Universitat de Lleida

TESI DOCTORAL

Diferències de gènere dels adolescents en l'ús de les TIC. Estudi longitudinal sobre els efectes de l'ús d'ordinadors personals en els centres educatius de Catalunya

Roser Cussó Calabuig

Memòria presentada per optar al grau de Doctor per la Universitat de Lleida
Programa de Doctorat en Tecnologia Educativa

Director/a
Dr. Xavier Carrera Farran

Tutor/a
Dr. Xavier Carrera Farran

2019

Roser Cussó
Firmado digitalmente por Roser Cussó
Fecha: 2019.03.10 17:16:00 +01'00'

There is no gate, no lock, no bolt that you can set upon the freedom of my mind.

Virgina Wolf

Al meu pare, sense ser-hi no hi pot ser més.
A la meva mare, sent-hi sempre.
Al Marc, a l'Anna i a la Neus, que hi són, dins i fora.
A X., que és.

A totes les noies i a tots els nois, per a què siguin allò que vulguin ser.

Agraïments

Aquest treball és el resultat d'un camí llarg, amb pujades, baixades i revolts, que no hagués pogut ni emprendre ni acabar sense molta gent que ha estat al meu costat, recolzant-me i animant-me.

En primer lloc, vull agrair al meu tutor de tesi, el Dr. Xavier Carrera Farran, tot el seu suport, la seva confiança i els seus consells, sempre encertats. M'ha estirat quan calia i m'ha acompanyat quan anava perduda, com a tutor però, sobretot, com a un bon amic.

En segon lloc, el meu reconeixement i el meu agraïment per en Jordi Vivancos Martí, cap de l'àrea de Cultura Digital del Departament d'Educació de la Generalitat de Catalunya que, amb tanta paciència, em va ajudar a arrencar el treball i ha estat al meu costat en tot el procés.

Als meus amics i amigues, que m'han recolzat i que s'han interessat per la meva feina durant tot aquest temps i amb els qui he mantingut llargues converses sobre com es pot canviar el món amb l'educació i com podem aconseguir que noies i nois siguin lliures per triar el seu futur. En especial, a la Rosanna Fernández, amb qui he compartit tantes hores de feina i il·lusions.

Als meus pares, que m'han permès ser qui sóc amb el seu recolzament i la seva estimació.

Als meus fills, el Marc, l'Anna I la Neus, que han estat el meu motor i han confiat sempre en mi malgrat els he robat moltes hores de ser el seu costat.

Al meu company, el Xavier, sense el seu ajut, el seu suport i el seu guiatge aquest treball no hauria arribat al final del camí. Ha estat la persona que mai ha deixat de creure que el que feia era important fins i tot quan jo no ho creia.

Finalment, el meu agraïment a tots els professors I professores i a les noies i els nois que han participat en aquest llarg procés de tres anys. Tota la feina no hauria estat possible sense la seva col·laboració.

Índex

Índex de figures

Índex de taules

Índex annexos

Resum

El baix nombre de matriculacions en els estudis superiors i tècnics de l'àmbit de les Tecnologies de la Informació i la Comunicació (TIC) és un fet que es manté constant. La manca de professionals TIC implica tant a homes com a dones, però és especialment preocupant en el cas de les dones, amb uns percentatges de graduades en TIC excepcionalment baixos.

L'estudi que es presenta pretén analitzar quines són les causes que poden explicar les baixes vocacions TIC de les noies i si l'ús intensiu dels ordinadors en els centres de secundària pot ajudar a disminuir aquestes diferències de gènere.

Aquesta anàlisi es planteja començant per una recerca sistemàtica de la literatura per tal de conèixer estudis previs amb objectius similars als proposats. En base a l'estat actual de la qüestió, es decideix dur a terme un estudi amb un disseny longitudinal amb alumnat d'educació secundària obligatòria considerant les següents variables: gènere, freqüència i tipus d'ús dels ordinadors, actituds vers l'ús dels ordinadors (ansietat, gaudi i autoconfiança) i autoeficàcia.

Els alumnes participants pertanyen a centres on es fa un ús intensiu dels ordinadors i a centres que no l'utilitzen de forma intensiva a les aules, triats de forma aleatòria entre tots els centres públics d'educació secundària de Catalunya i seguits al llarg de tota l'etapa. Les dades es recullen mitjançant les respostes a un qüestionari en línia basat en qüestionaris validats prèviament. La recollida de dades es realitza en cinc rondes d'intervenció, una a l'inici de cada curs escolar i una altra al final, excepte en el tercer curs d'educació secundària obligatòria on només es recullen les respostes al final del curs escolar.

L'anàlisi de les respostes permet una comparació de les diferències de gènere en l'ús dels ordinadors entre l'estat inicial i l'estat final dels centres d'intervenció i dels centres de control i mesurar els efectes de la intervenció per comparativa entre aquestes evolucions.

Finalment, s'analitzen les associacions entre les variables estudiades per tal d'establir possibles correlacions que permetin guiar futures recerques i definir estratègies d'aula que ajudin a incrementar les vocacions TIC.

Els resultats indiquen que els efectes de la intervenció sobre la reducció de diferències de gènere són, en general, poc importants i estadísticament no significatius. Només s'observa un increment en les variables de freqüència de joc i d'oci pel que fa als nois i de freqüència de comunicació i de resolució de tasques escolars pel que fa a les noies. Les variables d'actituds i d'autoeficàcia no indiquen cap efecte de la intervenció, malgrat la literatura consultada indica que un increment en l'ús de l'ordinador té efectes en la reducció d'ansietat i l'increment de l'autoconfiança i l'autoeficàcia.

