	Does not specify	Feedback to students after each session	Consistency	Pre-post-intervention evaluation	A single researcher	Does not use standardized instruments
Gabriele et al. (2019)	Horizontal relevance	Does not specify	feedback on your programming experience and skills from questionnaires	Reliability Consistency Validity	Pre-post-intervention evaluation	Does not specify	Does not use records such as interviews or portfolios
Gill et al. (2015)	Horizontal relevance	Does not specify	Feedback to students in each subject	Reliability Consistency Validity Exploratory factor analysis	Pre-post-follow-up evaluation	Do not specify	Does not apply any self-assessment scale
Hamutoglu et al. (2019)	Horizontal relevance	Does not specify	Feedback to students with the scores of each standardized instrument	Reliability Validity	Pre-post-intervention evaluation	A single researcher	Does not use records such as interviews or portfolios
Istenic et al. (2016)	Horizontal relevance	Does not specify	Feedback to students after completing each task (6)	Reliability Validity	Pre-post-intervention evaluation	Do not specify	Does not apply any self-assessment scale

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TABLE 5 (Continued)

Research	Pertinence	Meetings	Feedback	Reliability and validity assessment	Maintenance and generalization	Other controls	Feedback
Kajee and Balfour (2011)	Horizontal relevance	Does not specify	Student feedback at the end of each semester	Does not specify	Pre-post-intervention evaluation	A single researcher	Only applicable within the university and within the laboratory itself
Kuhn (2017)	Horizontal relevance	Does not specify	Continuous feedback after each student presentation	Vaqlidez	Pre-post-follow-up evaluation	Do not specify	Does not use standardized instruments
Lerdpornkulrat et al. (2019)	Horizontal relevance	Does not specify	Feedback from the researcher and self-assessment	Reliability Consistency Validity Exploratory factor analysis	Pre-post-intervention evaluation	A single researcher	Does not use records such as interviews or portfolios
Paige et al. (2016)	Horizontal relevance	Does not specify	Feedback after the intervention	Validity	Pre-post-intervention evaluation	Do not specify	Does not specify the duration
Pequeño et al. (2017)	Horizontal relevance	Does not specify	Feedback after the intervention	Consistency Validity	Pre-post-intervention evaluation	Do not specify	Does not use standardized instruments
Robertson et al. (2012)	Horizontal relevance	Does not specify	Continuous feedback from their own experiences	Does not specify	Pre-post-follow-up evaluation	Agreement between observers collecting data	Does not apply any self-assessment scale
Sharp (2018)	Horizontal relevance	Does not specify	Feedback after the intervention	Consistency Exploratory factor analysis	Pre-post-intervention evaluation	Do not specify	Does not use standardized instruments
Tomczyk et al. (2020)	Horizontal relevance	Does not specify	Feedback after the intervention	Reliability Consistency Validity Exploratory factor analysis	Pre-post-intervention evaluation	Do not specify	Does not use records such as interviews or portfolios
Vinokurova et al. (2021)	Horizontal relevance	Does not specify	Feedback from students through their own experience	Validity	Pre-post-follow-up evaluation	Do not specify	Does not indicate the process or sessions

Indicators and controls used in the instructional intervention in the empirical studies reviewed II.

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current, missing research questions or hypotheses, or even missing objectives. At the statistical level, we found several studies had a small or unrepresentative sample.

Analyzing the interventions themselves, we identified a few limitations, especially in those studies that neither indicates the tasks, record the entire process, or lack key informationto replicate the intervention. In some studies, key information relating to the person carrying out the intervention was missing, particularly on whether they had the specific training for this purpose. Another limitation that was identified was that very few evaluation strategies were in place to evaluate the interventions (see Table 7).

Similarly, gaps were found regarding ethical controls, where in some studies the main limitation was that ethical controls were non-existent or not specified (Robertson et al., 2012; Istenic et al., 2016; Kuhn, 2017; Elphick, 2018; Ata and Yildirim, 2019; Tomczyk et al., 2020).

Figure 3 shows the evolution over the years of the samples used in each of the studies from 2011 to 2020.

Figure 4 shows the evolution over the years of the controls used in each of the studies from 2011 to 2021.

Discussion

This work aimed to analyze the empirical evidence found in international studies between 2011 to 2021 related to the digital literacy of university students, including those pursuing degrees in education. This objective has been met.

Regarding the first focus related to literacy, this paper highlighted the fact that studies from the West are the most prevalent in this field (Çoklar et al., 2017; Ata and Yildirim, 2019; Hamutoglu et al., 2019; Sujarwo et al., 2022), which correspond to cross-sectional studies, mostly employing instruments such as "the Digital Literacy Scale" developed by Ng (2012), and "the information literacy self-efficacy scale (ILS)" developed by Kurbanoglu et al. (2006). Regarding the level of mastery, the results showed an upper intermediate level of competence in information and digital literacy, communication, and collaboration, but a low intermediate level in terms of digital content creation, particularly in the creation and dissemination of multimedia content using different tools (López-Meneses et al., 2020; Moreno et al., 2020).

Regarding the second focus, digital literacy in university students, this study reviewed the various contributions of other works and found the presence of a competent group in this field, which makes efficient use of both the Internet and digital media (Çoklar et al., 2016; Ata and Yildirim, 2019; Lim and Newby, 2021). However, differences were also found in this collective relating to gender, where women were more competent than men in digital literacy, information literacy, technological literacy, and communicative literacy (Hamutoglu et al., 2019; López-Meneses et al., 2020; Navarro, 2020). However, on the other hand, we lso found studies that revealed particular gender gaps where men showed a higher propensity for DL, while women outperform men in the overall digital literacy test (Ata and Yildirim, 2019). Ata and Yildirim (2019) also found differences in DL between students where university students studying science or mathematics-related majors had higher levels of digital literacy than students majoring in social sciences or psychology fields (Ata and Yildirim, 2019; Chow and Wong, 2020).

And as for the third focus, digital literacy in future teachers, we found a dual use of digital literacy, in its social and leisure aspect (searching or maintaining friendships through social networks, sharing digital content, downloading content, or playing online games), and in its academic aspect (searching in search engines, working through online documents, organizing or synthesizing information from different processors, using computer programs to make presentations, edit images or content, or create audiovisual content (López-Meneses et al., 2020).

The main contribution of this review lies in its comparison between pre/post-pandemic studies, which show a great increase in the use of technologies in the educational world (across the curriculum), and research work focused on measuring the competencies of these devices (Baber et al., 2022). These new investigations have not only followed the line of previous ones but focused on the measurement of digital literacy and its influence on it by variables such as the degree of origin, gender, age, or being a digital native or immigrant (Castañeda-Peña et al., 2015; Çoklar et al., 2016; Castañeda et al., 2018; Ata and Yildirim, 2019; Gür et al., 2019; Hamutoglu et al., 2019; Lerdpornkulrat et al., 2019; González et al., 2020; Navarro, 2020; De Sixte et al., 2021). But there has been an expansion of the topics and variables that are studied in conjunction with digital literacy, among which we find as a novelty, the study of psycho-educational variables such as academic motivation (Chow and Wong, 2020), self-efficacy and motivation (Lerdpornkulrat et al., 2019), effort expectations (Nikou and Aavakare, 2021), and self-concept as a student and as a teacher (Ye¸silyurt et al., 2016). The importance attached to the educational field, the identification of different roles or behaviors within the concept of digital literacy that is delimited, or even the types of uses within the concept of digital literacy (López-Meneses et al., 2020; Moreno et al., 2020; Navarro, 2020; Lim and Newby, 2021) are new trends.

Therefore, we can affirm that in this study the research predictions are fulfilled, in that the results found show relevant differences from international studies pre-post pandemic; and by different cultural backgrounds (Spanish Latin, Portuguese, Finnish...), gender, and personal digital resources. In termsof applications for educational practice, these results do not indicate that university students are competent in terms of digital literacy, although they demonstrate some competencies like online information search, information evaluation, information processing, information communication, and

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TABLE 6 Limitations of the instructional interventions described in the empirical studies reviewed.

Research	Background limitations	Limitations on participants	Limitations of the instrument	Program limitations	Limitations of results	Discussion on limitations and conclusions	General limitations	Comments
Alfonzo and Batson (2014)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data	Non-grouping	No graphs or tables They do not analyze each variable Not analyzing generalization effects	Does not indicate reliability and validity assessment	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Ata and Yildirim (2019)	The research question is missing	Lack of inclusion and exclusion criteria	No tasks Do not record the entire process	Non-grouping	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Few evaluation strategies
Ball (2019)	The research question is missing Missing assumptions or forecasts	No method	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	No graphs or tables They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Does not indicate the sample
Botturi (2019)	The research question is missing	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Few evaluation strategies
Campbell and Kapp (2020)	The research question is missing Missing assumptions or forecasts	Lack of inclusion and exclusion criteria	No tasks Do not record the entire process	Non-grouping	They do not analyze each variable	Does not indicate reliability and validity assessment current previews	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Carl and Strydom (2017)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping No duration	No graphs or tables They do not analyze each variable Not analyzing generalization effects	Does not indicate reliability and validity assessment	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger

(Continued)

TABLE 6 (Continued)

Research	Background limitations	Limitations on participants	Limitations of the instrument	Program limitations	Limitations of results	Discussion on limitations and conclusions	General limitations	Comments
Domingo-Coscolla et al. (2020)	The research question is missing Missing assumptions or forecasts	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Elliott et al. (2018)	The research question is missing Missing assumptions or forecasts	Lack of inclusion and exclusion criteria Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	No graphs or tables They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Elphick (2018)	The research question is missing Missing assumptions or forecasts	Lack of inclusion and exclusion criteria	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	No number of sessions	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	The application of standardized chords and instruments is lacking. Few evaluation strategies
Gabriele et al. (2019)	Obsolete fonts	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	Only the publication is compared	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Gill et al. (2015)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data	Non-grouping	No graphs or tables They do not analyze each variable Not analyzing generalization effects	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger

(Continued)

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TABLE 6 (Continued)

Research	Background limitations	Limitations on participants	Limitations of the instrument	Program limitations	Limitations of results	Discussion on limitations and conclusions	General limitations	Comments
Hamutoglu et al. (2019)	The research question is missing	Lack of inclusion and exclusion criteria	No tasks	Non-grouping	Only the publication is compared	The answer to the research question is not indicated	No ethical controls (informed acceptance to participate, confidentiality...)	Few evaluation strategies
Istenic et al. (2016)	The research question is missing Missing assumptions or forecasts Missing targets	Lack of inclusion and exclusion criteria	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	No graphs or tables They do not analyze each variable Not analyzing generalization effects	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	The application of standardized chords and instruments is lacking. Few evaluation strategies
Kajee and Balfour (2011)	Obsolete fonts The research question is missing Missing assumptions or forecasts	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Not who implemented	No graphs or tables They do not analyze each variable Not analyzing generalization effects	Does not indicate Reliability and Validity Assessment	Key information to replicate the intervention is missing	Sample must be larger
Kuhn (2017)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	No number of sessions Not who implemented	No graphs or tables They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Lerdpornkulrat et al. (2019)	Missing assumptions or forecasts	Lack of inclusion and exclusion criteria	No tasks Do not record the entire process	Does not indicate instruction procedure	No practical and theoretical applications	No explicit limitations	No ethical controls (informed acceptance to participate, confidentiality...)	Does not use the wallet
Paige et al. (2016)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	Non-grouping	No graphs or tables They do not analyze each variable Not analyzing generalization effects	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger

(Continued)

TABLE 6 (Continued)

Research	Background limitations	Limitations on participants	Limitations of the instrument	Program limitations	Limitations of results	Discussion on limitations and conclusions	General limitations	Comments
Pequeño et al. (2017)	The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	No number of sessions Not who implemented	No graphs or tables They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Sample must be larger
Robertson et al. (2012)	Obsolete fonts The research question is missing Missing assumptions or forecasts Missing targets	Reduced sample Non-representative sample	Non-validity and reliability of instruments with their own data Inadequacy of the age course of the instruments Instruments unknown and not provided for in the Annex	Not who implemented	No graphs or tables They do not analyze each variable Not analyzing generalization effects	Does not indicate Reliability and Validity Assessment	It's not an experimental intervention study, it's just a pre-post group Key information to replicate the intervention is missing No ethical controls (informed acceptance to participate, confidentiality...)	The application of standardized chords and instruments is lacking. Few evaluation strategies
Sharp (2018)	The research question is missing Missing assumptions or forecasts	Lack of inclusion and exclusion criteria	Non-validity and reliability of instruments with their own data Instruments unknown and not provided for in the Annex	No number of sessions Not who implemented	No graphs or tables They do not analyze each variable	They do not compare with previous current studies	Key information to replicate the intervention is missing	The application of standardized chords and instruments is lacking. Few evaluation strategies
Tomczyk et al. (2020)	Missing research question Missing assumptions or forecasts	Lack of inclusion and exclusion criteria	No tasks Do not record the entire process	Non-grouping	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Few evaluation strategies
Vinokurova et al. (2021)	The research question is missing Missing assumptions or forecasts Missing targets	Lack of inclusion and exclusion criteria	No tasks Do not record the entire process	Non-grouping	They do not analyze each variable	They do not compare with previous current studies	No ethical controls (informed acceptance to participate, confidentiality...)	Does not indicate the procedure or the participants or the sessions

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TABLE 7 Treatment fidelity.

Research	Moment	Comparison of the control group	Sequence of instruction	Previous written protocol	Comparable instructor training	File	Uniform and standard application
Alfonzo and Batson (2014)	Pre During Expose Follow	Evaluate the group in general	3 workshops: Library Orientation, APA style, ZOTERO	Day 1: Library orientation, APA style. Day 2, 3, and 4: ZOTERO	Does not specify	Pre-evaluation, post-evaluation, and follow-up evaluation using qualtrics software	Equal application of the program to all students: same duration, sequence, tasks, and context
Ata and Yildirim (2019)	During Expose Follow	Evaluate the group in general	Does not specify	Does not specify	Does not specify	Does not specify	Equal application of the program to all students: same duration, sequence, tasks, and context
Ball (2019)	During Expose Follow	Evaluate the group in general	Modules of history and editorial culture, markets, and media. Editorial Skills Module, Reading for Writing, and Grammar Development and General Literacy	Does not specify	Does not specify	Portfolios and weekly blog	Equal application of the program to all students: same duration, sequence, tasks, and context
Botturi (2019)	During Expose Follow	Evaluate the group in general	Agreed with students that provided instructions on the topics they wished to cover	Does not specify	Does not specify	Balance	Equal application of the program to all students: same duration, sequence, tasks, and context
Campbell and Kapp (2020)	During Expose Follow	Evaluate the group in general	Does not specify	Does not specify	Does not specify	Questionnaires, portfolio, and interviews	Equal application of the program to all students: same duration, sequence, tasks, and context
Carl and Strydom (2017)	Pre During Expose Follow	They evaluate the group in general although I am divided into two subgroups	Stages: familiarization, indexing, graphing and cartography, and interpretation	Familiarization -blo-share	Does not specify	-Recorded interviews - portfolio	Equal application of the program to all students: same duration, sequence, tasks, and context
Domingo-Coscolla et al. (2020)	During Expose Follow	Evaluate the group in general	Does not specify	Does not specify	Does not specify	Scales and focus groups	Equal application of the program to all students: same duration, sequence, tasks, and context

(Continued)

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TABLE 7 (Continued)

Research	Moment	Comparison of the control group	Sequence of instruction	Previous written protocol	Comparable instructor training	File	Uniform and standard application
Elliott et al. (2018)	During Expose Follow	Evaluate the group in general	Sessions with opportunities for group discussions and questions. Module essential reading was provided in weekly online study units	Does not specify	Broader university support from support staff specializing in academic skills in the "learning development team" and library staff.	Questionnaires, essays, and portfolio	Equal application of the program to all students: same duration, sequence, tasks, and context
Elphick (2018)	During Expose Follow	Evaluate the group in general	Conferences and seminars—direct observation—scales—interviews	Does not specify	Training sessions facilitated by an Apple professional Authorized Development Coach	Narratives—presentations—classroom observations—comments and feedback—audiovisual recordings	Equal application of the program to all students: same duration, sequence, tasks, and context
Gabriele et al. (2019)	During Expose Follow	Evaluate the group in general	1. Experimental research plan 2. The reading material was organized (power point presentations, introductory videos of the software, brochures, applications created *ad hoc* as examples)	Does not specify	Does not specify	Scales and individual tests	Equal application of the program to all students: same duration, sequence, tasks, and context
Gill et al. (2015)	Pre During Expose Follow	Evaluate the group in general	Of the different subjects related to ICT in the career	Of the different subjects related to ICT in the career	Does not specify	Interviews	Equal application of the program to all students: same duration, sequence, context tasks
Hamutoglu et al. (2019)	During Expose Follow	Evaluate the group in general	Preliminary tests of the first week. In the following week session on the Edmodo platform and an orientation training on the content of the course	Does not specify	Does not specify	Two standardized scales	Equal application of the program to all students: same duration, sequence, context tasks
Istenic et al. (2016)	Pre During Expose Follow	Evaluate the group in general	Six tasks	Students completed the pre-test before the start of the study and the subsequent test 15 days later.	Does not specify	Digital Literacy Stories—Pre and Post-Assessment	Equal application of the program to all students: same duration, sequence, context tasks

Kajee and Balfour (2011)	Pre During Expose Follow	Evaluation of the intervention group and another equivalent control group to verify differential efficacy	Semester 1: Digital Writing Semester 2: Digital Research	Does not specify	Does not specify	Digital literacy stories—semi-structured interviews—observations—access and sufficiency surveys—journal of researchers' reflections	Equal application of the program to all students: same duration, sequence, context tasks

(Continued)

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TABLE 7 (Continued)

Research	Moment	Comparison of the control group	Sequence of instruction	Previous written protocol	Comparable instructor training	File	Uniform and standard application
Kuhn (2017)	During Expose Follow	Evaluation of the intervention group and another equivalent control group to verify differential efficacy	Scales—exhibition—discussion groups	Does not specify	Does not specify	Narratives—exhibitions—classroom observations—comments and feedback—audiovisual recordings	Equal application of the program to all students: same duration, sequence, context tasks
Lerdpornkulrat et al. (2019)	During Expose Follow	Only the GC participates in a formalized face-to-face activity based on the use of the course rubric as a self-assessment tool	Through the rubric they were able to self-evaluate your own work After receiving feedback, both groups of students reviewed and resubmitted their feedback Complete projects again	Does not specify	Does not specify	Questionnaires developed *ad hoc*—standardized questionnaires	only the students of the experimental group participated in a formalized activity in the classroom
Paige et al. (2016)	Pre During Expose Follow	Evaluate the group in general	Slowmation, vivas, digital narratives, roundtables, interviews and oral assessments	Slow	Does not specify	Pre- and post- intervention test—Scale	Equal application of the program to all students: same duration, sequence, context tasks
Pequeño et al. (2017)	During Expose Follow	Evaluation of the intervention group and another equivalent control group to verify differential efficacy	Narrative—characteristics—exhibition—analysis—reworking—exhibition and possibilities	Digital ethnography for examine relations with technologies and the media and how they mediate in the configuration of subjectivities	Does not specify	Narratives—exhibitions—classroom observations—comments and feedback—audiovisual recordings	Equal application of the program to all students: same duration, sequence, context tasks
Robertson et al. (2012)	Pre During Expose Follow	Evaluate the group in general	Digital stories. After the presentation, you are asked to write a written reflection describing your experience	Content analysis and categorization	Does not specify	Digital literacy stories of the—observations—journal of researcher's reflections	Equal application of the program to all students: same duration, sequence, context tasks

(Continued)

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TABLE 7 (Continued)

Research	Moment	Comparison of the control group	Sequence of instruction	Previous written protocol	Comparable instructor training	File	Uniform and standard application
Sharp (2018)	During Expose Follow	Evaluation of the intervention group and another equivalent control group to verify differential efficacy	Does not specify	Does not specify	Does not specify	Scales	Equal application of the program to all students: same duration, sequence, context tasks
Tomczyk et al. (2020)	During Expose Follow	Evaluate the group in general	Unspecified	Does not specify	Does not specify	Scale	Equal application of the program to all students: same duration, sequence, context tasks
Vinokurova et al. (2021)	During Expose Follow	Evaluate the group in general	Does not specify	Does not specify	Does not specify	Theoretical analysis of the pedagogical experience, interpretation of scientific data, pedagogical design method (planning, modeling, and conducting classes), and analysis of empirical data in the form of a survey	Equal application of the program to all students: same duration, sequence, context tasks

Indicators and controls used in the instructional intervention in the empirical studies reviewed.

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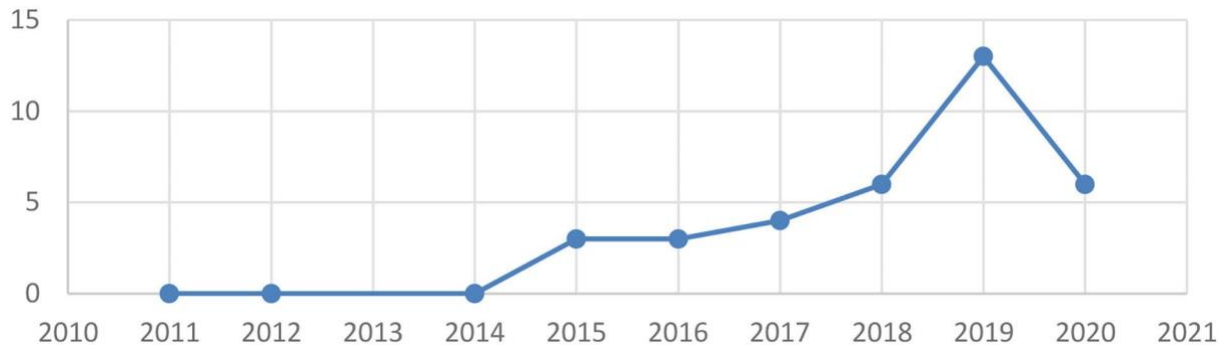

FIGURE 3
Evolution over years of the samples used in the studies from 2010 to 2021.

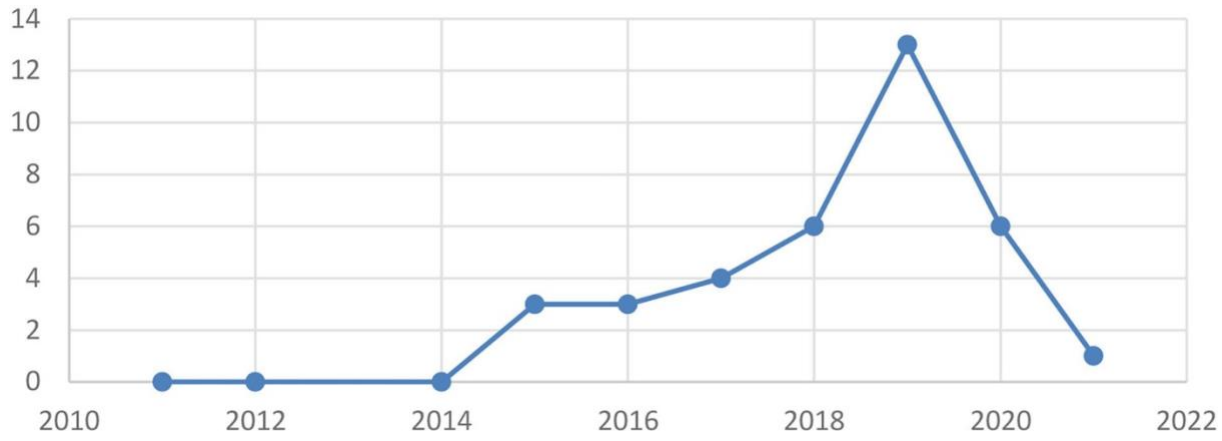

FIGURE 4
Evolution over years of the controls used in studies from 2010 to 2021.

dissemination skills (Çoklar et al., 2016; Lerdpornkulrat et al., 2019). Therefore, there is the risk of training an incomplete student body in digital competence. For complete and comprehensive digital literacy for university students, especially future teachers, there is an urgent need to invest in digital literacy programs. This will ensure that the comprehensive digital competence of students corresponds to the use and employment of the Internet and digital devices in their teaching tasks (Gisbert et al., 2016), and be a guarantee of their integration into teaching practice (Aslan and Zhu, 2016; Nikou and Aavakare, 2021).

As for the limitations of this work, they are closely related to the seven indicators for analyzing study quality and effectiveness (Acosta and Garza, 2011), which are: alignment of theory, findings, reliability and validity, descriptive details of participants, and the study, sample, and consistency of findings and conclusions with the data (Risko et al., 2008). Along with evidence-based indicators, and effect sizes of studies (Díaz and García, 2016; Canedo-García et al., 2017). So future lines of research or work, should take into account overcoming these limitations, and embrace them in the face of their development.

The number of studies found in the systematic review is comparable to what is usual in this type of study and even higher. For example, in the exemplary systematic review by Scott et al. (2018), they identified only 29 studies that met the quality criteria, reviewing 50 years of studies published in the US, and of these, only four were quantitative. In the study by Borgi et al. (2020), they only found ten studies that fit the criteria in a very good analysis. Other systematic reviews go along the same lines, and in the same journal and section *Frontiers in Psychology*. For example, Dickson and Schubert (2020) and Liu et al. (2022) found only six studies in a review of great interest; the study by Nguyen et al. (2021) identified 18 eligible articles; Shou et al. (2022) with 12 studies included; or Tarchi et al. (2021), Huang (2022) found seven studies for quantitative analysis and eight for indirect evidence; Coxen et al. (2021) with 21 articles

included in the focal analyzes of the systematic review. The number of studies to be representative is not defined by the number but by the existence of such studies. In a systematic review, all studies are reviewed, thus the population of published studies that fit the indicated criteria. With these studies, it was possible to do an analysis of objective indicators in ageneral comparison between studies; assessing the instruments used; examining the characteristics of the interventions such as strategies, instructional procedure, and psychological variables considered; comparing the fidelity controls of the treatments, which guarantees their rigor and their application in the terms prescribed by the empirical validation of the interventions; and reviewing the limitations of the studies and their contributions by years. These contributions were based on objective data from the studies and have been represented in tables and figures. In addition, a qualitative analysis is provided that highlights the value of intervention studies in relation to digital competence, and the key psychological variables that have been used. It is true that the studies published since 2010 were used, and that there could have been more studies before, but considering the evolution of this type of focus in relation to digital competence and the psychological variables involved, it is evident that the most interesting thing is to consider the recent years which is when its need and use has been generalized throughout the population.

Conclusions

In general, the results show that university students are digitally literate and make efficient use of both the Internet and digital media. In this sense, we found an intermediateor higher level in skills related to communication and collaboration, such as through different chat rooms, platforms, and communication applications. But an intermediate-low level in terms of digital content creation, especially in the creation and dissemination of multimedia content. So, this should be one of the future competencies to increase in this group. Although there are differences according to gender, age, or degree of origin.

We have to invest in comprehensive digital literacy programs for teachers in initial training, which appears implicit in the training plans of their official studies. Digital literacy needs to be a part of the official curriculum, and be developed rather quickly as a separate subject but in an interdisciplinary manner throughout their training. In this way, they become digitally literate people capable of creating and generating digital content and possessing the necessary competencies and skills to use and share such content.

We must also invest in assessing teachers' self-perception. Only by knowing their opinion, skills, and shortcomings, can digital training programs be designed. Digital literacy is a predictor of good digital use and a predictor of the good use and employment of digital devices and the Internet in the future when they would be teaching.

The findings of this study compel us to consider the following: first, we need to rethink the form and manner in which future teachers are capacitated in digital literacy,if we are doing it in the best way, or if on the contrary there are gaps that should be solved. Second, we should take into account the contributions of the results found and their consequences to formulate effective intervention designsand strategies to effectively capacitate pre-service teachers in digital literacy.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Author contributions

J-NS-G, NG-Á, IM-R, JG-M, and SB-C: conceptualization, methodology, software, writing—review and editing, visualization, supervision, and validation. NG-A: formal analysis, investigation, and resources: UAL, ULE, USAL, IPC, data curation, writing—original draft preparation, and funding acquisition. J-NS-G and NG-A: project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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Article

Digital Competence, Use, Actions and Time Dedicated to Digital Devices: Repercussions on the Interpersonal Relationships of Spanish Adolescents

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Abstract: Digital media play a fundamental role in the social, emotional, and cognitive development of adolescents, since they involve a very significant use and investment of time at this age. The objectives of this work are twofold: analyze the use of the Internet and digital devices by Spanish young people outside school, and the time they use them and their attitude towards the use of digital devices, as well as to identify the effects of the use of internet and digital devices on social and interpersonal relationships. The sample is composed of 35,943 students of Compulsory Secondary Education, from different Spanish high schools that participated in the PISA 2018 Report. The data provided by this study confirm the widespread consumption of digital devices. Identified as actions that they carry out every day were: the use of online chat, use of social networks to contact their friends, and surfing the internet for fun. Regarding the attitude towards digital devices, the participants say they feel comfortable using digital devices and discovering new applications or games. However, we also found as one of the most relevant results of this study the fact that participants say they feel bad if they do not have internet connection.

Keywords: digital media; adolescents; PISA 2018; attitude; use of internet

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1. Introduction

The term digital competence is not a new concept, and its meaning has changed over time [1]. Nowadays, it refers to a set of technical-processual, cognitive, and socioemotional skills needed to live, learn, and work in a digital society [2]. From these ideas, we can establish that digital competence has different dimensions: technological, informational and multimedia, and communicative [3]. These involve reading, writing and arithmetic, and the objective use of technology in personal, social, and work environments, since these literacies cannot be separated from the social and educational needs of the society in which we live [4]. It is precisely this society in which digital media have been postulated as the protagonists that have transformed our lives, both socially and personally [3,5–8]. Internet is a tool that offers infinite possibilities to adolescents, ranging from communication with family members to the collection of different types of information, social networks, games, and content downloads. Refs. [9,10] state that these have given rise to new opportunities for leisure and entertainment [11] and have revolutionized our mechanisms for thinking, studying, communicating, and playing [12]. Therefore, these digital mediaplay a fundamental role in the social, emotional, and cognitive development of adolescents, as theyinvolve a very significant use and investment of time at this age [13,14].

In terms of their use, in recent years, there has been an increase in the use by ado- lescents of both digital devices [15] and the Internet [16]. The increase in both the use ofthe Internet and digital devices has been parallel, a fact that has also been added to the

great diversity and types of existing devices, and the ease of access and use of these [17].This is revealed by the "Survey on equipment and use of information and communication technologies in households", which puts internet use among the population aged between 16 and 24 at around 98.1% for men and 97.9% for women, where the high figures for the use of these devices can be seen. In general, one of the most frequent uses of the Internet corresponds to interpersonal communication, through social networks, instant messaging,or blogs [17], online games, searching for information, consulting news, and shopping [18].The most frequent uses of digital devices are mobile phones, video game consoles, and tablets [19]. Despite the benefits and advantages offered by the Internet (such as new ways of learning, communicating, relating, and entertaining oneself), there are several studies that warn of its dangers [20,21], including the fact that excessive time on the Internet and its misuse can be an educational, social, and health problem for adolescents. Current studies have even shown a link between adolescent depression and abusive use of the Internet [19,20], but also between abusive use of the Internet and the negative repercussions it can have on academic performance, or even on relationships with others [19]. It is a social problem, because adolescents may be subject to situations of exclusion or victimization [20].In addition, it is a health problem, because internet abuse can lead to different mental problems, the most serious of which are suicidal ideation or depression [21–23]. Adoles- cence is a developmental stage characterized by the presence of high vulnerability and susceptibility [20]. In the face of all these issues, there are a large number of studies [24–27] that have aimed to analyze the use that adolescents make of the Internet.

There are studies about problematic internet use (PIU), which has increased in preva- lence due to the pandemic and the virtualization of teaching. By PIU, we mean a major risk factor, both academically and for psychopathological symptoms (i.e., depression, anxiety,and insomnia) in adolescence [21]. Ultimately, PIU refers to a lack of ability on the part of the subject to record internet use leading to feelings of distress and functional impair- ment [22]. The data are alarming, for example, recent studies in China showed that 17.3% of adolescents under 18 yearsof age had these behaviors [20], which are closely related to emotional management problems, sleepdisorders, or problems in the educational environ- ment. [23]. However, other studies have highlighted that, in addition to these risks, one of the major consequences of IPU is social isolation [24–27]. In other words, studies haveshown a direct and positive correlation between the time adolescents spend online and PIU. In a way, the more time they spend online, the more time they remain disconnected from the real world [28]. In addition, in this regard, other research has highlighted the fact that,compared to adolescents in general, people with PIU experience more social recognitionin the online world than offline [29]. In short, we can state that adolescents with PIU, in addition to having problems with depression and anxiety, also experience alterations in their own lifestyle, hygiene and sleep habits, loss of control, anger, symptoms of distress, family conflicts, and social isolation [30–33]. Therefore, the aims of this study aretwofold:to analyze the use that young Spaniards make of the Internet and digital devices outside school, the time they use them, and their attitudes towards the use of digital devices. It also aims to identify the effects of the use of the Internet and digital devices on social and interpersonal relationships.

2. Materials and Methods

The method used is correlational, corresponding to an ex post facto, retrospective, and comparative design, since different variables, such as sex, are compared with other types of variables, in this case, dependent variables, which correspond to the use of the Internet, the frequency of such use, and the attitude towards the use of digital devices.

2.1. Participants

The sample is composed of 35,943 students of Compulsory Secondary Education from different Spanish high schools that participated in the 2018 PISA Report. The mean age of the sample is 15.83 years, with a standard deviation SD = 0.28. Regarding gender, 50%

(*N* = 17,987) are male and 50% (*N* = 17,956) are female. As for nationality, 90.7% (*N* = 31901)were of Spanish nationality and 9.3% (*N* = 3253) were of a nationality other than Spanish. Finally, 82.9% (*N* = 29,129) had not repeated a grade and 11.8% (*N* = 6814) had repeated a grade.