Pel que fa a les associacions de variables, s'observen correlacions entre gènere i totes les variables de freqüència i les d'actituds, excepte la d'ansietat que, segons la literatura consultada presenta una forta associació amb el gènere (major ansietat a les noies). La variable d'autoeficàcia també està associada amb el gènere, mostrant una alta probabilitat d'elevada autoeficàcia en les noies per a dur a terme operacions bàsiques, resultat contradictori amb la literatura consultada.

Les associacions entre freqüència d'ús dels ordinadors i edat d'iniciació en l'ús i la resta de variables indiquen de forma clara una correlació positiva: a major ús i menor edat d'inici, milloren les actituds i l'autoconfiança.

Es conclou que: (a) l'ús dels ordinadors personals a l'aula no sembla aportar una millora en la disminució de diferències de gènere excepte en aquelles tasques relacionades de forma directa amb activitats a l'aula i deures escolars; i (b) un ús més freqüent dels ordinadors i una iniciació a edats primerenques indica una major probabilitat de millora d'actituds i autoeficàcia.

Es proposen com a futures línies de recerca: (a) l'estudi de la tipologia d'activitats a l'aula, metodologies i organització de les classes que poden afavorir la disminució d'aquestes diferències de gènere i proporcionar majors valors d'autoconfiança i autoeficàcia a les noies, com a base d'un assoliment de les competències digitals i de la possibilitat de tria de carreres TIC; i (b) l'estudi dels efectes de la introducció de l'ús de l'ordinador en les aules a edats primerenques respecte de les diferències de gènere.

Paraules clau: diferències de gènere, actituds vers l'ús dels ordinadors, autoeficàcia, educació secundària, programes 1:1.

Resumen

El bajo número de matriculaciones en los estudios superiores y técnicos del ámbito de las Tecnologías de la Información y la Comunicación (TIC) es un hecho que se mantiene constante. La falta de profesionales TIC implica tanto a hombres como a mujeres, pero es especialmente preocupante en el caso de las mujeres, con unos porcentajes de graduadas en TIC excepcionalmente bajos.

El estudio que se presenta pretende analizar cuáles son las causas que pueden explicar las bajas vocaciones TIC de las chicas y si el uso intensivo de los ordenadores en los centros de secundaria puede favorecer a disminuir estas diferencias de género.

Este análisis se plantea empezando por una búsqueda sistemática de la literatura para conocer estudios previos con objetivos similares a los propuestos. En base al estado de la cuestión, se decide realizar un estudio longitudinal focalizado en alumnos de educación secundaria obligatòria considerando las siguientes variables: género, frecuencia i tipus de uso de los ordenadores, actitudes frente al uso de los ordenadores (ansiedad, satisfacción y autoconfianza) y autoeficacia.

Los alumnos participantes pertenecen a centros donde se hace un uso intensivo de los ordenadores y en centros que no lo utilizan en las aulas, elegidos de forma aleatoria entre todos los centros públicos de educación secundaria de Cataluña y seguidos a lo largo de toda la etapa. Los datos se recogen mediante las respuestas a un cuestionario en línea basado en cuestionarios validados previamente. La recogida de datos se lleva a cabo en cinco rondas de intervención, una al inicio de cada curso escolar y otra al final, excepto en el tercer curso de educación secundaria obligatoria donde sólo se realiza al final del curso escolar.

El análisis de las respuestas permite una comparación de las diferencias de género en el uso de los ordenadores entre el estado inicial y el estado final de los centros de intervención y de los centros de control y medir los efectos de la intervención por comparativa entre estas evoluciones.

Finalmente, se analizan las asociaciones entre las variables estudiadas para establecer posibles correlaciones que permitan guiar futuras investigaciones y definir estrategias de aula que ayuden a incrementar las vocaciones TIC.

Los resultados indican que los efectos de la intervención sobre la reducción de diferencias de género son, en general, poco importantes y estadísticamente no significativos. Sólo se observa un incremento en las variables de frecuencia de juego y de ocio con respecto a los chicos y de frecuencia de comunicación y de resolución de tareas escolares en cuanto a las chicas. Las variables de actitudes y de autoeficacia no indican ningún efecto de la intervención, a pesar que la literatura consultada indica que un incremento en el uso del ordenador tiene efectos en la reducción de ansiedad y el incremento de la autoconfianza y la autoeficacia.

En cuanto a las asociaciones de variables, se observan correlaciones entre género y todas las variables de frecuencia y las de actitudes, excepto la de ansiedad que, según la literatura consultada presenta una fuerte asociación con el género (mayor ansiedad en las chicas). La variable de autoeficacia también está asociada con el género, mostrando una alta probabilidad de elevada autoeficacia en las chicas para llevar a cabo operaciones básicas, resultado contradictorio con la literatura consultada.

Las asociaciones entre frecuencia de uso de los ordenadores y edad de iniciación en el uso y el resto de variables indican de forma clara una correlación positiva: a mayor uso y más baja edad de inicio, mejoran las actitudes y la autoconfianza.

Se concluye que: (a) el uso de los ordenadores personales en el aula no parece aportar una mejora en la disminución de diferencias de género excepto en aquellas tareas relacionadas de forma directa con actividades en el aula y deberes escolares; y (b) un uso más frecuente de los ordenadores y una iniciación a edades tempranas indica una mayor probabilidad de mejora de actitudes y autoeficacia.