2.2. Instrument

The instruments used are the placement tests referring to the 2018 PISA Report, from which only those items referring to questions of a socio-demographic nature and those related to the frequency of ICT use outside of school and internet use, the frequency of such use, and the attitude towards the use of digital devices were chosen. Of the total items in the PISA report, we chose only those related to the time of use of digital devices, the actions carried out through such devices, and the attitudes towards them.

It is the OECD countries that publish a report (International Student Assessment Pro- gram, PISA) of statistics to establish the direction of the economy, industry, and educationin such countries. In the educational field, they investigate and present information related to mathematical, scientific, and problem-solving content, but they are also investigating various types of student knowledge, such as information and communication technolo- gies (ICT). In addition, it corresponds, therefore, to a large-scale triennial international educational survey, carried outby the Organization for Economic Co-operation and De- velopment (OECD), which assesses the academic performance of 15 year olds every threeyears. Therefore, it is a scale of categories, widely used in research in the field of psychology to measure preferences, attitudes, or beliefs, through which the sample gives an answer based on a set of specific categories distributed in order of frequency or quantity. In this case, in the Likert scale used, the value of zero corresponded to not agreeing at all, and thevalue of five to totally agreeing.

2.3. Procedure

The results have been collected and processed from the database corresponding to the responses of the PISA 2018 Report level tests. Said database is available on the websiteof the Ministry of Education and Vocational Training and the INEE (National Institute for Educational Evaluation).

2.4. Data Analysis

In this study, the statistical analysis programs SPSS version 26 and AMOS version 22were used to perform various analyses in order to analyze the relationships between the study variables, such as descriptive and frequency analyses, bivariate correlations, and amodel of structural structures. In addition, confidence and descriptive analyses (means and standard deviation) were performed.

For the model of structural structures, the maximum likelihood method and a boot- strapping of 6000 iterations were changed. The fit indices that are taken into account to judge the factorial validity of the proposed model are the following: χ^2/df, incremental fitindex (IFI), comparative fit index (CFI), Tucker Lewis index (TLI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) plus its confidence interval (CI) at 90%. Thus, the fit indices are: χ^2/df, values between 2 and 3; IFI, CFI, and TLI, values greater than 0.95; SRMR, values below 0.06; and RMSEA, with valuesbelow 0.83.

3. Results

3.1. Descriptive Uses of Digital Devices

First, participants were asked about the age at which they first used a digital device.Thus, while males stated that it was between 7 and 9 years with 36.8%, females stated that it was between4 and 6 years with 33.6%.

The age at which they accessed the Internet for the first time was also asked; both males and females reported accessing the Internet for the first time between the ages of 7and 9 most frequently, with 45% and 43.6%.

We also asked how much time they spend on the Internet, and 30% of both men and women spend between 2 and 4 h.

3.2. Time of Use and Actions across Digital Devices

Regarding the actions related to the use of ICT in which the participants spent more time, the results show that some actions are performed to a greater extent than others. Thus,regarding online games, 35.9% never or almost never play single-player games 41.8% use collaborative online games, or 52.4% play online games through social networks.

On the other hand, regarding academic tasks, they never or hardly ever use social networks to communicate with other students about schoolwork, with 41.7%, upload content to the school website, with 44.1%, or consult the school website, with 44.4%.

In terms of the use of certain digital devices, among the tasks that they only recognize as being carried out via mobile devices once or twice a month are downloading an app, with 33.1%, or sending homework and communicating with teachers, with 34.7%. In addition, they acknowledge using digital devices once or twice a week to send emails, with 30.9%,read news on the Internet, with 25.2%, get practical information on the Internet, with 27.6%,surf the Internet to do homework, with 36.3%, or surf the Internet to find explanations for homework, with 29.3%.

On the other hand, they reported daily use of online chatting, with 77.3%, using social networks, with 67.9%, surfing the Internet for fun, with 52.4%, and downloading music, movies, or games, with 26.9%.

3.3. Attitudes towards the Use of Digital Devices

In this case, the statements were aimed at finding out participants' personal tastes and attitudes towards digital devices. Thus, 49.9% of the participants stated that they like to share digital content. In addition, they like to use different digital devices in their day-to-day life according to 53.1%. They also agree that they are totally excited to discover new devices or applications, with 38.6%. In addition, they acknowledge using them to make friends, with 38.1%.

From another point of view, participants were also asked if they felt bad if they did not have an internet connection available. In this case, 43% said they agreed.

This was similar to losing track of time when using digital devices, where 44.4% acknowledged forgetting time when using digital devices.

3.4. Influence of the Uses of Digital Devices on Interpersonal Relationships

Descriptive statistics, reliability, and bivariate correlations:

As can be seen in Table 1, the correlations between the study variables were positive, reflecting the reciprocity between the study variables. On the other hand, the reliabil - ityanalysis through Cronbach's alpha showed that each of the three factors had scores above 0.70.

Table 1. Description of the actions related to the use of ICT.

communicate with other students	41.7% (*N* = 1859)
upload content to the school's website	44.1% (*N* = 12,466)
download an app	33.1% (*N* = 9968)
submit assignments and communicate with teachers	34.7% (*N* = 9898)
send emails	30.9% (*N* = 9363)
read news on the Internet	27.6% (*N* = 8444)
get practical information on the Internet	27.6% (*N* = 8444)
surf the Internet to do homework	36.3% (*N* = 10,565)
browse the Internet to find explanations of duties	29.3% (*N* = 8380)

3.5. Structural Equation Model

The purpose of using an SEM model from a theoretical point of view lies in analyzing the relationships between different variables and their inter-relation (see Table 2). In this way, the SEM model itself and Figure 1 allow us to visualize the relationship that is initially established between the use of digital devices and the use of digital communication devices and, secondly, between the use of digital devices, the use of digital communication devices, and interpersonal relationships.

Table 2. Preliminary analysis.

Factors	M	SD	α	1	2	3
Uses of digital devices	3.34	1.08	0.80	-	0.45 ***	0.48 ***
Use of digital communication devices	3.12	1.10	0.82		-	0.61 ***
Interpersonal relations	3.64	0.88	0.77			-

Note: *** $p < 0.001$; SD = standard deviation; M = mean.

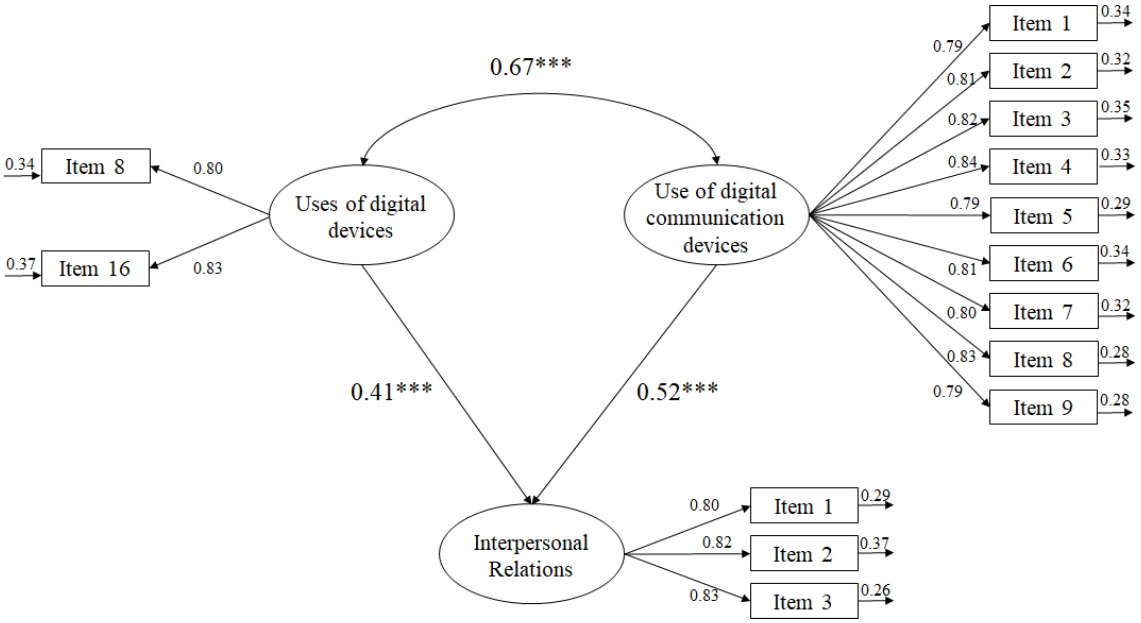

Figure 1. Relationships between the study variables through an SEM. *** $p < 0.001$.

To explain the relationships between the study variables, a model with a set of pre- dictive relationships was hypothesized (Figure 1). The fit indices revealed that the fits were adequate: χ^2 (87, N = 35,943) = 187.32, χ^2/df = 2.15, $p < 0.001$, TLI = 0.96, IFI = 0.96,CFI = 0.96, RMSEA = 0.051 (90% CI = 0.048–0.057), and SRMR = 0.038.

The relationships established between the study variables through the SEM areas follows:

(a) The correlation between the use of digital devices and the use of digital communication devices was positive (β = 0.67, $p < 0.001$).

(b) The use of digital devices showed positive effects on interpersonal relationships (β = 0.41, $p < 0.001$).

(c) The use of digital communication devices showed positive effects on interpersonal relationships (β = 0.52, $p < 0.001$).

4. Discussion

The main objective or purpose of this study was to analyze the use of the Internet and digital devices by young Spanish people outside of school, taking as variables the time they use these devices and the attitudes they have towards the use of digital devices. In addition,

the effects of the use of the Internet and digital devices on face-to-face social relationships established by adolescents were analyzed.

The main findings of this study confirm the widespread use of digital devices in adolescence, with results similar to those obtained in previous studies [34–36]. However, one of the novelties established by this study is the identification of the average age of initiation of its use. Specifically, this study places the average age of initiation of its use in the case of men between 7 and 9 years, and, in the case of women, between 4 and 6 years. The study provides similar results for early ages of digital device use [37,38] investigations that established 11 years as the age of onset of use, or even a previous investigation in time that places the age of onset at 7 years [39].

Regarding the time of internet use outside of school, the participants place the average time between 2 and 4 h per day, results that coincide with those reported [15,39].

On the other hand, as actions that adolescents carry out on a daily basis, we find use of online chat, use of social networks to contact their friends, and surf the Internet tohave fun, results that are similar to the study of [40]. This is followed by making friends through these means and downloading music, movies, or games. So, we can establish thatthe use of digital devices has a strong socializing character, hence the explanation of our results regarding the correlation between the use of digital devices and the use of digitalcommunication devices, as well as the fact that the use of digital devices shows positive effects on interpersonal relationships, since, for adolescents, it is a means of relating to their peers.

SEM results have shown that the use of digital devices is positively correlated with theuse of digital devices for communication. This result is related to the fact that many of the current advances in the field of new technologies are marked by the increase and quality of devices and software related to the field of communication. In addition, the use of digital and communication devices has been positively related to interpersonal relationships. These relationships are mainly due to the fact that young people make extensive use of these devices, due to their ease of use and accessibility, to interact with their social environment, either directly (for example, telephone call, chat, and video call)or indirectly (e.g., uploading videos or images on social networks).

However, this use of digital devices is not as widespread among the participants in terms of educational use, since the participants acknowledge that they never or almost never use the Internet to download educational applications, consult educational websites, communicate with other students about work from school, upload content to the school website, or check the school website [41].

In terms of attitudes towards digital devices, participants reported feeling comfortable using digital devices and discovering new apps or games. In addition, they consider the Internet to be a great resource for information of interest to them. However, we also found cases in which they admit to feeling bad if they do not have an internet connection or losing track of time during their employment. These results coincide with those re- ported by [42,43], for whom these excessive attitudes may even correspond to withdrawal symptoms in the face of addiction.

Finally, regarding the influence of these uses on interpersonal relationships, the results obtained show that, in the case of the participants who like to make friends through digital devices, they do not spend any days with friends after school and spend less time awayfrom home with friends. In addition, the feelings they experience when they are out with their friends correspond to a greater extent to boredom. These isolation behaviors related to the preference for digital devices over being with friends have already been highlightedin other studies, such as the one carried out by [13,44], which could even be said to resultin social isolation [45–49]. Therefore, we could even be facing cases of PIU.

5. Conclusions

All this leads us to ask ourselves, as a future educational implication, if we are really training our students in digital competence from an ethical, civic, and respectful point

of view, or, on the contrary, the digital competence of students in the current Spanish educational context is merely technical. As the results of this research show, the educationaluse of digital devices is less than their recreational use.

The main limitations of this work correspond to the fact that the way of evaluating these elements has corresponded to self-report measures. However, we consider it appropri-ate to bet on digital competence assessment scales validated in terms of digital literacy itself.The solution paths or future perspectives of the limitations of the present study, in addition to taking these limitations into account, are related to identifying which psychological and educational determinants affect the development of students' digital competence, as wellas their efficiency in achieving academic goals, persistence and resistance to achieving these goals and objectives, the need for belief in one'sown ability or self-efficacy towards digital competence and literacy, involvement or engagement and commitment or commitment to learning, or other relevant psychological variables, which havebeen shown to be key in the attainment of competence expertise and producing effects on the achievement of academic goals and learning outcomes, including personal and social adjustment.

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Digital Competence, Validation and Differential Patterns between Spanish and Portuguese Areas as Assessed from the Latest PISA Report as a Pathway to Sustainable Educationand Social Concerns

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Abstract: PISA reports aim both to analyze and describe the educational reality of each country and to assess different academic competences, including digital competence. In this paper, we are committed to the vision of digital literacy as an indispensable element of sustainable education and social concerns, which, together with the environment, the economy, social justice and humanrights, form the basis of the concept of sustainability. From this point of view, it is considered that an improvement in digital competence has a positive impact on the use made of ICT and also on its linkwith sustainable development. The aim of this research is to comparatively analyze the results in terms of literacy itself, digital skills and digital resources and experiences according to the PISA 2018 report in four OECD countries: Spain, Portugal, Colombia and Brazil, specifically, two Latin countries (Brazil and Colombia) and two Hispanic countries (Spain and Portugal), and for the enjoymentin the use of digital devices between one country in each area (Brazil and Spain). The sample is composed of 54,323 participants (18,073 participants from Brazil and Colombia, Latin America, and 36,250 from Spain and Portugal, Iberian Peninsula), using as an instrument the surveys developedand implemented in the PISA 2018 dataset for the OECD sample, which is related to some aspect ofdigital skills. The main findings of this study confirm that the variables related to digital resources,digital literacy and digital skills are statistically significant in the four countries. Therefore, in viewof this, we want to support the promotion of digital competence as a key element in the sustainable, educational and social development of a community. At a pedagogical level, this means that we are committed to different specific programs, innovative educational practices and the creation ofresources that promote inclusion and educational quality, focusing on social concerns and the fit ofeach country and area for promoting sustainable education.

Keywords: digital competence; PISA report; digital resources; adolescents

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1. Introduction

1.1. Digital Competence in the PISA Reports

There is no doubt about the great impact that technology has had in recent years in all areas of our lives in general, and in education in particular [1]. We can therefore affirm that we arefacing a society in which schools are understood as a vehicle to ensure that allstudents benefit from digital technology, as well as a means to meet the needs of studentsand a means to enable them to meet their needs in an inclusive environment [2].

Given these facts, and their presence in education, in 2001, the European Union published guidelines for action as a guide to what ICT-enabled education should be [3,4]. These were up-held until 2006, when the reference framework for competence-based education was published,which made a great commitment to the development of digital competence, and considered it to be a key element in the training of future citizens [5] and understood it as the ability to handle digital devices in a critical, reflective, safe and responsible manner.

These contributions have extended to the present day, and there are even some planned for the near future. An example of this are the various plans organized at the European level, such as the "Digital Europe Program 2021–2027", which offers subsidies for plans in five areas: computing, artificial intelligence, cybersecurity, the use of digital technologies in all sectors of the economy and society and, of course, digital skills. Similar initiatives havebeen implemented even at the national level, where we find the plan "Spain can. Plan for recovery, transformation and resilience" [6], which aims at the digitalization of business and public administration as well as education through the digital empowerment of citizens.At the national level, we also find, among others: (i) the Plan for the Digitalization of Public Administrations (Government of Spain, 2021a); (ii) the National Plan for Digital Skills [7];and (iii) the Plan for the Digitalization of Small and Medium-sized Enterprises (SMEs) [8].Among these, within our field, we should highlight the National Digital Skills Plan (2023), which covers various measures (paying special attention to groups at risk of social exclusion) through a national network of digital training centers, specific actions for digital inclusion, free mass access offerings (MOOCs), various programs to promote the use of ICT in the education system, digital training for women and the participation of women in technological training pathways, the creation of open educational resources (OERs) forteaching with digital media, etc., without neglecting post-compulsory education, such as vocational training, which is attended to by the Digital Vocational Training Plan (FPDigital)for the digitalization of vocational training and the introduction of digital skills in the educational curriculum. Additionally, in university education, similar efforts have been made through the Uni Digital Plan for the modernization of the Spanish university system,which is committed to the learning of digital skills through both new qualifications and the renovation of existing qualifications [9].

As a result of this report, the member states of the European Union and the OECD began to incorporate digital competence in the field of education, based on different strate- gies, for example, different programs for the incorporation of technology in schools. The PISA (Program International Student Assessment) reports, which appeared in 2000, aimed not only to analyze and describe the educational reality of each country [10–13], but also to evaluate different academic competences, including digital competence. It is precisely this importance of ICT in schools in the 21st century that has led to the inclusion of these issues in the PISA report, which covers different types of information on the use and employment of ICT in education [14,15]. In this sense, it is the OECD countries that publish a (PISA) of statistics to guide the direction of the economy, industry and education in such countries.In the field of education, they investigate and present information related to mathematical, scientific and problem-solving content, as well as investigate the knowledge of students in different subjects, such as Information and Communication Technologies (ICTs) [16], and thus correspond to a triennial large-scale international educational survey, conducted by the Organization for Economic Co-operation and Development (OECD), which assesses the academic performance of 15-year-olds every three years [17]. Additionally, within the report itself, this competence is found within the global competence, which is made up of the following indicators: the proportion of computers per student, technological investment, the use of software or the relationship between the use of these and results inthe three basic competences. However, the research carried out on the subject provides contradictory data on the impact of ICT in education [18], and there are even data that lead us to believe that students are overusing ICT [19].

There are different studies and reports carried out in Latin American countries that have taken into consideration digital competence, the enjoyment of digital devices and

the digital resources available both at school and at home [20], indicating as reference data the existence of 7 countries that used learning platforms, 22 that provided digital content, 13 that used didactic material content and social networks and 20 that providededucation through radio or television programs. At the same time [21], in terms of accessto digital media at school, countries such as Chile, Mexico, Uruguay, Uruguay, Nicaragua, Guatemala and Colombia are the poorest countries in terms of access to digital devices atschool. At home, 52% of households have access to the Internet and 45% have access to acomputer [22]. For this reason, the PISA reports have established themselves as appropriatetools for understanding the impact of ICT use and usage on the education of adolescentsaround the world [23]. In this paper, we are going to focus on the results of the latest report, the results of which were published in 2018, with the aim of analyzing the resources,enjoyment of digital experiences and digital literacy and skills in the countries of Spain, Portugal, Brazil and Colombia. Additionally, we carry out an analysis of the functional useof digital devices and the Internet by adolescents.

In this sense, the report itself, in relation to digital competence, takes into account different items related to "accessing, handling, integrating and evaluating information; constructing new knowledge from electronic texts" and therefore also assesses the cognitivecompetence required for the effective and efficient use of digital devices, as is the case with surfing the Internet, or searching for information, with actions referring to the ability to analyze the relevance and veracity of information available online.

Thus, the PISA report is committed to the assessment of media literacy, which it considers to be the ability to adhere to, examine and value the media, as well as the creation of multimedia content [5–20].

These facts occur at national, European and global levels: the need to train citizens in the necessary skills to use digital technologies critically and creatively. Additionally, it is the European Digital Competence Framework (DigComp) that provides an organization to analyze and improve digital self-competence through the implementation of differentinitiatives with the aim of developing digital competence, a critical digital spirit and digital citizenship. All of this is based on the provision of digital structures and equipment, organizational capacity, teacher training in digital competences and the learning of content focused mainly on digital privacy and ethical rules regarding its use. In fact, in most European Union countries, this has been translated into the implementation of these contents in the curricula [24,25]. In the case ofSpain, there is even the so-called Digital Education Action Plan (2021–2027), which was created by the European Union in order to promote a reasonable and effective adaptation of the education and training systems of the EU member states.

From all these premises, the need to assess such knowledge of students through thePISA Report arises, as they are part of the learning that students must acquire during their education in today's society.

1.2. Digital Competency as a Path for Sustainability in Countries and Cultural and Geographical Regions

However, in this paper, we cannot fail to mention the current social and health situation we are living in, which is characterized by being closely linked to change, to reconceptu- alization and new modifications [26]. The pandemic caused by COVID-19 has given rise to new educational practices and approaches [27]. Furthermore, Information and Com- munication Technologies (ICTs) have become an indispensable element in our daily lives, on a social, educational and organizational level [28]. However, we must also critically analyze these facts, and highlight the fact that the pandemic has accentuated the social and educational inequalities that already existed in society, giving rise to the so-called digital divide [29,30]. It is therefore necessary to think about these issues in depth, and to rethink not only digital competence itself, but also the impact that this competence has on global citizenship and sustainability through issues such as accessibility, access, equal opportunities, etc. In short, it is a question of assuming that an improvement in digital

competence has a positive impact on the use made of ICTs and also on their correlation with sustainable development [31]. In this sense, the UN considers digital competence itself as an essential element of social sustainability, which, together with the environment and the economy, forms the basis of the concept of sustainability [32], without forgettingsocial justice and human rights [33].

We can affirm that all factors that promote the digital competence of citizens will therefore also promote a sustainable society [26].

However, when we talk about sustainability, we are referring to a term whose meaning is not unanimous [34], but for which there are a series of characteristics on which there is agreement in the specific literature, such as equity in learning, equal opportunities, social mobility, social justice, quality of life, cooperation, empowerment or cultural features [35]. Therefore, a society that is committed to being sustainable must also be committed to the promotion of equitable digital competence, in order to contribute to the improvement in social cohesion and sustainable community life [26]. This should be understood as all those actions aimed at increasing the well-being of society, whether at the economic, social or educational level [36].

Undoubtedly, the essential channel for this is the educational sphere [37]. This is why the development of education is currently one of the greatest educational challenges in achieving so-called social sustainability. For it must be education that becomes the key element of accessibility to digital competence, both at the level of general education and lifelong learning [26].

At the pedagogical level, this translates into a commitment to different specific pro-grams, innovative educational practices and the creation of resources that are committedto inclusion and educational quality [37–39]. Various international organizations, such as the OECD and UNESCO, set the objectives of sustainable development. So, what digital competences are being applied to develop sustainability in compulsory education?

1.3. The Present Study

The works found that take digital literacy into consideration correspond to the re- search [40] that, in this case, carries out a comparative study of four OECD countries, two Mediterranean and two Baltic: Spain, Italy, Estonia and Lithuania, and evaluates reading performance and its relationship with the implementation of ICT. Several different insti - tutional reports have attempted to assess digital literacy from a multidimensional point of view, such as the Australian National Assessment Program for ICT Literacy (NAP-ICT) and the International Computer and Information Literacy Study (ICILS) [41–43]. Therefore, we have not found any precedents in the Latin American or Ibero-American context thathave been carried out, which justifies the relevance of this research.

We should also highlight the work of [18], which aimed to analyze the effects of social networks, their use and attitude with respect to digital reading performance through a longitudinal study on the last three PISA reports. It is relevant that our search yielded a large number of papers related to digital reading [44,45].

We also wish to point out the work by [46], who, in this case, take into consideration the use of ICT, but only in the home environment and with the aim of investigating their relationship with academic performance.

The works of [46,47], who, in this case, measure ICT use and its influence on motiva- tion, self-efficacy and persistence, is also of interest. Additionally, with regard to motivation, we found the work of [48], who in this case validate the items of the PISA 2018 report referring to motivation to study and future expectations of adolescents, but without taking into account digital literacy in their work.

From this arises the justification for this research, since it highlights the need for studiesthat focus on digital literacy as a protagonist and validates the methods used to measureit. We consider not only digital literacy in terms of other subjects, but also variables suchas the time spent, the actions carried out or the digital resources available. For all of these reasons, we believethat research is needed that focuses on digital literacy in our immediate

context, such as the Latin American and Ibero-American context, taking as a reference the countries of Spain and Colombia (in terms of the use of the Spanish language) and Portugal and Brazil (in terms of the use of the Portuguese language).

In view of the evidence and arguments and gaps in previous studies, the problem or re- search question that we seek to answer in this study can be stated as follows: By comparing different Hispanic and Portuguese and Iberian and Latin American cultural settings, in relation to the constructs of digital competence measured by the PISA reports, is their validation (measurement models) confirmed, and do they allow us to identify differentialpatterns reflected by geographical, cultural and language differences?

In order to solve the problem or answer the research question, the objective of this research is posed as the comparative analysis of the results in terms of alpha literacy, digital skills and digital resources and experiences according to the latest PISA report (2018) in four OECD countries: Spain, Portugal, Colombia and Brazil: specifically, two Latin countries (Brazil and Colombia) and two Hispanic countries (Spain and Portugal), and for the enjoyment of the use of digital devices between one country in each area (Brazil and Spain). We will consider these factors from a confirmatory analysis, or measurement models, of the construct validity of the aspectsof digital competence measured in the latest PISA survey as well as identify differential patterns between countries and domains.

Therefore, the reports produced by each country were the sources of consultation for data extraction. However, we must clarify that the variables used are different according to the focus of research, and in this case, a comparative study of the four countries indicatedin terms of literacy and available resources (the clarification of which is best done in detailin the methodology, and not here), is carried out. This objective is materialized in the following forecasts or hypotheses to be tested:

H1. *Relevant differences are observed in the contributions in empirical evidence of the results by different cultural spheres (Hispanic and Latin American) in terms of personal digital resources*.

H2. *Differential patterns contributed by the variables will be identified in relation to digital competences in different cultural backgrounds (Hispanic and Latin American).*

H3. *Geographical and cultural variables play a relevant mediating role in the causal relationship between digital literacy competences and digital literacy skills.*

2. Materials and Methods

2.1. Sample

The sample is composed of 54,323 participants, of which 17.8% (N = 10,619) belong to Brazil, 59.8% belong to Spain (N = 35,943), 9.9% belong to Portugal (N = 5,932) and 12.5% belong to Colombia (N = 7,522). The mean age of the sample is 15.83 years old (SD = 0.28) (Table 1).

Table 1. Description of the sample according to country, language of application of the questionnaireand gender. The number of participants is represented by N, and in brackets is the percentage % included.

	Females	Males	Total	Portuguese	Spanish
Brasil (BRA)	5436 (51.2)	5183 (48.8)	10,619	10,619	
Colombia (COL)	3827 (51.3)	3627 (48.7)	7454		7454
Total Latinoamérica (LAT)	9263	8810	18,073		
España (ESP)	15,163 (49.9)	15,216 (50.1)	30,379		30,379
Portugal (PRT)	2917 (49.7)	2954 (50.3)	5871	5871	
Total Pen Ibérica (PIB)	18,080	18,170	36,250		
Totales	27,343	26,980	54,323	16,490	37,833

Note: in Spain, the questionnaire was applied in Spanish (N = 30,379), but other samples received questionnaires in the other official Spanish languages (Catalan, Basque, Galician, Valencian; N_F = 2,675; N_M = 2,655; Total = 5,305; not added in Table 1, but included in analysis); Spanish participants = N_F = 17,838; N_M = 17,871; N_{Total} = 35,709.In the other countries, the questionnaire language and country overlap.

2.2. Surveys

We used surveys developed and implemented in the PISA 2018, OECD, relating to some aspect of digital skills. Specifically, for this study, two types of surveys (ST and IC) were used. One type of survey focused on digital resources (ST012Q05-08, four items asking about how many mobile phones, how many computers, how many tablets and how many e-book readers participants had at home), digital literacy (ST158, seven items) anddigital skills (ST166, five items referring to digital skills with email). The other type, on the other hand, focused on digital availability (IC001 and IC009, 11 + 11 items referring to both resources at home and resources at school) and enjoyment with digital tools andexperiences (IC013-016, 21 items).

The internal consistency analysis of the scales indicates a standardized Cronbach's alpha for digital resources of $\alpha = 0.658$, $\alpha = 0.752$ for digital literacy and $\alpha = 0.572$ for digital skills. For the survey part, a standardized alpha of 0.91 is achieved, and for digitalreadiness, the alpha is $\alpha = 0.82$.

The exploratory factor analysis EFA identified the three expected factors in the survey related to digital skills, literacy and resources, as confirmed by the confirmatory factor analysis CFA, and is presented in the results. The MacDonald's composite or omega reliability gives coefficients of 0.71, 0.76 and 0.65. The construct validity, evidenced by the average variance extracted AVE or convergent validity, gives coefficients close to 0.50, and the discriminant validity (square root of the AVE) gives scores higher than the intercorrelations between the latent variables or factors (with 0.192 being the highest), withcoefficients between 0.60 and 0.70. The KMO measure of sampling adequacy and Bartlett's sphericity of sampling give significant results ($p < 0.001$), as does the goodness-of-fit test.The total variance explained by the three factors is 42.5%. In relation to the survey on digital availability and enjoyment, the most interesting aspectis the analysis of enjoyment of digital experiences. While comparable results to the previous variables are found with the EFA, a further CFA analysis is presented in the results.

2.3. Data Analysis

PISA dataset: The first step was to download the data in an SPSS format from the latest sampling conducted by PISA in different OECD and collaborating countries. From these datasets, data were extracted for Spain, Portugal, Brazil and Colombia; this allowed a com- parisonbetween countries with different cultural and geographical backgrounds (Iberian Peninsula and Latin America) and all Ibero-American countries, which share the same two languages: Portuguese, in Portugal and Brazil, and Spanish, in Spain and Colombia, with comparable cultural, linguistic, historical and geographical traditions, in divergent aspects (two languages, two geographical areas) and in coinciding aspects (language and geographical area). This allowed for a descriptive and comparative analysis to identify differential patterns in digital competences.

Once the dataset matrices for each country and for the four selected countries had been assembled, cross-tabulations were made to describe the samples by gender, country, language and geographical area. Secondly, we proceeded to the construct validity analyses of the surveys for the two types of surveys: (i) on digital resources, digital literacy and digital skills (these data are available for the four countries); and (ii) on the availability and enjoyment of digital devices, tools and experiences (these data are only available for Brazil and Spain).

The surveys: The internal consistency of the different parts of the survey was calcu-lated with the IBM Corp SSPS 26.0 Scales module, providing the standardized Cronbach'salphas. In addition, an analysis of construct validity was carried out; on the one hand, anexploratory factor analysis (EFA) was performed, using the maximum likelihood method,which is recommended when there are interrelationships between the factors or latent variables. Direct oblimin rotation, the KMO sampling adequacy and Bartlett's sphericity measures were calculated; the Chi2 goodness-of-fit test and the total variance explained by each latent variable and by the set were measured; the loadings graphs were considered

to visually confirm the latent variables extracted; and the number of latent variables, the correlation matrix between the latent variables and the pattern matrix were also consid-ered. In addition, factor scores were calculated for each participant, using Bartlett scores. All these analyses were carried out with SPSS v26. With the lambda coefficients or factorial weights of the pattern matrix, through Excel, we calculated the composite reliability or Mac- donald's omega, which was expected to be 0.70 or higher; the average variance extracted AVE or convergent validity CV, which was expected to be 0.50 or higher; and the discrim-inant validity DV (square root of the AVE), whose coefficients must be higher than the intercorrelations between the latent variables. Convergent and discriminant validity were considered a good measure of the construct validity of a scale or survey in this case. A CFAconfirmatory factor analysis was also performed with AMOS v26 (measurement models)on the basis of the pattern matrices, using the plug-ins of Gazkin's Pattern Matrix Model Builder (http://statwiki.gaskination.com/index.php/Plugins, accessed on 1 June 2022).

Several CFAs were carried out, by country and jointly, which also made it possible to consider the invariance of the measurement model. In order to illustrate its adequacy, diagramsare presented for the first of the digital skills, literacy, availability and digi-tal enjoyment components. The model fit check is considered adequate when the NFI, TLI and CFI coefficients are above 0.90, and higher scores are considered evidence of a good fit of the model to the data together with the RMSEA, which has to be below 0.080. When this fit is confirmed with different samples, it is evidence of the invariance of the measurement model.

Differential patterns between countries: On the other hand, differential patterns between countries were identified. For this purpose, the general linear model's module GLM of SPSS v26 was used. This made it possible to extract the differences between countries in the different dependent variables of digital competence analyzed for this study. This was carried out in three steps: the multivariate test, which was significant for both types of variables (ST and IC); tests for intersubject effects; and post hoc tests for the case of the ST variables (all four countries) as ICs are only available for two countries, Brazil and Spain. Mean scores and their standard deviations were provided for each dependent variable, statistical significance and effect size or practical significance. For the effect size, indicated by the eta-squared statistic (^{2}), Cohen's (1988) rule is considered = 0.01–0.06 (small effect); > 0.06–0.14 (medium effect); > 0.14 (large effect).

3. Results

3.1. Measurement Models

Various analyses have been carried out, although the most interesting in terms of the fit observed are the two presented here, and allow the calculations of the Spanish and Brazilian samples. On the one hand, the three-factor model of digital skills, literacy and resources is confirmed; on the other hand, an analysis of interest is provided with the bifactorial componentof the enjoyment of digital experiences (general and foreign or social).