Se proponen como futuras líneas de investigación: (a) el estudio de la tipología de actividades en el aula, metodologías y organización de las clases que pueden favorecer la disminución de estas diferencias de género y proporcionar mayores valores de autoconfianza y autoeficacia a las chicas, como base de un logro de las competencias digitales y de la posibilidad de elección de carreras TIC; y (b) el estudio de los efectos de la introducción del uso del ordenador en las aulas a edades tempranas respecto de las diferencias de género.

Palabras clave: diferencias de género, actitudes en referència al uso de los ordenadores, autoeficacia, educación secundaria, programas 1:1.

Abstract

The low number of students in higher and technical studies in the field of Information and Communication Technologies (ICT) is a fact that remains constant. The lack of ICT professionals involves both men and women, but it is especially worrying in the case of women, with rates of graduation in ICT exceptionally low.

The study aims to analyze the causes that may explain the low level of vocations in ICT in girls and whether the intensive use of computers in secondary schools may help to reduce these gender differences.

This analysis is considered starting from a systematic search of the literature to know previous studies with objectives similar to those proposed. Based on the state of the matter, it is decided to conduct a longitudinal study focused on compulsory secondary education students considering the following variables: gender, frequency and type of use of computers, attitudes to the use of computers (anxiety, enjoyment and self-confidence) and self-efficacy.

The participating students belong to schools where computers are used in an intensive way and centers that do not use them in the classrooms, randomly chosen among all public high schools in Catalonia and followed throughout three years. The data is collected through the answers to an online questionnaire based on previously validated questionnaires. The data collection is carried out in five rounds of intervention, one at the beginning of each school year and one at the end, except for the third year of compulsory secondary education where it is only carried out at the end of the course school

The analysis of the answers allows a comparison of gender differences in the use of computers between the initial state and the final state of intervention centers and control centers and measure the effects of the intervention by comparison between these evolutions.

Finally, the associations are analyzed between the variables studied in order to establish possible correlations that allow to guide future researches and to define classroom strategies that help to increase TIC vocations.

The results indicate that the effects of the intervention on the reduction of gender differences are, in general, not important and statistically not significant. Only an increase in the frequency variables of game and leisure with regard to boys and the frequency of communication and the resolution of school tasks regarding to girls was observed. The variables of attitudes and self-efficacy do not indicate any effect of the intervention, despite the literature consulted indicates that an increase in the use of the computer has effects in the reduction of anxiety and the increase of self-confidence and self-efficacy

Regarding the associations of variables, correlations between gender and all frequency variables and those of attitude are observed, except for the one of anxiety that, according to the literature consulted, has a strong association with gender (greater anxiety in girls). The self-efficacy variable is also associated with the gender, showing a high probability of high self-efficacy in girls to carry out basic operations, which is in contradiction with the literature consulted.

The associations between the frequency of computer use and the age of initiation in their use and the rest of the variables clearly indicate a positive correlation: to greater use and lower age of onset, they improve the attitudes and the self-confidence.

It is concluded that: (a) the use of personal computers in the classroom does not seem to provide an improvement in the reduction of gender differences except in those tasks directly related to activities in the classroom and school duties; and (b) a more frequent use of computers and initiation at early ages indicates a greater probability of improvement of attitudes and self-efficacy.

Finally, we propose possible future lines of research: (a) the study of the type of classroom activities, methodologies and organization of classes that can favor the reduction of these gender differences and provide greater values of self-confidence and self-efficacy for girls, as a basis for the achievement of digital competences and the possibility of choosing ICT careers; and (b) the study of the effects of the introduction of the use of the computer in classrooms at early ages with respect to gender differences.

Keywords: gender differences, attittudes towards computers' use, self-efficacy, secondary education, one-to-one computer's programmes.

1. Introducció

La present recerca parteix de l'interès personal al voltant de quines són les causes que condueixen als adolescents a fer la tria del seus estudis postobligatoris i universitaris cap a un o altre camp. Com a professora de Tecnologia d'educació secundària, he pogut copsar, al llarg dels meus anys de docència, que el nombre d'estudiants de Batxillerat de l'àmbit tecnològic ha estat sempre molt baix, especialment si ens centrem en les noies. Aquest fet implica que poques alumnes es plantegen seguir estudis de caire tècnic, situació que ve confirmada pel baix nombre d'estudiantes matriculades als graus universitaris d'enginyeria.

La branca dels estudis d'informàtica (d'ara en endavant TIC, Tecnologies de la informació i la Comunicació) és una de les més afectades per aquesta tendència. Tenint en compte l'elevat ús de les TIC que fan els joves en el seu dia a dia, resulta sorprenent i contradictori aquesta manca d'interès per dedicar-s'hi professionalment.

L'observació d'aquesta situació em va fer plantejar una recerca sobre les percepcions de nois i noies al voltant de les TIC, en relació al seu ús i la seva prospectiva professional. Vaig dur a terme una llicència retribuïda pel Departament d'Ensenyament (Cussó, 2006) al llarg d'un curs escolar (2005-2006) que em va permetre iniciar aquesta recerca a partir de qüestionaris i entrevistes als alumnes del meu centre. A partir d'aquest estudi, vaig continuar la recerca en grups de treball de la Universitat Politècnica de Catalunya amb l'objectiu de detectar les possibles causes d'aquesta manca de vocacions TIC de les noies i generar materials didàctics d'orientació vocacional i publicacions, així com impartir cursos de formació a professorat de secundària sobre el tema.