3.1.1. Digital Skills, Literacy and Resources

A good fit of the model to the data is obtained. The coefficients for the Spanish sample are good: NFI = 0.951; TLI = 0.929; CFI = 0.951; RMSEA = 0.037. The invariance of the modelis also confirmed for the Brazilian sample: NFI = 0.959; TLI = 0.943; CFI = 0.961; RMSEA = 0.040. See the graph for Brazil (see Figure 1).

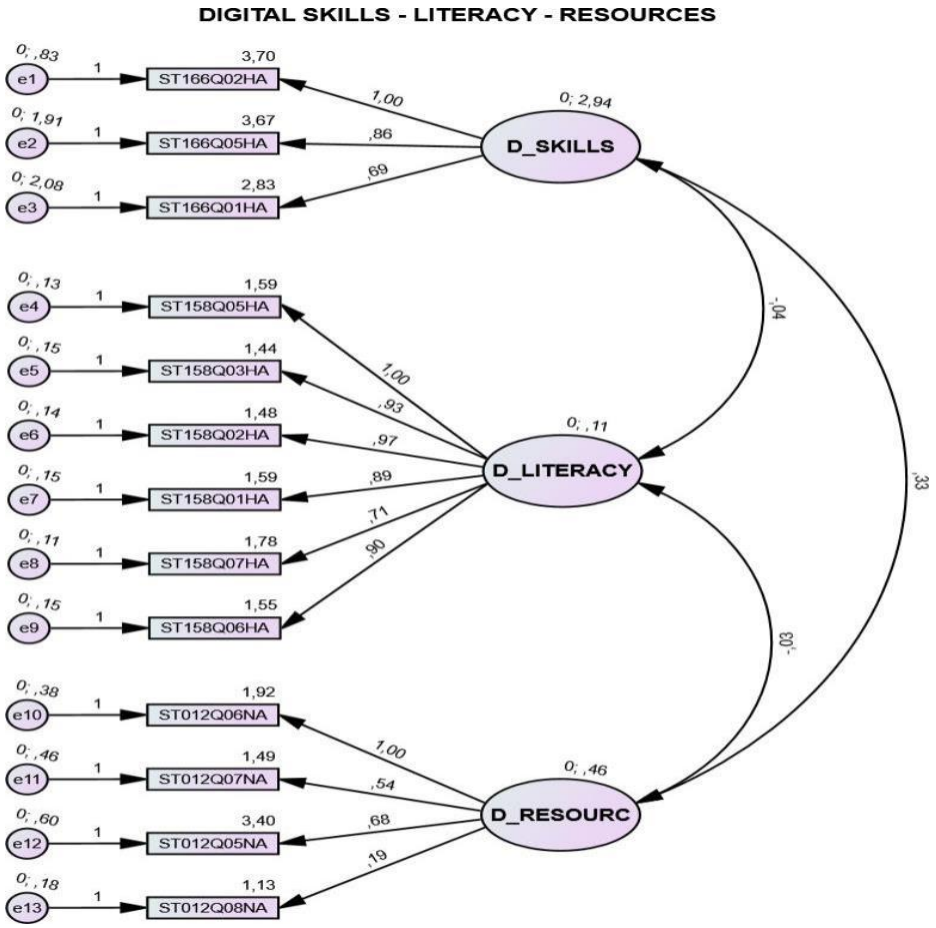

Figure 1. Illustration of the measurement model (CFA) for the digital skills, literacy and resources components of the survey, with the Brazilian sample.

3.1.2. Digital Enjoyment

A good fit of the model to the data is obtained. The coefficients for the Spanish sample are good: NFI = 0.931; TLI = 0.889; CFI = 0.931; RMSEA = 0.067. The invariance of the model is also confirmed for the Brazilian sample: NFI = 0.939; TLI = 0.903; CFI = 0.940; RMSEA = 0.065. See the graph for Spain (see Figure 2).

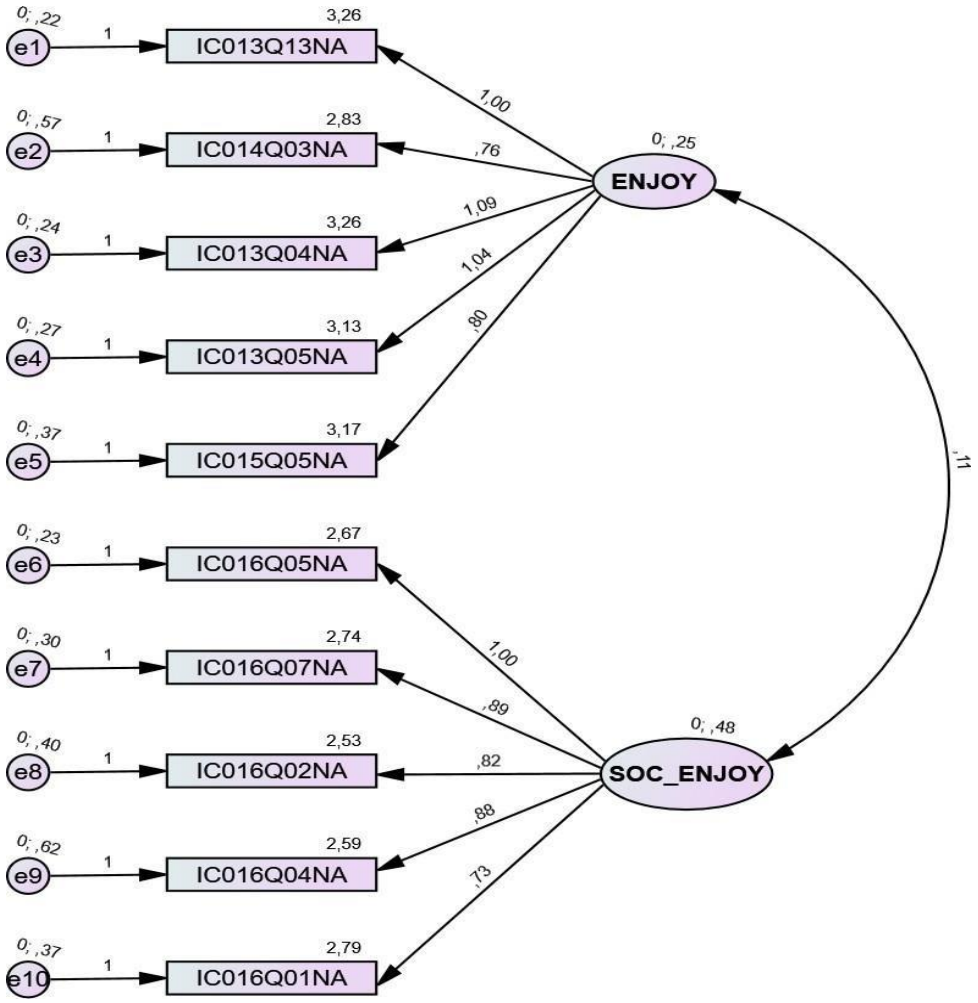

Figure 2. Illustration of the measurement model (CFA) for the digital enjoyment survey component,with the Spanish sample.

3.2. Differential Patterns between Countries

3.2.1. Cross-Country Differential Patterns in Digital Resources, Digital Literacy and Digital Skills

The multivariate contrasts between the digital competence dependent variables stud- ied for digital resources, digital literacy and digital skills are statistically significant between the four countries, and with a large effect size (λ_{Wilks} = 0.523; F = 564.901; gl = 60–139,683; $p < 0.001$; ^{2} = 0.194). When testing for intrasubject effects, most of the dependent variables give statistically significant results, with significant effect sizes, as do the post hoc contrasts, as can be seen in Tables 2 and 3 below.

Table 2. Results of the application of the general linear model (GLM), considering country of origin as the grouping variable and the use of digital resources, digitalliteracy and digital skills as dependent variables.

	VARIABLES PISA	Brazil	(N = 6900)	Colombia	(N = 5567)	Spain	(N = 29,448)	Portugal	(N = 4927)	Total	(N = 46,842)	F	p	$\blacksquare^2$
		M	σ	M	σ	M	σ	M	σ	M	σ			
						DIGITAL ASSETS								
How many in your home: <Cell phones> with Internet access (e.g., smartphones)	ST012Q05NA	3.48	0.844	3.30	1.020	3.91	0.346	3.80	0.531	3.76	0.620	2392.064	0.001	0.133
How many in your home: Computers (desktop computer, portable laptop, or notebook)	ST012Q06NA	2.01	0.935	2.13	0.960	3.00	0.866	2.94	0.877	2.74	0.980	3343.393	0.001	0.176
How many in your home: <Tablet computers> (e.g., <iPad>, <BlackBerry PlayBook>)	ST012Q07NA	1.51	0.778	1.70	0.902	2.48	0.960	2.25	0.921	2.22	1.002	2744.790	0.001	0.150
How many in your home: E-book readers (e.g., <Kindle>, <Kobo>, <Bookeen>)	ST012Q08NA	1.14	0.448	1.35	0.783	1.56	0.771	1.23	0.561	1.44	0.733	867.006	0.001	0.053
						LITERACY								
Taught at school: How to use keywords when using a search engine such as <Google©>, <Yahoo©>, etc.	ST158Q01HA	1.59	0.491	1.46	0.498	1.60	0.489	1.43	0.495	1.57	0.496	273.471	0.001	0.017
Taught at school: How to decide whether to trust information from the Internet	ST158Q02HA	1.48	0.500	1.27	0.445	1.32	0.467	1.36	0.479	1.34	0.474	275.837	0.001	0.017
Taught at school: How to compare different web pages and decide what information is more relevant for your school work	ST158Q03HA	1.44	0.496	1.35	0.476	1.42	0.493	1.38	0.485	1.41	0.491	46.279	0.001	0.003
Taught at school: To understand the consequences of making information publicly available online on <Facebook>, [. . .] Taught at school: How to use the short description below the links in the list of results of a search	ST158Q04HA	1.51	0.500	1.19	0.391	1.16	0.370	1.21	0.409	1.22	0.416	1404.516	0.001	0.083
Taught at school: How to detect whether the information is subjective or biased	ST158Q05HA	1.60	0.490	1.46	0.498	1.65	0.477	1.46	0.498	1.60	0.490	394.478	0.001	0.025
Taught at school: How to detect phishing or spam emails	ST158Q06HA	1.55	0.498	1.57	0.496	1.53	0.499	1.45	0.498	1.53	0.499	53.139	0.001	0.003
	ST158Q07HA	1.79	0.408	1.61	0.489	1.64	0.480	1.45	0.497	1.64	0.481	506.613	0.001	0.031
How appropriate in reaction to this email:						DIGITAL LITERACY								
Answer the email and ask for more information about the smartphone	ST166Q01HA	2.88	1.873	2.86	1.643	3.04	1.720	3.05	1.785	2.99	1.743	28.538	0.001	0.002
How appropriate in reaction to this email: Check the sender´s email address	ST166Q02HA	3.81	1.941	3.91	1.710	4.35	1.602	4.51	1.567	4.24	1.682	313.310	0.001	0.020
How appropriate in reaction to this email: Click on the link to fill out the form as soonas possible	ST166Q03HA	2.50	1.707	2.66	1.558	2.44	1.546	2.38	1.544	2.47	1.574	37.289	0.001	0.002
How appropriate in reaction to this email: Delete the email without clicking on the link	ST166Q04HA	2.56	1.735	2.94	1.631	3.19	1.789	3.34	1.807	3.09	1.781	289.295	0.001	0.018
How appropriate in reaction to this email: Check the website of the mobile phone operator to see whether [. . .]	ST166Q05HA	3.76	2.022	3.78	1.801	4.27	1.709	4.38	1.704	4.15	1.784	265.310	0.001	0.017

Note: multivariate tests: $\lambda_{W\,ks} = 0.523$; F = 564.901; gl = 60–139,683.

Table 3. Post hoc contrasts that are significant in multivariate analyses by cross-country comparisonfor both digital resources and digital literacy and digital skills, as measured by PISA results.

PISA VARIABLES		Brazil vs. Colombia	Brazil vs. Spain	Brazil vs. Portugal	Colombia vs. Spain	Colombia vs. Portugal	Spain vs. Portugal
			DIGITAL RESOURCES				
How many in your home: <Cell phones> with Internet access (e.g., smartphones)	ST012Q05NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: Computers (desktop computer, portable laptop, or notebook)	ST012Q06NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: <Tablet computers> (e.g., <iPad>, <BlackBerry PlayBook>)	ST012Q07NA	0.001	0.001	0.001	0.001	0.001	0.001
How many in your home: E-book readers (e.g., <Kindle>, <Kobo>, <Bookeen>)	ST012Q08NA	0.001	n.s.	0.001	0.025	0.001	0.001
			DIGITAL LLITERACY				
Taught at school: How to use keywords when using a search engine such as <Google©>, <Yahoo©>, etc.	ST158Q01HA	0.001	0.001	0.001	0.001	0.001	0.001
Taught at school: How to decide whether online information from the Internet	ST158Q02HA	0.001	0.001	0.001	0.001	0.001	0.001
Taught at school: How to compare different web pages and decide what information is more relevant for your school work	ST158Q03HA	0.001	0.020	0.001	0.001	0.018	0.001
Taught at school: To understand the consequences of making information publicly available online on <Facebook>, [. . .]	ST158Q04HA	0.001	0.001	0.001	0.001	0.028	0.001
Taught at school: How to use the short description below the links in the list of results of a search	ST158Q05HA	0.001	0.001	0.001	0.001	n.s.	0.001
Taught at school: How to detect whether the information is subjectiveor biased	ST158Q06HA	n.s.	n.s.	0.001	0.001	0.001	0.001
Taught at school: How to detect phishing or spam emails	ST158Q07HA	n.s.	0.001	0.001	0.001	0.001	0.001
			DIGITAL SKILLS				
How appropriate in reaction to this email: Answer the email and ask for more information about the smartphone How appropriate in reaction to this email:	ST166Q01HA	0.001	0.001	0.001	0.001	0.001	n.s.
Check the sender's email address How appropriate in reaction to this email:	ST166Q02HA	0.018	0.001	0.001	0.001	0.001	0.001
Click on the link to fill out the form as soon as possible How appropriate in reaction to this email:	ST166Q03HA	0.001	0.001	0.001	0.001	0.001	0.001
Delete the email without clicking on the link How appropriate in reaction to this email:	ST166Q04HA	0.001	0.001	0.001	0.001	0.001	0.001
Check the website of the mobile phone operator to see whether [. . .]	ST166Q05HA	n.s.	0.001	0.001	0.002	0.002	0.001

Note: n.s. Not statistically significat.

The results obtained are presented below. Firstly, in terms of the digital devices in the home, such as mobile phones with Internet connection, computers, tablets or e-books. Next, we present the results obtained in relation to the self-assessment of digital literacy, where we present the results related to the use of search engines, critical and reliable Internet search, digital privacy and the detection of spam or possible phishing emails. Finally, the results obtained in terms of email use and usage are presented.

As can be seen in Table 2, there are differences in terms of email skills, where we find greater discrepancies between countries in each of them, with the greatest skills being thoserelated to checking the sender (MPTR = 4.51 vs. MESP = 4.51 vs. MESP = 4.51). 51 vs. MESP = 4.35; F = 313.310; $p < 0.001$; $^{2} = 0.020$) and following email links (MPTR = 2.38 vs. MESP = 2.44; F = 37.289; $p < 0.001$; $^{2} = 0.002$).

In terms of digital resources, the following graph shows the differences between countries. Clearly, in all countries, the most used digital device is the smartphone, followed by computers, tablets and e-books. The statistically significant differences, as well as theeffect sizes, can be seen in Figure 3.

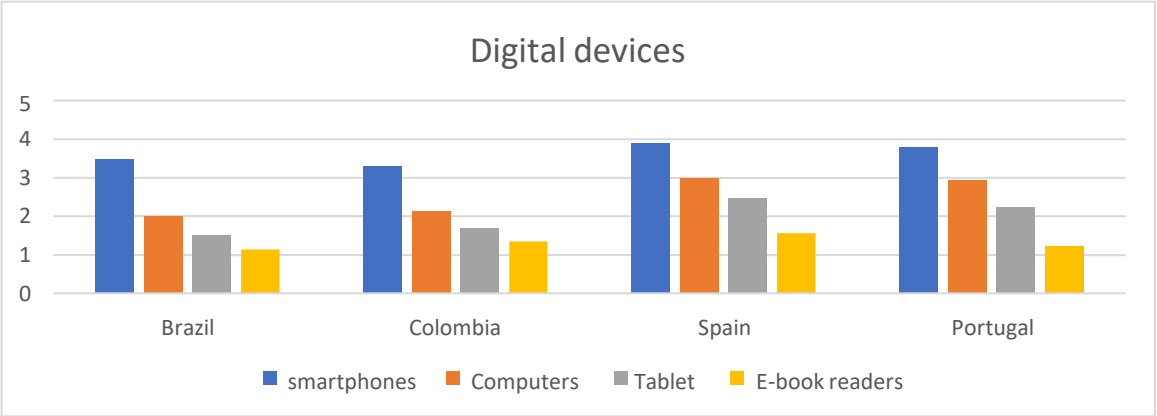

Figure 3. Distribution of digital device use by country.

In terms of literacy, the following graph shows the differences between countries, which are mainly to be found in skills such as checking the veracity of information, ana- lyzing the relevance of information, the consequences of publishing certain content and detecting spam emails (Figure 4).

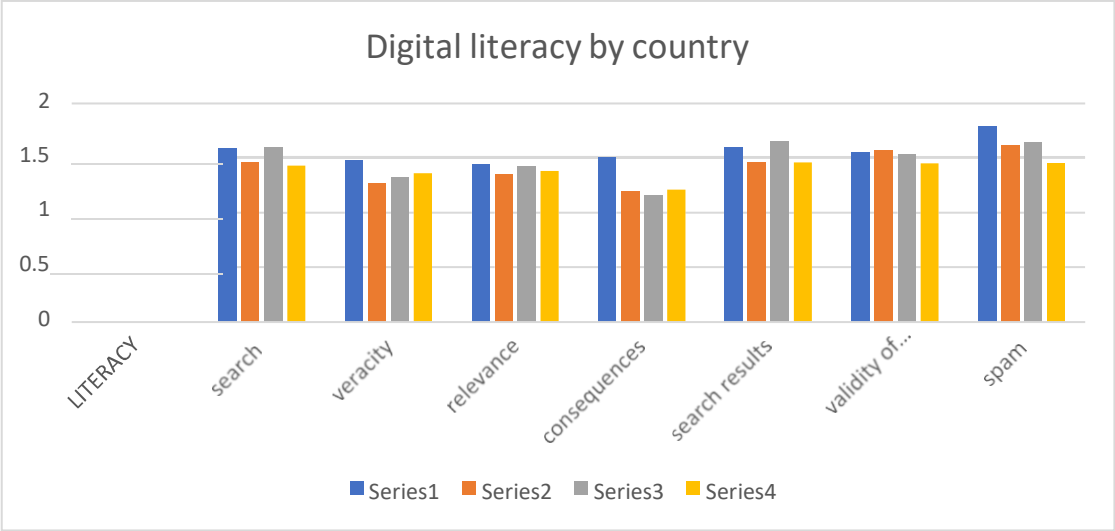

Figure 4. Distribution of actions related to digital literacy by country.

Post Hoc Contrast

When comparing the differences between countries, statistically significant differences can be seen in practically all the dependent variables and between countries ($p < 0.001$),except for some isolated exceptions with lower p's, and only in some cases are there no significant differences. See the results in Table 3. It is interesting to note that in the use of digital resources, the exception is the use of digital book readers, in which Spain and Colombia are compared (MCOL vs. MESP = 0.025).

On the other hand, in terms of digital literacy, we also find statistically significant differences in practically all the dependent variables and between countries ($p < 0.001$),except when comparing different websites and deciding which information is more relevant between Brazil and Spain (MBRA vs. MESP = 0.020), and between Colombia and Portugal(MCOL vs. MPOR = 0.018), from which we deduce that this difference is mainly due to cultural differences between one territory and another, since the difference is establishedbetween Hispanic and Latin American countries.

In this sense, we must also highlight the exception in the case of digital privacy, where we compare Colombia and Portugal (MCOL vs. MPOR = 0.028).

Finally, in terms of digital skills, statistically significant differences can be seen inpractically all the dependent variables and between countries ($p < 0.001$), except for checkingand verifying the email address, where the difference between Brazil and Colombia (MBRA vs. MCOL = 0.018) shows that within the same Latin American context, these differences tend to be lower. Additionally, in terms of checking the web address or website, differences exist between Colombia and Spain, and between Colombia and Portugal, which highlightsthe fact of the influence of the context, since in this case, the discrepancy between a Latin American country and two Hispanic countries is demonstrated (Figure 5).

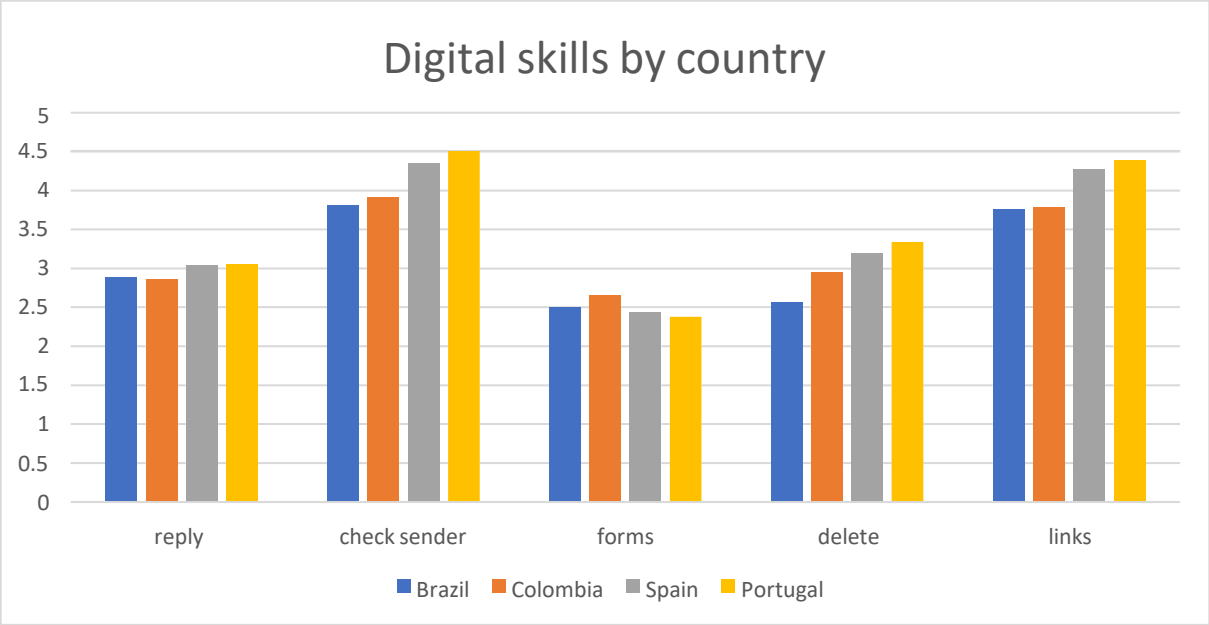

Figure 5. Distribution of digital skills by country.

3.2.2. Differential Patterns between Brazil and Spain in the Dependent Variables of Digital Availability and Enjoyment

Statistically significant multivariate contrasts are evident with a large effect size ($\lambda_{Wilks} = 0.627$; F = 311.909; gl = 42–22,030; $p = 0.001$; ^{2} (SE) = 0.373). Tests for inter-subject effects provide statistically significant differences in most variables, as can be seen in Table 4.

Table 4. Results of the application of the general linear model (GLM), considering as the grouping variable the country of origin (in this case, Brazil vs. Spain; Colombia and Portugal not applicable) and as dependent variables, the availability of digital experiences and enjoyment.

	VARIABLES PISA	Brazil	(N = 4177)	Spain	(N = 17,896)	Total	(N = 22,073)	F	p	$\blacksquare^2$
		M	σ	M	σ	M	σ			
AVAILABILITY AT HOME										
Available for you to use at home: Desktop computer	IC001Q01TA	2.01	0.941	1.63	0.846	1.70	0.878	664.051	0.001	0.029
Available for you to use at home: Portable laptop, or notebook	IC001Q02TA	1.89	0.932	1.32	0.645	1.43	0.742	2180.058	0.001	0.090
Available for you to use at home: <Tablet computer> (e.g., <iPad>, <BlackBerry PlayBook>)	IC001Q03TA	2.31	0.859	1.51	0.741	1.66	0.827	3736.723	0.001	0.145
Available for you to use at home: Internet connection	IC001Q04TA	1.19	0.558	1.05	0.279	1.07	0.354	581.229	0.001	0.026
Available for you to use at home: <Video games console>, e.g., <Sony PlayStation>	IC001Q05TA	1.99	0.927	1.48	0.693	1.57	0.770	1640.505	0.001	0.069
Available for you to use at home: <Cell phone> (without Internet access)	IC001Q06TA	2.30	0.866	2.26	0.802	2.27	0.814	11.559	0.001	0.001
Available for you to use at home: <Cell phone> (with Internet access)	IC001Q07TA	1.16	0.499	1.05	0.289	1.07	0.341	332.279	0.001	0.015
Available for you to use at home: Portable music player (Mp3/Mp4 player, iPod or similar)	IC001Q08TA	2.08	0.938	1.59	0.753	1.68	0.815	1321.549	0.001	0.056
Available for you to use at home: Printer	IC001Q09TA	2.09	0.925	1.47	0.768	1.59	0.836	2024.536	0.001	0.084
Available for you to use at home: USB (memory) stick	IC001Q10TA	1.43	0.714	1.13	0.396	1.19	0.487	1348.785	0.001	0.058
Available for you to use at home: <ebook reader>, e.g., <Amazon Kindle>	IC001Q11TA	2.61	0.730	2.20	0.855	2.27	0.848	840.867	0.001	0.037
Available for you to use at school: Desktop computer	IC009Q01TA	1.99	0.837	1.64	0.820	1.71	0.834	622.875	0.001	0.027
Available for you to use at school: Portable laptop or notebook	IC009Q02TA	2.46	0.778	2.12	0.897	2.18	0.886	524.606	0.001	0.023
Available for you to use at school: <Tablet computer> (e.g., <iPad>, <BlackBerry PlayBook>)	IC009Q03TA	2.69	0.656	2.53	0.781	2.56	0.761	135.807	0.001	0.006
AVAILABILITY AT THE SCHOOL										
Available for you to use at school: Internet connected school computers	IC009Q05NA	1.98	0.840	1.35	0.648	1.47	0.731	2782.212	0.001	0.112
Available for you to use at school: Internet connection via wireless network	IC009Q06NA	2.05	0.883	1.68	0.856	1.75	0.874	649.133	0.001	0.029
Available for you to use at school: Storage space for school-related data, e.g., a folder for own documents	IC009Q07NA	2.32	0.827	1.94	0.926	2.01	0.920	604.567	0.001	0.027
Available for you to use at school: USB (memory) stick	IC009Q08TA	2.39	0.823	1.90	0.933	1.99	0.934	992.378	0.001	0.043
Available for you to use at school: <ebook reader>, e.g., <Amazon Kindle>	IC009Q09TA	2.69	0.628	2.73	0.620	2.72	0.622	11.680	0.001	0.001
Available for you to use at school: Data projector, e.g., for slide presentations	IC009Q10NA	1.86	0.881	1.33	0.684	1.43	0.755	1801.444	0.001	0.075
Available for you to use at school: Interactive Whiteboard, e.g., <Smartboard>	IC009Q11NA	2.53	0.763	1.63	0.852	1.80	0.907	3919.262	0.001	0.151
ENJOYMENT										
Agree: I forget about time when I'm using digital devices.	IC013Q01NA	2.84	0.874	2.77	0.866	2.78	0.868	23.750	0.001	0.001
Agree: The Internet is a great resource for obtaining information I am interested in (e.g., news, sports, dictionary).	IC013Q04NA	3.20	0.734	3.31	0.703	3.29	0.710	76.063	0.001	0.003
Agree: It is very useful to have Social Networks on the Internet.	IC013Q05NA	3.05	0.734	3.16	0.720	3.14	0.724	80.907	0.001	0.004
Agree: I am really excited discovering new digital devices or applications.	IC013Q11NA	2.98	0.757	2.83	0.798	2.86	0.792	115.729	0.001	0.005
Agree: I really feel bad if no Internet connection is possible.	IC013Q12NA	2.88	0.823	2.99	0.852	2.97	0.847	60.800	0.001	0.003
Agree: I like using digital devices.	IC013Q13NA	3.17	0.724	3.29	0.672	3.27	0.684	100.539	0.001	0.005
Agree: I feel comfortable using digital devices that I am less familiar with.	IC014Q03NA	2.77	0.816	2.86	0.828	2.84	0.827	44.502	0.001	0.002
Agree: If my friends and relatives want to buy new digital devices or applications, I can give them advice.	IC014Q04NA	2.93	0.751	2.95	0.793	2.95	0.785	2.073	0.150	0.000
Agree: I feel comfortable using my digital devices at home.	IC014Q06NA	3.18	0.701	3.33	0.683	3.30	0.689	168.542	0.001	0.008
Agree: When I come across problems with digital devices, I think I can solve them.	IC014Q08NA	2.89	0.753	3.00	0.759	2.98	0.759	65.799	0.001	0.003
Agree: If my friends and relatives have a problem with digital devices, I can help them.	IC014Q09NA	2.90	0.765	3.01	0.774	2.99	0.773	68.286	0.001	0.003
Agree: If I need new software, I install it by myself.	IC015Q02NA	2.93	0.816	2.78	0.901	2.81	0.887	91.312	0.001	0.004
Agree: I read information about digital devices to be independent.	IC015Q03NA	2.85	0.771	2.61	0.864	2.65	0.852	284.550	0.001	0.013
Agree: I use digital devices as I want to use them.	IC015Q05NA	2.95	0.738	3.21	0.705	3.16	0.719	473.369	0.001	0.021
Agree: If I have a problem with digital devices I start to solve it on my own.	IC015Q07NA	2.82	0.792	2.98	0.768	2.95	0.775	139.732	0.001	0.006
Agree: If I need a new application, I choose it by myself.	IC015Q09NA	3.06	0.714	3.14	0.721	3.13	0.721	44.610	0.001	0.002
Agree: To learn something new about digital devices, I like to talk about them with my friends.	IC016Q01NA	2.80	0.762	2.80	0.773	2.80	0.771	0.001	0.974	0.000
Agree: I like to exchange solutions to problems with digital devices with others on the Internet.	IC016Q02NA	2.68	0.784	2.51	0.856	2.55	0.845	134.649	0.001	0.006
Agree: I like to meet friends and play computer and video games with them.	IC016Q04NA	2.74	0.858	2.58	1.013	2.61	0.987	90.777	0.001	0.004

Table 4. *Cont.*

	VARIABLES PISA	Brazil	(N = 4177)	Spain	(N = 17,896)	Total	(N = 22,073)	F	p	η^2
Agree: I like to share information about digital devices with my friends.	IC016Q05NA	2.78	0.772	2.66	0.847	2.69	0.835	63.597	0.001	0.003
Agree: I learn a lot about digital media by discussing with my friends and relatives.	IC016Q07NA	2.81	0.768	2.73	0.826	2.75	0.816	31.977	0.001	0.001

Note: multivariate tests: $\lambda_{Wilks} = 0.627$; F = 311.909; gl = 42–22,030; $p = 0.001$; ^{2} (SE) = 0.373. W only inclu e the statist i cally significant results ($p < 0.05$) ^{2} (e ta-s uared statistic) = e stimates o size effects. The Cohen (1988) rule signals = 0.01–0.06 (small effect); > 0.06–0.14 (medium effect); > 0.14 (large effect).

When we compare the differences between Spain and Brazil, statistically significant differences can be seen in all the dependent variables and between both countries ($p < 0.001$)when we focus on the digital devices available in the home, including: computer, laptop, tablet, Internet connection, video games, smartphone, e-book and USB memory sticks. This situation is similar to the digital devices available at school.

On the other hand, in terms of enjoyment, when comparing the differences betweenSpain and Brazil, statistically significant differences can be seen in almost all the dependent variables and between both countries ($p < 0.001$), for example, in terms of forgetting about time during their employment, using the Internet for fun to look for information about their interests or to make friends, as well as not feeling well when they are not connectedto the Internet. However, there are exceptions, and there are no statistically significant differences when it comes to advising friends or family about buying a digital device or app (MBRA = 2.93 vs. MESP = 2.95; F = 2.073; $p < 0.001$; $^{2} = 0.000$) and talking to friendsto learn more about digital devices (MBRA = 2.80 vs. MESP = 2.80; F = 0.001; $p < 0.001$;$^{2} = 0.000$).

In terms of the digital resources available at home, comparisons between Brazil andSpain show that the Brazilian average is higher for all devices, although some of them, such as mobile phones, are on a par with each other. However, in others, such as the use of tablets or video games,the differences are greater. The statistically significant differences and effect sizes for each dependent variable can be seen in Figure 6.