La implementació dels ordinadors personals als centres de secundària catalans, a partir del programa eduCAT, va permetre'n un ús normalitzat a les aules i a totes les matèries, implicant canvis metodològics i organitzatius. Per primera vegada tots els alumnes tenien la possibilitat d'emprar-lo individualment i seguir el propi ritme d'aprenentatge. Aquest fet va obrir una situació d'igualtat de gènere i d'equitat social per a tots els alumnes i, per tant, és d'esperar que tingui un impacte en nois i noies pel que fa a la seva percepció de domini de la competència digital.

És en aquesta situació quan prenc la decisió de cursar el màster Tecnologia Educativa: e-learning i gestió del coneixement (cursos escolars del 2011-12 al 2013-14) i decideixo dur a terme com a tema de treball final de màster, i acompanyada pel meu tutor el Dr. Xavier Carrera Farran, una recerca al voltant de quin és l'efecte de l'ús dels ordinadors personals sobre les diferències de gènere en les TIC (Cussó, 2014). La continuació d'aquesta recerca es va convertir en el nucli de la present tesi que es va iniciar en el curs 2014-15 i que coincideix amb la última recollida de dades. El següent curs, el 2015-16, es decideix que la tesi sigui de la tipologia per articles.

El resultat de tota la recerca es recull en el present document on es defineix, en primer lloc, quin és el problema d'estudi i planteja els objectius de la recerca. Segueix amb una descripció de la metodología emprada, una petita introducció als articles redactats, la discussió dels resultats i finalment les conclusions de la recerca. Com a material de suport es presenten els articles en els annexos així com el qüestionari emprat per a la recollida de dades.

2. Problema d'estudi

La disminució de les vocacions dels joves cap a les enginyeries és una tendència marcada en els últims anys, més acusada encara pel que es refereix a les noies que estan infrarrepresentades a la majoria dels estudis tècnics, en especial els relacionats amb les TIC. En el cas d'Espanya, el percentatge d'alumnes en estudis universitaris de l'àmbit de les TIC es manté pràcticament constant des de l'any 2006, representant un 4,7%, del qual un 4% són homes i un 0.7% dones. Pel cas concret de Catalunya, a la Figura 1 es mostren les xifres d'homes i dones graduats en el període 2006-2016 a carreres de l'àmbit de les TIC.

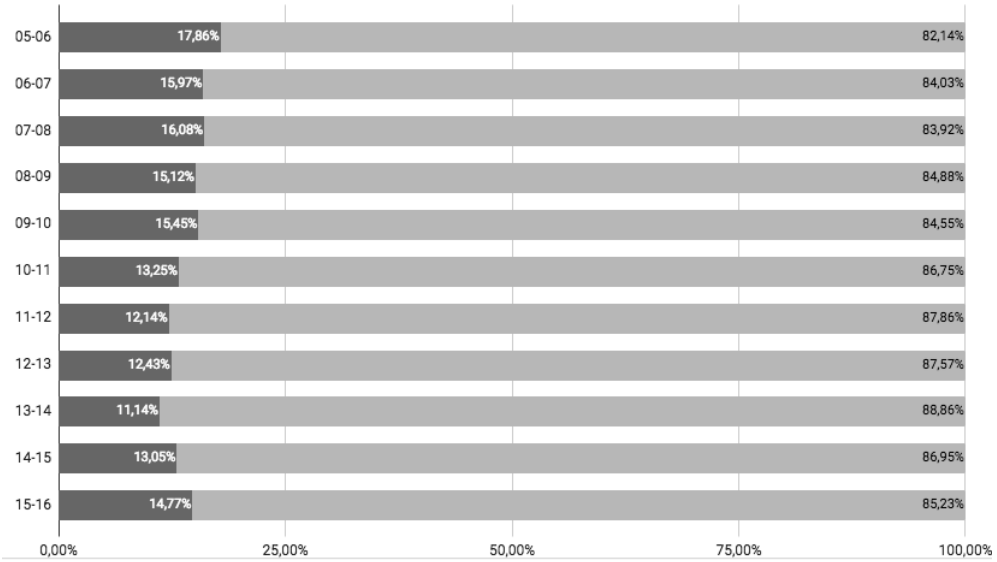


Figura 1. Percentatge de dones (gris fosc) i homes (gris clar) graduats en l'àmbit de les TIC en els últims deu anys (Font: elaboració pròpia a partir de les dades de l'Agència Catalana de la Qualitat Universitària)

El baix interès dels alumnes per dedicar el seu futur laboral a l'àmbit de les TIC es reflecteix de forma clara en els resultats PISA del 2015. Tenint en compte la mitjana de la OCDE, només un 25% dels nois i un 24% de les noies mostren expectatives de treball relacionades amb la ciència i la tecnologia. Si ens focalitzem en les TIC, les xifres baixen a un 4.8% dels nois i un 0.4% de les noies (Figura 2).

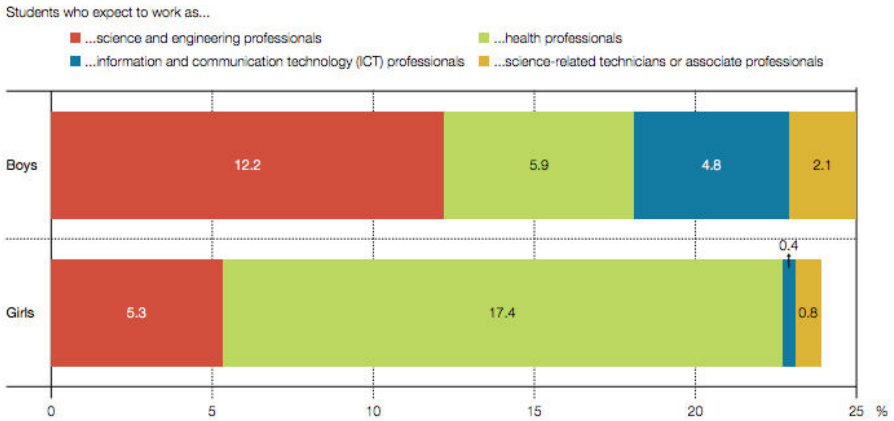


Figura 2. Expectatives de treball dels estudiants participants a PISA 2015 (Font: OECD, PISA 2015 Database, Taules I.3.11a-d)

Paral·lelament a la necessitat d'afavorir l'increment de les vocacions en TIC i del nombre de graduats en aquest àmbit, tenint en compte les necessitats del mercat laboral, cal assegurar que tots els ciutadans assoleixen un nivell acceptable de competència digital, imprescindible en una societat on les TIC estan presents en tots els àmbits.

La definició de la competència digital, com una de les competències clau de l'aprenentatge al llarg de la vida, va ser definida per la Comissió Europea el 2006 (European Comission, 2006). Paral·lelament, es defineix l'agenda digital europea que estableix iniciatives per assegurar que les polítiques educatives dels països membres incloguin accions per a l'assoliment de la competència digital (European Comission, 2010).

Al gener de 2018, la Comissió Europea redefineix l'agenda digital europea, des del punt de vista educatiu, mitjançant el Digital Education Plan (European Comission, 2018) amb l'objectiu de donar suport a l'ús de la tecnologia als centres educatius i afavorir l'assoliment de la competència digital dels estudiants. Aquest pla defineix tres prioritats dividides en onze accions, una de les quals es refereix específicament a les noies: "Action 8: Training in digital and entrepreneurial skills for girls. Support measures to further decrease the gender gap in the technology and entrepreneurial sector by promoting digital and entrepreneurial competences among girls; mobilise stakeholders (companies, NGOs) to equip girls with digital skills and inspirational models, building on the Digital Competence Framework for Citizens and the Entrepreneurship Competence Framework".

Si la competència digital és, per tant, una de les competències fonamentals dels ciutadans del segle XXI, cal assegurar que tant els nois com les noies l'assoleixen en el mateix grau. Per tant, és necessari no només definir accions i afavorir la seva implementació sinó també identificar quines són les possibles causes que provoquen les diferències respecte de les actituds de nois i noies quan fan ús de les TIC, així com analitzar quins són els factors fonamentals que porten a les noies, majoritàriament, a no plantejar-se la seva projecció professional en aquest àmbit.

L'anàlisi de la literatura permet identificar tres grups de factors que influeixen en les diferències de gènere respecte de les TIC: (a) en primer lloc, es defineix com a possible causa la manca de valor que les noies donen als estudis en aquest àmbit influenciades per les opinions de famílies i professorat respecte a la tipologia de professionals que s'hi dediquen, definits a l'imaginari col·lectiu com a persones individualistes amb manca d'habilitats socials (Sáinz et al., 2012; Stockdale i Keane, 2016); (b) en segon lloc, trobem la influència dels estereotips i la manca de models de dones professionals en l'àmbit que implica que les noies desconeixen en realitat quines són les possibles tasques que pot dur a terme un professional en TIC i que defineixen aquestes professions, en la seva majoria, lligades als homes (Thomas i Allen, 2006; Clayton et al., 2009; Von Hellens et al., 2009; Castaño i Webster, 2011; Pechtelidis et al., 2015; Master et al., 2016); (c) per últim, s'agrupen les causes que depenen específicament de les percepcions en les pròpies capacitats lligades als usos personals que nois i noies fan de les TIC i les seves actituds en front de l'ús dels ordinadors (Colley i Comber, 2003; Volman et al., 2005; Kubiatko, 2013).

És en aquest últim grup de causes on els centres educatius poden influir de forma més eficient tenint en compte que l'ús de les TIC s'està generalitzant a les escoles de forma molt ràpida, integrant-les en les activitats escolars. Donada la tendència creixent de la implementació dels

programes 1:1 (un ordinador personal per alumne/a) a les aules i els canvis metodològics associats, és necessari analitzar si els factors identificats per la recerca educativa com a possibles causes d'aquestes diferències de gènere en referència a l'ús de les TIC poden ser minimitzades. Cal preguntar-se, doncs, quin pot ser el paper dels centres escolars en la possibilitat de disminuir les diferències de gènere i quines accions poden tenir un efecte clar que condueixi a un canvi.

3. Objectius

La recerca pretén conèixer l'efecte de l'ús dels ordinadors personals en els centres de secundària en el canvi de les actituds i l'autoeficàcia de nois i noies respecte de l'ús de les TIC, sent aquestes actituds una de les possibles causes que afavoreixen la baixa elecció d'estudis en aquest camp per part de les noies.

Els objectius plantejats són:

1. Analitzar la recerca educativa centrada en l'estudi dels efectes de l'ús intensiu dels ordinadors en els centres de secundària sobre les actituds en l'ús de les TIC i l'autoeficàcia de nois i noies.
2. Mesurar l'efecte de l'ús intensiu dels ordinadors als centres de secundària sobre la disminució de les diferències de gènere en les actituds de l'ús de les TIC i en l'autoeficàcia.
3. Identificar les associacions significatives entre les variables estudiades.

4. Metodologia

A continuació s'especifica la metodologia seguida que es presenta esquematitzada a la Figura 3.