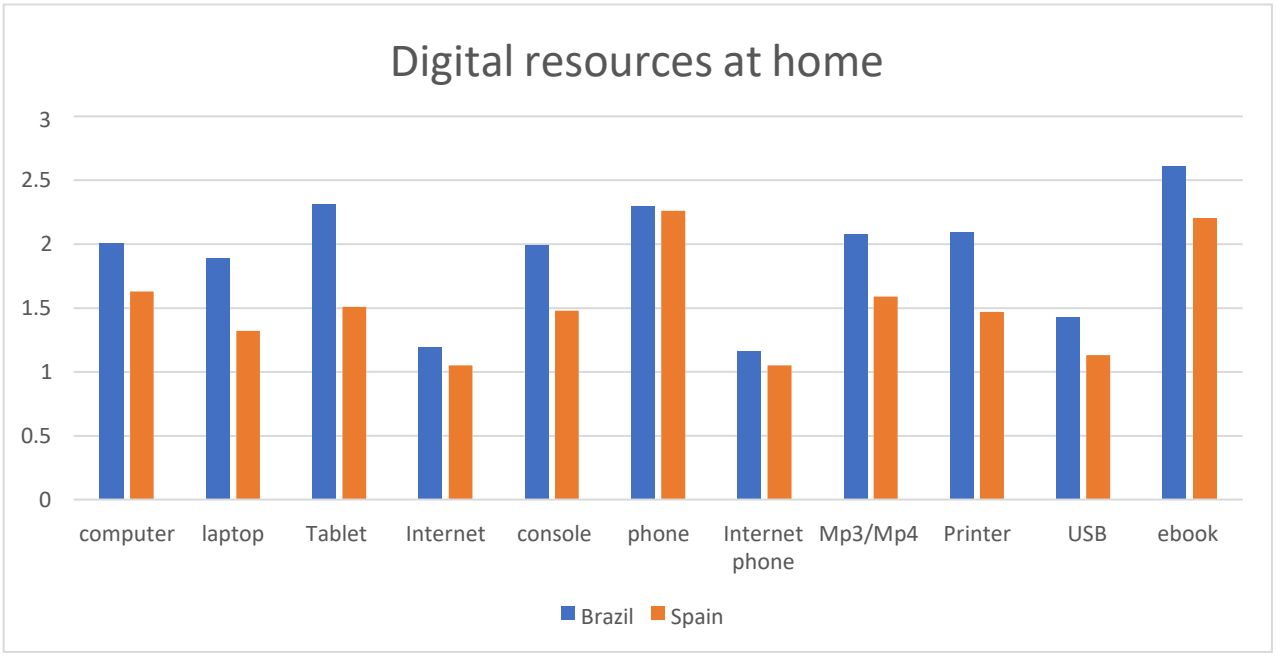

Figure 6. Distribution of digital resources at home.

On the other hand, in terms of resources available at school, Brazil is also the countrywith the highest average scores, except in the case of the availability of books at school, where Spain has the highest average (Figure 7).

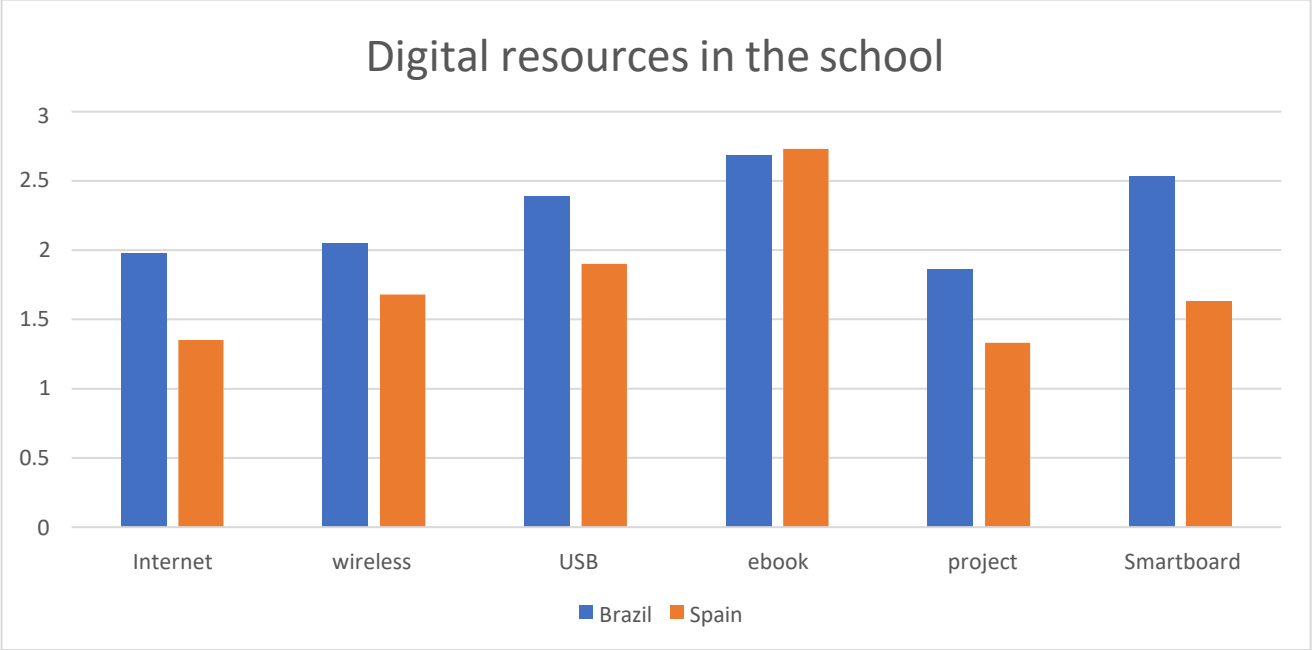

Figure 7. Distribution of digital resources in the school.

In terms of enjoyment, we find some statements with higher average scores in Spainthan in Brazil, such as considering the Internet as a great resource, liking the use of digitaldevices and using them as desired or choosing applications. However, the opposite is true for other statements, such as forgetting about time when online, learning about digital devices, playing online games or sharing information about digital devices with friends (Figure 8).

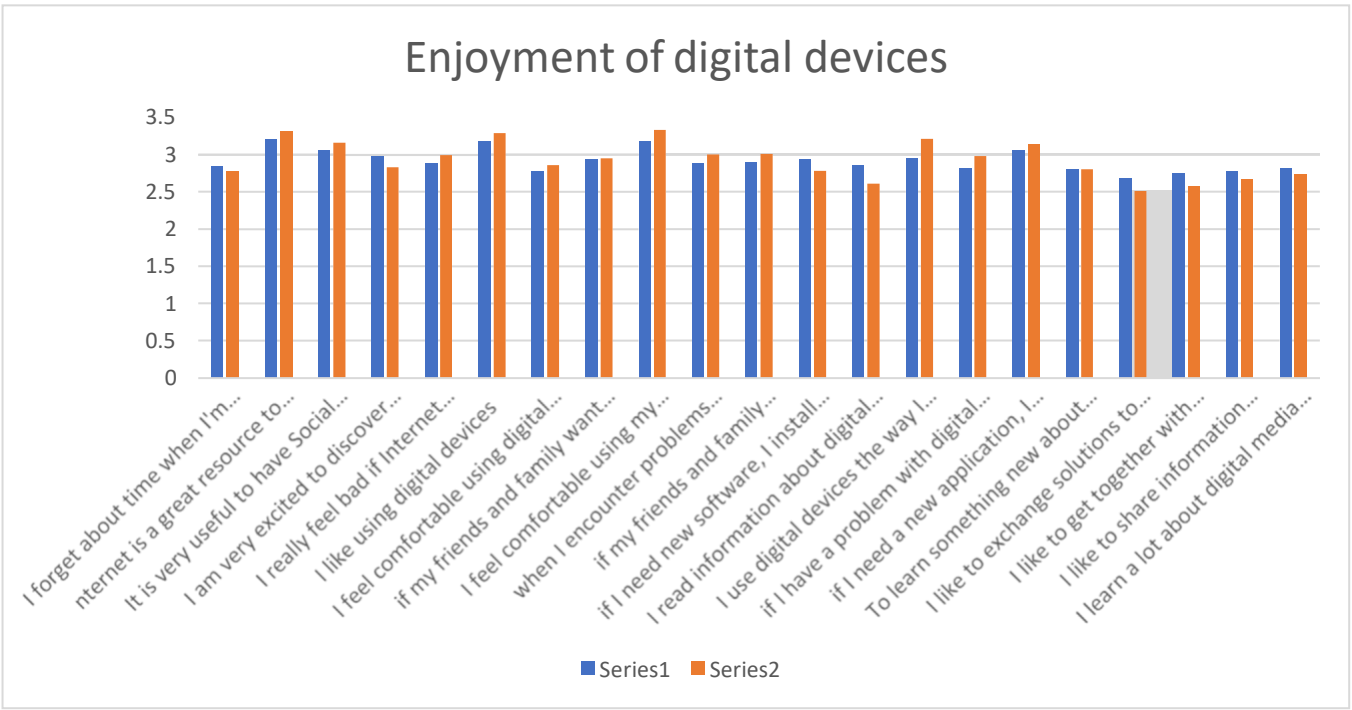

Figure 8. Country-specific enjoyment of digital devices.

4. Discussion and Conclusions

The present study has made it possible to answer the research question or researchproblem by asking the following question: Can we affirm that the original constructs of the PISA survey on some aspects of digital competence are validated by distinguishing between Latin American and Hispanic countries (taking into account geographical, cultural and language differences) and that differential patterns are obtained in terms of these constructs?In this way, it was possible to confirm the validity of the PISA digital competence construct, and the existing differential patterns have been verified.

Furthermore, it was possible to achieve the objective of comparatively analyzing theresultsin terms of literacy, digital skills and digital resources and experiences according to the PISA 2018 report in four OECD countries: Spain, Portugal, Colombia and Brazil: specif- ically, two Latin countries (Brazil and Colombia) and two Hispanic countries (Spain and Portugal), and for the enjoyment of the use of digital devices between one country in eacharea (Brazil and Spain) in adolescents, given that this evolutionary moment correspondsto the part of the population with the highest prevalence of Internet use [49]. Therefore,the objective has been achieved. However, variables such as enjoyment and availability of digital resources are only compared in the case of Spain vs. Brazil, since the official OECD database for the PISA 2018 report does not have these data for the countries of Colombiaand Portugal. It follows that we can even consider that the assessment of digital literacy in the latter countries is biased with respect to the rest.

The hypotheses put forward can be confirmed by the fact that there are differences in personal digital resources in different cultural spheres (Hispanic and Latin American)as wellas the identification of differential patterns provided by the variables related to digital competence by different cultural backgrounds (Hispanic and Latin American), andthe effect that geographical and cultural variables have on digital literacy competences.

The main findings of this study confirm that the variables related to digital resources, digital literacy and digital skills, are statistically significant across the four countries.A plausible interpretation, in light of previous recent studies presented in the background, indicates the fact that for adolescents in industrialized countries, the Internet has become an indispensable tool in the development of their identity and socialization [50].

Among digital resources, we find, for example, mobile phones, Internet access, home computers and tablets. Results are similar to those provided by [51]. This fact demonstratesthe fact that both digital devices and the Internet have now become an essential part of the daily lives of adolescents in particular, and of society in general [52].

Additionally, in terms of literacy, we find aspects such as searching the Internet, publishing information, knowing how to choose truthful and relevant information [53,54]. Additionally, in relation to digital skills, we find different actions related to emails, such asconsultation, reactions or use. In this sense, other studies have affirmed the fact that the Internet, together with digital devices, has become for adolescents a support for information,learning and discovery, but also for communication and entertainment [55,56]. It is therefore essential to talk about digital literacy, understood as a multiarea competence in relation to the use of digital technology, which involves actions such as the ability of a subject to analyze, compose and originate digital content, solve digital issues, co-communicate andrelate to others in a safe and appropriate way [57].

On the other hand, regarding the availability of digital experiences and enjoyment, in this case between Brazil and Spain, our research shows the existence of statistically significant multivariate contrasts. Thus, participants were shown to have computers, tablets, Internet connection, video games, telephone with Internet access or printers at home. These results are consistent with those reported by [58], who indicate that Internet use has become a critical problem in recent years, as between 88 and 98% of adolescentsuse the Internet at home or at school [59–63]. While in the school environment, they acknowledge having computers with Internet access, their own document folders, USB storage devices or projectors [64–67].

On the other hand, in the case of enjoyment, the sample acknowledges losing track of time when using digital devices, as they consider the Internet to be a great resource both for obtaining information and for making friends. In this sense, recent research has shown that the use of social networks among 13–17-year-olds is around 93–97% [68,69], so we canaffirm that, in a way, the Internet has become a place where adolescents build their identity, relate to others and share tastes, preferences and language with their peers [49].

They also enjoy themselves while using them. In this regard, there are numerous recent studies that even state that the amount of time adolescents spend online has doubled in the last ten years [70,71].

Sustainability and Digital Competence

The comparative study included four countries with Spanish languages, Spain and Colombia, and Portuguese languages, Portugal and Brazil, belonging to two diverse cultural and geographical regions with similarities and differences, Latin America and the Iberian Peninsula; in these countries, various constructs of digital competence, measured bythe surveys ofthe latest PISA, allow the identification of patterns on which to act to promoteand improve social, educational and economic sustainability, and to increase the quality of life of the people living in these regions and countries. In either case, we find ourselves in a society that is increasingly concerned about certain issues related to the sustainability of its own educational, economic and social models [72], of which form part of what is known as sustainable development. It is thereforea society in which ICTs are present in all processes related to teaching and learning and have become an indispensable element in educationthrough their digitalization, which offers a much more flexible type of learning, globalizedin time and place and student-centered, and it is practically strange to teach without theuse of ICTs. Therefore, it is more than necessary to teach digital competence [73].

Among the three basic principles of sustainable development, it is the principle of equity that is most closely related to education and has the greatest importance in the worldat large [74]. Despite the good intentions embedded within the principle, which mainly correspond to equal opportunities and sustainable development, we have to be aware that research related to the topic has mainly focused on equal opportunities and equal outcomes [75], with little work focusing on aspects related to sustainability and emotional issues, such as social support, participation or different psychological determinants that may have an influence [76].

Thus, both intra- and intergenerational equity measures are postulated here as a majorkey to the development of countries [77]. However, it should be noted that events such as globalization, crises related to immigration, war, capitalism or negative prejudices towards certain social groups have a negative impact on societies in terms of the sustainability of countries [78].

It is in this field where ICTs take on a leading role through autonomous learning and where sustainability is postulated as a tool for reflection on a personal level and the construction of societies based on social justice, equity and sustainability on a social level [79].It is therefore not just a matter of teaching and learning mere knowledge, butalso of promoting an emotional education based on values and attitudes, i.e., an education whose purpose is the integral development of the human being, in order to minimize social aspects such as poverty, exclusion or repression [80].

Along with this, the concept of Education for Sustainable Development, or Educationfor Sustainability (EfS), towards which we must move [81,82], appears, which can be understood as education that aims to create awareness through different skills and values that guarantee full participation in society, whether at the local, national or internationallevel, with the aim of creating a more equitable society [72]. From these ideas, therefore, we can glimpse an idea of education that can be taught in any curricular area, and to which ICTs are postulated as a resource that can ensure its implementation. See the works that evaluate sustainability in virtual education [73–80]. We must not fall into the error of maintaining the same traditional education system without encouraging improvements in

learning, so we must commit to learning in which ICTs are accompanied by pedagogical approaches focused on innovation and quality [81].

In short, educational sustainability means being committed to inclusion, equity, equal- ity and quality [81–83]. Additionally, it implies doing so in two main spheres: the first being the very education offered to students, and the second being inclusion, equality and quality [84]. Furthermore, this is where we must ask ourselves, at the international level, can digital devices be a tool to promote such indicators? In order to do so, we mustundoubtedly focus on sustainable education where ICTs and digital devices, and, of course, digital competence [80], require taking advantage of new knowledge, as well as enormous vivacity and adaptability [81].

What do we mean when we talk about digital competence in the aftermath of the pandemic? An accurate answer may be all those competences that help us to achieve sustainable digital environments [72], under the vision of digital literacy as an indispensableelement in the formation of effective and efficient citizens on a personal, professional and social level [80]. This leads us to rethink what our students should learn, how they should learn it and why they should learn it [75], and this is impossible to achieve without a huge change in school and culture. For this reason, the commitment to digital literacy is not only the responsibility of the teacher, or of the education system, but also involves a process of change in all social and economic spheres [81].

In conclusion, we must point out that the variables related to digital resources, digital literacy and digital skills are statistically significant among the four countries. These data arerelevant for educational and social practice as they demonstrate the importance of assessingdigital competence at school. Today, we are facing a situation where more than half of the school-age population has been introduced to online learning through the pandemic (Digital Education Action Plan, 2021–2027); therefore, this has been a turning point in the use of digital devices in education. Learning is now linked to access to the Internet, phones and other digital devices, which have become the means for learning a particular subject. This translates into a shift in traditional teaching, which changes the focus of attention and places it on the students. Additionally, in particular, the pandemic caused by COVID-19 has sharpened the educational and social need for digital literacy [79], which is currentlyunderstood as the mastery of different skills, abilities and competences required to use technology, media and digital tools, without neglecting critical and reflective attitudes and behaviors in their use [66]. This has also been echoed by the European Framework of Digital Competences for Citizens, which has supported different training plans, both European and national.

In addition to taking these limitations into account, future solutions or prospects forthe limitations of the present study are related to identifying whether these results havechanged or are maintained in the data provided by the PISA report that will be publishedat the end of this year. In addition, the aim is also to analyze the possible influencethat the pandemic caused by COVID-19 may have had on the use and enjoyment of the same technologies.