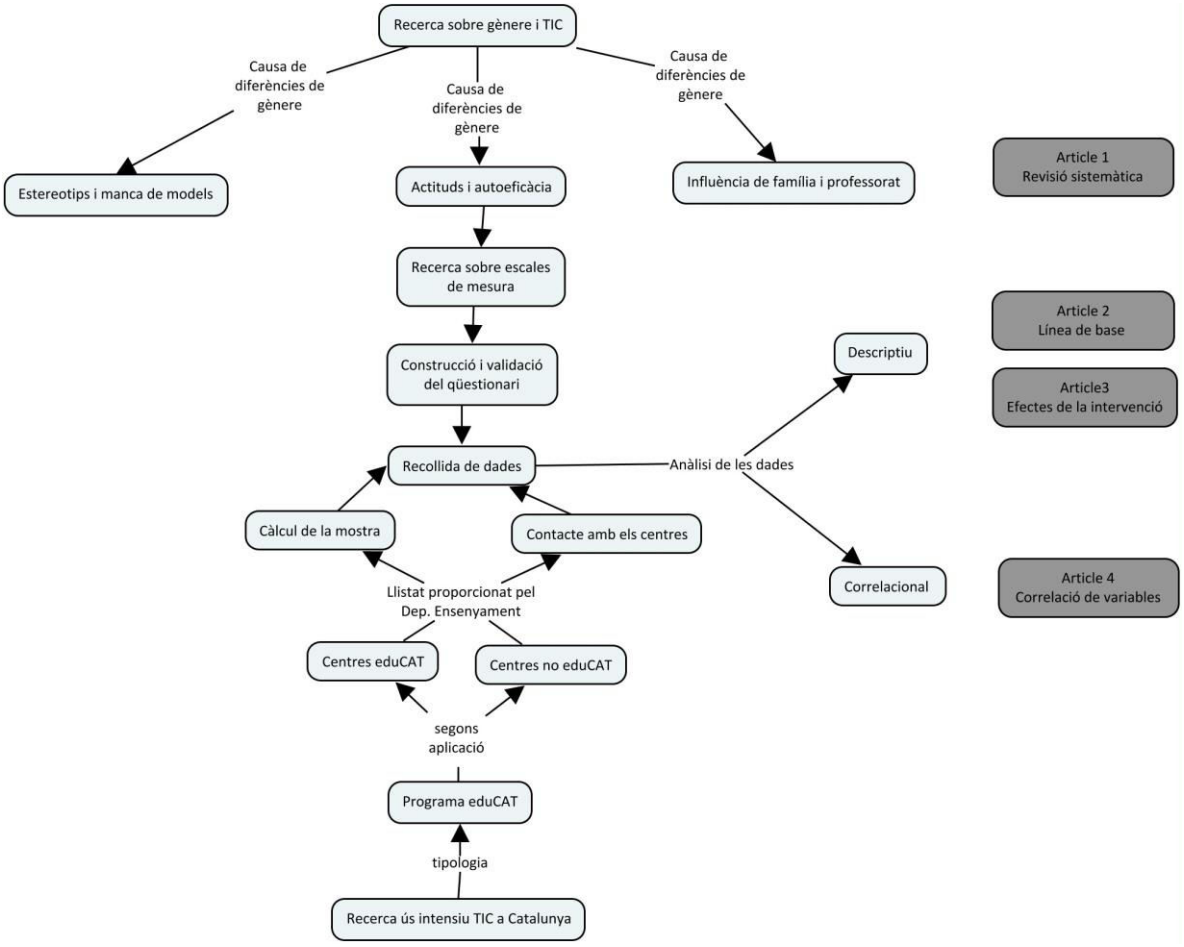


Figura 3. Esquema metodològic gobal

4.1. Descripció i disseny de la investigació

Des del paradigma positivista d'investigació es planteja un estudi quantitatiu i longitudinal, que permeti mesurar l'efecte de la utilització intensiva dels ordinadors personals sobre la disminució de la diferència de gènere en les actituds de noies i nois en l'ús dels ordinadors i la seva autoeficàcia.

Es defineixen dos grups de centres: (a) aquells en els quals s'aplica un projecte 1:1 (un ordinador personal de propietat per alumne); i (b) aquells on l'ús de l'ordinador es realitza esporàdicament per no haver-se involucrat en aquest projecte.

Atès que la pertinença a un o altre grup no l'estableixen els investigadors, sinó que ve determinada per la decisió del centre i que no es realitza cap intervenció en la forma d'ús de les TIC, no es tracta d'un estudi experimental sinó ex - post facto.

L'estudi té per marc els centres públics de secundària de Catalunya. El projecte 1:1 implementat en ells va rebre el nom d'eduCAT. La naturalesa de la investigació descrita anteriorment fa necessari el coneixement i classificació dels centres escolars en dues categories: (a) centres participants en el projecte eduCAT (considerats com a grup experimental); i (b) centres que no

participen (considerats com a grup de control), així com el nombre total d'estudiants implicat en cada tipologia.

Es decideix realitzar un estudi longitudinal de seguiment de la mateixa promoció d'estudiants al llarg dels tres primers cursos d'ESO en els quals l'alumnat cursa Tecnologia com a matèria comuna. Val a dir que no es pot assegurar de manera absolutament estricta que els individus de les recollides successives siguin els mateixos, ja que hi ha moviments d'alumnes d'un curs escolar a un altre a causa de repeticions, baixes o incorporacions externes, encara que en essència es tracta de grups naturals que es mantenen al llarg de l'etapa (taxa de repetició de 1r d'ESO al curs 2012-13: 7,3%; taxa de repetició de 2n d'ESO al curs 2013-14: 7,9% ; taxa de canvi de centre en finalitzar 1r d'ESO al curs 2012-13: 4,7%; taxa de canvi de centre en finalitzar 2n d'ESO al curs 2013-14: 4,5% [1]).

S'analitza l'existència de diferències (a) en el grup experimental; (b) en el grup de control; i (c) entre els dos grups comparant l'estat inicial (primer curs d'educació secundària obligatòria) i l'estat final (tercer curs d'educació secundària obligatòria; no es té en compte el quart curs ja que es tracta d'un curs amb una elevada optativitat i en el qual els alumnes ja han decidit una via acadèmica diferenciada). Per a això, es planifiquen dues recollides anuals de dades, a l'inici i al final de curs, sent un total de sis administracions.

Les característiques descrites referents a l'estudi, és a dir, randomitzat, longitudinal repetit en sis moments temporals, observacional, prospectiu i amb grup de control, l'emmarquen dins de la tipologia d'estudi abans-després, tenint en compte que les primeres dades s'obtenen en la mateixa situació de partida en el grup experimental i en el grup de control.

4.2. Revisió sistemàtica de la literatura

Amb l'objectiu de recollir tota l'evidència al voltant dels efectes de l'ús intensiu dels ordinadors als centres escolars sobre les diferències de gènere en l'ús de les TIC, es realitza una revisió sistemàtica de la literatura.

Aquesta revisió sistemàtica segueix:

a) les convencions estàndard de revisions sistemàtiques descrites al protocol PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses; Moher et al., 2009) i
b) els criteris d'inclusió dels articles segueixen l'estratègia PICOTS (població, intervenció, comparador, resultats, temps, disseny de l'estudi).

Les bases de dades consultades són: TESEO, DART-Europe, ERIC, Taylor & Francis, SAGE i Science Direct. Considerant la ràpida evolució de les TIC, es considera raonable restringir la cerca als últims deu anys.

S'identifiquen 740 articles que, un cop eliminades les duplicitats, es transformen en 700, dels quals es revisen els abstracts. D'aquesta primera selecció, es mantenen 59 articles sobre els quals es fa

[1] Font Departament d'Ensenyament http://ensenyament.gencat.cat/ca/departament/estadistiques/indicadors/sistema-educatiu/edicions-anteriors/index.html

una lectura completa, passant a la última selecció 9 articles que són els que s'analitzen en profunditat.

4.3. Mostra

Es pren com a univers mostral tots els centres públics de secundària de Catalunya, amb un total de 537, establint la separació entre aquells que segueixen el projecte eduCAT i els que no l'han implementat. Tenint en compte la diferenciació inicial, els centres eduCAT corresponen a un total de 362 i els centres no eduCAT a un total de 175. Les dades de què es disposen han estat facilitades pel Departament d'Ensenyament de la Generalitat de Catalunya.

Amb l'objectiu de contactar amb els centres es generen, en un primer moment i de forma aleatòria, dues mostres de 100 instituts, una per a cada tipologia. Les respostes positives a la participació es redueixen únicament a 10 centres en total, amb el que es decideix incrementar el contacte a un major nombre de centres. Amb aquest objectiu, s'amplia la mostra fins a 175 centres per a cada tipologia, triant de forma aleatòria els centres eduCAT i incloent tots els centres no eduCAT (ja que són 175). Les respostes positives s'incrementen fins a un total de 29 centres. S'observa mitjançant aquestes respostes el canvi de tipologia d'alguns d'aquests centres (4 centres passen de tipologia eduCAT a tipologia no eduCAT) de manera que s'estableix una nova diferenciació en funció de les dades reals.

No s'exclou cap centre en funció de la seva localització, grandària o qualsevol altre motiu. A la Figura 4 es mostra la distribució territorial dels centres. Els centres es consideren com a clústers i participen tots els alumnes dels centres seleccionats que inicien primer d'ESO el curs acadèmic 2012-2013.

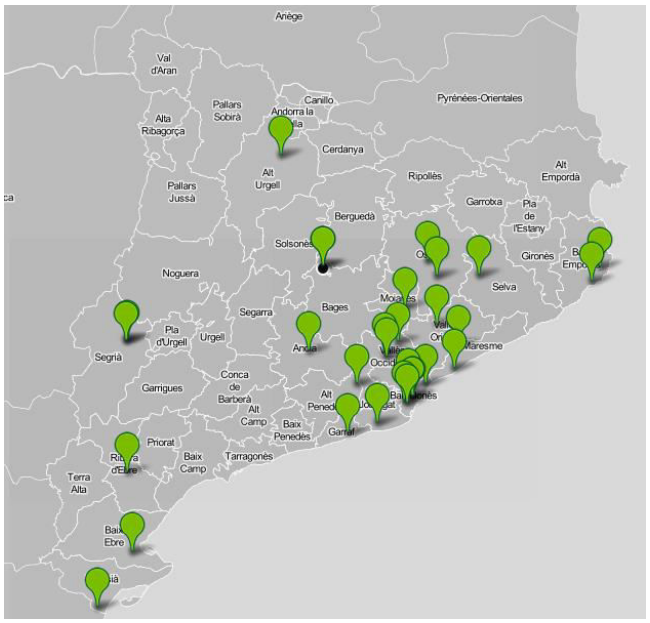


Figura 4. Distribució territorial dels centres participants a l'estudi

El primer contacte amb els centres es realitza mitjançant correu electrònic dirigit a la direcció del centre. Posteriorment les comunicacions es mantenen amb els professors encarregats de l'administració dels qüestionaris.