This work attempts to encompass digital competence itself as a leading component in social sustainability, which, together with the environment, the economy, social justice and human rights, forms the basis of the concept of sustainability. This fact makes it necessaryto think about the said competence of citizens, taking as a hypothesis the fact that an improvement in digital competence has a positive impact on the use made of ICT and also on its connection with sustainable development. For this reason, at a social level, it isnecessary to bet on the promotion of digital competence as a key element in the sustainable, educational and social development of acommunity. This fact corresponds with one of the greatest educational challenges that we face in achieving real social sustainability. At thepedagogical level, all these hypotheses are specified in different specific programs, inno-vative educational practices and the creation of resources that are committed to inclusionand educational quality. However, it is not just a matter of teaching and learning mere knowledge, but also of promoting an emotional education based on values and attitudes,

that is, an education whose purpose is the integral development of the human being, in order to minimize aspects such as poverty, exclusion or repression. This is united with the concept of Education for Sustainable Development, or Education for Sustainability (EfS).

The limitations of this work correspond to the fact that the way in which these itemshave been evaluated corresponds to self-report measures. However, we consider it appro- priate to use validated scales for assessing digital competences in terms of digital literacy.In addition, despite the importance and consideration of sustainability and digital com- petence, there is currently little research on assessing the level of achievement, progressand improvement of sustainabilityin education [37,66]. This is coupled with a dearth of measurement tools.

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5.4 Otras publicaciones generadas durante la formación predoctoral relacionadas con el tema de la tesis

Junto a los estudios que integran la tesis doctoral, se generaron otras cinco publicaciones relacionadas con el campo de estudio intergeneracional (entre otras pertenecientes a diferentes temáticas y disciplinas) que complementan la formación investigadora y contribuyen al cumplimiento de los objetivos planteados al inicio de esta tesis, a saber: (i) elaborar un trabajo de calidad dentro de los estándares en el campoobjeto de estudio a nivel internacional, y (ii) crear un currículum competitivo y de excelencia en dicha áreade trabajo.

Capítulos de libro

Gutiérrez-Ángel, N. (2022). Pandemia y brecha digital: situación actual en la literatura específica. *Cuestiones relativas a la inclusión de colectivos vulnerables* (pp. 160-169). Dykinson. ISBN: 978-84-1122-205-1

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DISCUSIÓN

En la actualidad, nos encontramos ante una sociedad en la que más de la mitad de la población en edad escolar se ha visto inmerso en el aprendizaje en línea debido a las medidas y consecuencias sociales y educativas de la pandemia (Plan de Acción de Educación Digital, 2021-2027). Por tanto, este ha sido un punto de inflexión en el uso dedispositivos digitales en la educación, dando lugar a un nuevo tipo de aprendizaje ahora vinculado al acceso a Internet, teléfonos y otros dispositivos digitales para convertirse enlos medios para aprender un tema en particular. Lo cual supone en un giro en la enseñanzatradicional, que cambia el foco de atención y lo sitúa en los alumnos.

Podemos afirmar, por tanto, que la pandemia provocada por el COVID-19 ha agudizado la necesidad educativa y social de la alfabetización digital entendida actualmente como el dominio de diferentes habilidades, capacidades y competencias necesarias para el usode la tecnología, los medios y los medios digitales, sin descuidar actitudes y comportamientos críticos y reflexivos en su uso (Martzoukou, et al., 2020).

Este contexto social donde las TIC están presentes en todos los procesos relacionados con la enseñanza y el aprendizaje han hecho de las mismas un elemento indispensable enla educación a través de su digitalización, que ofrece un aprendizaje mucho más flexible,globalizado en el tiempo y el lugar, y centrado en el estudiante, y es prácticamente extrañoenseñar sin el uso de las TIC. Por tanto, es más que necesario enseñar competencia digital(Barragán-Sánchez et al., 2020).

A partir de estas ideas, por tanto, podemos vislumbrar una idea de educación que puede ser impartida en cualquier área curricular, ya la que se postulan las TIC como un recurso que puede asegurar su implementación. Por tanto, es fundamental hablar de alfabetizacióndigital, entendida como una competencia multiárea en relación con el uso de tecnología digital, que implica acciones como la capacidad de un sujeto para analizar, componer y originar contenidos digitales, resolver temas digitales, comunicarse y relacionarse con otros de una manera segura y apropiada (Jin et al., 2020).

Por su parte, el primer estudio tuvo como objetivo analizar la evidencia empírica encontrada en estudios internacionales entre 2011 a 2021 relacionados con la alfabetización digital alfabetización de los estudiantes universitarios de titulaciones relacionadas con la educación. Los resultados del mismo, se centran en tres enfoques principales: En cuanto al primer enfoque relacionado con la lectoescritura, este trabajo

destacó el hecho de que los estudios de Occidente son los predominante en este campo (Çoklar et al., 2017; Ata y Yildirim, 2019; Hamutoglu et al., 2019; Sujarwo et al., 2022), que corresponden a estudios transversales, empleando en su mayoría instrumentos como "la Escala de Alfabetización Digital" desarrollada por Ng (2012), y "la escala de autoeficacia de alfabetización informacional (ILS)" desarrollado por Kurbanoglu et al. (2006). Y, en cuanto al nivel de dominio, los resultados mostraron un nivel intermedio alto de competencia en información y alfabetización digital, comunicación, y colaboración, pero un nivel intermedio bajo en términos de digital creación de contenidos, particularmente en la creación y difusión de contenidos multimedia utilizando diferentes herramientas (López-Meneses et al., 2020; Moreno et al., 2020).

En cuanto al segundo foco, la alfabetización digital en la universidad estudiantes, este estudio revisó las diversas contribuciones de otros trabajos y encontró la presencia de ungrupo competente en este campo, que hace un uso eficiente tanto de Internet como de losmedios digitales (Çoklar et al., 2016; Ata & Yildirim, 2019; Lim & Newby, 2021). Sin embargo, también se encontraron diferencias en este colectivo. relacionados con el género, donde las mujeres eran más competentes que hombres en alfabetización digital, alfabetización informacional, tecnología alfabetización y alfabetización comunicativa (Hamutoglu et al., 2019; López-Meneses et al., 2020; Navarro, 2020). Por otro lado, también encontramos estudios que revelaron particular género brechas donde los hombres mostraron una mayor propensión a la LD, mientras que las mujeres superan a los hombres en la prueba general de alfabetización digital (Ata & Yildirim, 2019). Ata & Yildirim (2019) también encontraron diferencias en DL entre estudiantes donde estudiantes universitarios estudiar ciencias o carreras relacionadas con las matemáticas tenían mayor niveles de alfabetización digital que los estudiantes de ciencias sociales o campos de la psicología (Ata & Yildirim, 2019; Chow & Wong, 2020).

Y en cuanto al tercer foco, la alfabetización digital en los futuros docentes, encontramosun doble uso de la alfabetización digital, en su ámbito social y de ocio (buscar o mantener amistades a través de redes sociales) redes sociales, compartir contenido digital, descargar contenido o jugar juegos en línea), y en su aspecto académico (buscar en motores de búsqueda, trabajar con documentos en línea, organizar o sintetizar información dediferentes procesadores, usando programas informáticos para realizar presentaciones, editar imágenes o contenido, o crear contenido audiovisual (López-Meneses et al., 2020).La principal contribución de esta revisión radica en su comparación entre los estudios pre/post pandemia, que muestran un gran aumento en el

uso de las tecnologías en el mundo educativo (a través el currículo), y trabajos de investigación centrados en medir la competencias de estos dispositivos (Baber et al., 2022). Entre los que encontramos como novedad, el estudio de las variables como la motivación académica (Chow & Wong, 2020), autoeficacia y motivación (Lerdpornkulrat et al., 2019), expectativas de esfuerzo (Nikou & Aavakare, 2021) y autoconcepto como estudiante y como docente (Ye¸silyurt et al., 2016). Por lo tanto, podemos afirmar que en este estudio la investigación se cumplen las predicciones, en el sentido de que los resultados encontrados muestran diferencias con estudios internacionales pre-post pandemia; y por diferentes orígenes culturales (latín español, portugués, finlandés...), género y recursos digitales personales. En términos de aplicaciones para la práctica educativa, estos resultados no indican que los estudiantes universitarios son competentes en términos de alfabetización digital, aunque demuestran algunas competencias más limitadas como búsqueda de informaciónen línea, evaluación de información, procesamiento de información, comunicación de información, habilidades de difusión (Çoklar et al., 2016; Lerdpornkulrat et al., 2019). Por lo tanto, existe el riesgo de formar un incompleto estudiantado en competencia digital. En cuanto al segundo estudio, confirma el uso generalizado de dispositivos digitales en adolescencia. En cuanto al tiempo de uso de internet fuera de la escuela, los participantes ubican el promedio tiempo entre 2 y 4 horas al día. Por otro lado, como acciones que realizan los adolescentes en su día a día, encontramos uso de chat en línea, uso de redes sociales para contactar a sus amigos y navegar por Internet para divertirse, seguido por hacer amigos, y la descarga de música, películas o juegos. Además, este estudio demuestra que el uso de dispositivos digitales se correlaciona positivamente con el uso de dispositivos digitales para la comunicación. Este resultado está relacionado con el hecho de que muchos de los avances actuales en el campo de las nuevas tecnologías están marcados por el aumento y calidad de los dispositivos y software relacionados con el campo de la comunicación. Además, el uso de dispositivos digitales y de comunicación se ha relacionado positivamente con las relaciones interpersonales. Estas relaciones se deben principalmente al hecho de que los jóvenes hacen uso extensivo de estos dispositivos, por su facilidad de uso y accesibilidad, para interactuar con su entorno social, ya sea directamente (por ejemplo, llamada telefónica, chat y videollamada) o indirectamente (por ejemplo, subiendo videos o imágenes en las redes sociales). Sin embargo, este uso de dispositivos digitales no está tan extendido entre los participantes en términos de uso educativo, ya que los participantes reconocen que nunca o casi nunca use Internet para descargar aplicaciones educativas, consultar sitios web educativos, comunicarse con otros estudiantes sobre el trabajo de la escuela, subir contenido a la escuela sitio web, o consulte el sitio web de la escuela (Moral et al., 2016).

En cuanto a su uso, los participantes informaron sentirse cómodos usar dispositivos digitales y descubrir nuevas aplicaciones o juegos. Además, consideran Internet como un gran recurso de información de interés para ellos. Sin embargo, nosotros también encontramos casos en los que admiten sentirse mal si no tienen conexión a internet o perder la noción del tiempo durante su empleo. Estos resultados coinciden con los reportados por Fernández-Montalvo et al. (2015) o Muñoz Rivas et al. (2010) para quienestas actitudes excesivas pueden incluso corresponder a un retiro síntomas frente a la adicción. Todo esto nos lleva a preguntarnos, como una futura implicación educativa, si realmente estamos formar a nuestros alumnos en competencia digital desde un punto de vista ético, cívico y respetuoso o, por el contrario, la competencia digital de los estudiantes en el español actual contexto educativo es meramente técnico. Como muestran los resultados de esta investigación, la educación el uso de dispositivos digitaleses menor que su uso recreativo.

En cuanto al tercer estudio, pone de manifiesto la existencia de diferencias en los recursos digitales personales en ámbitos culturales distintos (hispánico y latinoamericano). Así como la identificación de patrones diferenciales proporcionados por las variables relacionadas con la competencia digital por diferentes contextos culturales (hispano y latinoamericano), y el efecto que las variables geográficas y culturales tienen sobre las competencias de alfabetización digital. Una interpretación plausible, a la luz de estudiosrecientes previos presentados en antecedentes, indican el hecho de que para los adolescentes que habitan en países industrializados, Internet se ha convertido en una herramienta indispensable en el desarrollo de su identidad y 8 socialización (Gómez-Galán et al., 2021). Este hecho demuestra que tanto los dispositivos digitales como Internet se han convertido en parte esencial de la vida cotidiana de los adolescentes en particular, y de la sociedad en general (Manago et al., 2020). Por otro lado, este estudio permite identificar como habilidades digitales la búsqueda en internet, publicar información, saber elegir información veraz y relevante (McGrew et al., 2018; Ofcom, 2020). Y, en relación con las habilidades digitales, diferentes acciones relacionadas con el correo electrónico, como la consulta, las reacciones o el uso.

En este sentido, otros estudios han afirmado que Internet, junto con los dispositivos digitales, se ha convertido para los adolescentes en un soporte de información, aprendizaje y descubrimiento, pero también de comunicación y entretenimiento (Lozano & Cortés, 2020).

Por otro lado, en el caso del disfrute, la muestra reconoce perder la noción del tiempo al usar dispositivos digitales, ya que consideran que Internet es un gran recurso tanto para obtener información como para hacer amigos. En este sentido, investigaciones

recientes han demostrado que el uso de las redes sociales entre jóvenes de 13-17 años ronda el 93-97% (Anderson et al., 2018; Barry et al., 2017) por lo que podemos afirmar que, en ciertomodo, internet se convierte en un lugar donde los adolescentes construyen su identidad, se relacionan con los demás y comparten gustos, preferencias y lenguaje con sus pares (Khatcherian et al., 2022). Además de disfrutar mientras los usa. En este sentido, hay numerosos estudios recientes que incluso afirman que la cantidad de tiempo que los adolescentes pasan en línea se ha duplicado en los últimos 13 años (De Felice et al., 2022).

CONCLUSIONES

Con base en los resultados obtenidos en la presente tesis, podemos llegar a lassiguientes conclusiones:

1. Dentro del campo de investigación de alfabetización digital, la revisión de las de base empírica, indica la necesidad de incrementar el número de intervenciones de tipo formativo en la formación académica inicial de los futuros docentes para que esto sea una moneda de doble cambio y permita la inclusión de la alfabetización digital en las enseñanzas del alumnado en el futuro.

2. Mediante el estudio internacional, se ha demostrado que el uso y disfrute de las tecnologías digitales por parte de los adolescentes en la sociedad actual es un fenómeno mundial.

3. Asimismo, nuestros resultados indican que el empleo de los dispositivos digitales y deinternet supone en la actualidad una nueva forma de enseñar y de aprender, perosobretodo de relacionarse con los demás. A través del uso del ordenador, de la Tablet, odel teléfono.

CONCLUSIONS

Based on the results obtained in this thesis, we can arrive at the following conclusions:

1. Within the field of digital literacy research, the review of the empirically based, indicates the need to increase the number of emergency training in the initial academic training of future teachers so that this is a double currency and allows the inclusion of digital literacy in the teaching of students in the future .

2. Through international study, it has been shown that the use and enjoyment of digital technologies by adolescents in today's society is a worldwide phenomenon.

3. Likewise, our results indicate that the use of digital devices and the Internet is currently a new way of teaching and learning, but above all of relating to others. Through the use of the computer, the Tablet, or the telephone.

LIMITACIONES Y PROSPECTIVA

El trabajo presenta una serie de limitaciones que deben tenerse en cuenta.

Las principales limitaciones de este trabajo corresponden a que la forma de evaluar estos elementos ha correspondido a medidas de autoinforme. No obstante, consideramos adecuado apostar por escalas de evaluación de competencias digitales validadas en términos de la propia alfabetización digital.

Los caminos de solución o perspectivas futuras de las limitaciones del presente estudio, además de tener en cuenta dichas limitaciones, se relacionan con identificar qué determinantes psicológicos y educativos inciden en el desarrollo de la competencia digital de los estudiantes, así como en su eficiencia en el logro de las metas académicas . , la persistencia y la resistencia para lograr estas metas y objetivos, la necesidad de creer en la propia capacidad o autoeficacia hacia la competencia digital y la alfabetización, la participación o compromiso y el compromiso o compromiso con el aprendizaje, u otras variables psicológicas relevantes, que se ha demostrado que ser clave en el logro de la experiencia de competencia y producir efectos en el logro de metas académicas y resultados de aprendizaje, incluido el ajuste personal y social.

Además, a pesar de la importancia y consideración de la sostenibilidad y la competencia digital, actualmente hay poca investigación sobre la evaluación del nivel de logro, progreso y mejora de la sostenibilidad en la educación. Esto se suma a la escasez de herramientas de medición.

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ANEXOS

Escola Superior
de Educação
Politécnico de Coimbra

Com o presente documento, D. Sofia de Lurdes Rosas da Silva, Professora na Escola Superior de Educação de Coimbra,

CERTIFICA

Que a doutoranda NIEVES GUTIÉRREZ ÁNGEL, aluna do Programa de Doutorado em Psicologia da Educação e Ciências da Educação da Universidade de León, realizou uma estadia de pesquisa por três meses: de 15 de junho de 2022 a 15 de outubro de 2022, sob a minha supervisão na Escola Superior de Educação do Instituto Politécnico de Coimbra, Portugal.

Durante esta estadia, a doutoranda NIEVES GUTIÉRREZ ÁNGEL realizou toda as atividades propostas no plano de trabalhos que considerarámos adequados à sua investigação, assim como a frequência de diferentes semanários que foram importantes para a sua formação.

A doutoranda fez um trabalho de pesquisa adequado que lhe permitiu avançar na sua pesquisa.

Coimbra, 15 de outubro de 2022

Fdo. **Sofia de Lurdes Rosas da Silva**

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