La Taula 1 mostra el nombre d'alumnes i centres participants a les successives recollides de dades, diferenciant per centres de control i d'intervenció.

Taula 1. Nombre d'alumnes i centres participants per rondes de recollida de dades

Recollida de dades	Noies		Nois		Total	
	Intervenció	Control	Intervenció	Control	Intervenció	Control
Ronda 1 (Inici 1r ESO) 29 centres	422	526	442	530	864 (13 centres)	1056 (16 centres)
Ronda 2 (Finals 1r ESO) 29 centres	365	462	367	448	732 (12 centres)	910 (16 centres)
Ronda 3 (Inici 2n ESO) 27 centres	392	505	332	528	724 (10 centres)	1033 (16 centres)
Ronda 4 (Finals 2n ESO) 27 centres	262	386	228	459	490 (11 centres)	845 (15 centres)
Ronda 5 (Finals 3r ESO) 27 centres	217	466	225	500	442 (10 centres)	966 (16 centres)

4.4. Variables

Les variables analitzades corresponen a quatre grans grups: (a) dades personals; (b) freqüència i hàbits d'ús dels ordinadors; (c) actituds respecte de l'ús dels ordinadors; i (d) autoeficàcia.

Aquestes variables s'han classificat en dues tipologies, variables primàries i secundàries (veure Taula 2). Les variables primàries es refereixen a aquelles recollides directament en el qüestionari i s'utilitzen tant per a la seva anàlisi directa com, en alguns casos, per obtenir els valors de variables secundàries derivades d'elles (veure apartat 4.6. Anàlisi de dades).

Taula 2. Variables primàries i secundàries

Variables primàries	Variables secundàries	
	Compostes	Índex
Dades personals		
Gènere		
Edat		
Centre escolar		
Edat d'inici d'ús d'ordinadors		
Lloc d'inici d'ús d'ordinadors		
Lloc de referència d'aprenentatge		
Nivell digital pare		
Nivell digital mare		
Persona de referència digital		
Freqüència i hàbits d'ús dels ordinadors		
Email	Freqüència de comunicació	Índex de freqüència
Xarxes socials		
Xats		
Tasques escolars	Freqüència de tasques escolars	
Jocs en línia	Freqüència d'oci	
Navegació per Internet		
Descàrrega de continguts		
Webs personals		
Actituds respecte de l'ús dels ordinadors		
Ítems referits a ansietat	Ansietat	Índex d'actitud
Ítems referits a gaudi	Gaudi	
Ítems referits a autoconfiança	Autoconfiança	
Autoeficàcia		
Edició de fotografies	Operacions bàsiques	Índex d'autoeficàcia
Presentacions		
Documents de text		
Documents col·laboratius		
Llegir i respondre emails		
Creació de bases de dades	Operacions avançades	
Presentacions amb imatges i sons		
Disseny de lloc web		
Creació d'un blog		

4.4.1. Dades personals

Les variables d'aquest grup es refereixen a característiques personals i de context dels alumnes i es defineixen tenint en compte aspectes que segons alguns autors (Chen, 1986; Shashaani, 1993; Busch, 1995; Durndell i Haag, 2002; Ogan et al., 2005; Sáinz i López-Sáez, 2010; Stockdale i Keane, 2016) influeixen de forma directa en les actituds. Totes són variables primàries ja que no es porta a terme cap agrupació a partir d'elles.

Aquestes variables són: (a) gènere; (b) edat; (c) centre escolar; (d) edat d'iniciació en l'ús dels ordinadors; (e) lloc d'iniciació en l'ús dels ordinadors; (f) lloc de referència respecte de l'aprenentatge en l'ús dels ordinadors; (g) nivell de competència digital de pare i (h) mare; i (i) persona de referència respecte de la resolució de problemes informàtics.

4.4.2. Freqüència i hàbits d'ús dels ordinadors

Aquest grup de variables recull un llistat de tasques habituals, utilitzant l'ordinador, realitzades fora de l'àmbit escolar. La selecció d'aquestes tasques es fa en base als qüestionaris utilitzats en els estudis PISA 2009 i 2012.

Les variables primàries són: (a) ús de l'email; (b) participació a xarxes socials; (c) participació a xats; (d) realització de tasques escolars; (e) jocs d'ordinador en línia; (f) navegació per Internet; (g) descarrega de continguts; i (h) gestió de llocs web personals.

Les variables secundàries resulten de les següents agrupacions: freqüència de comunicació (a, b, c); tasques escolars (d); freqüència d'oci (e, f, g, h); i índex de freqüència (a partir de totes les variables primàries de freqüència). El procés de càlcul de les variables secundàries s'especifica a l'apartat 4.6. Anàlisi de dades.

4.4.3. Actituds respecte de l'ús dels ordinadors

Les actituds vinculades a l'ús de l'ordinador es classifiquen en tres dimensions (ansietat, gaudi i autoconfiança), seguint l'escala CAS (Computer Attitude Scale) definida per Loyd i Gressard (1984).

Es defineix l'ansietat respecte de l'ús dels ordinadors com la por a interactuar amb ells i presentar actituds globalment negatives, la qual cosa provoca una disminució en el desenvolupament de les tasques i la seva conclusió (Shashaani, 1993). Malgrat l'ansietat té generalment connotacions negatives, es poden establir nivells òptims d'ansietat que provoquen que l'usuari estigui més alerta respecte de les tasques que ha de realitzar.

Respecte del gaudi en l'ús dels ordinadors es defineix com l'interès en l'ús de les TIC no només per al seu ús acadèmic dins o fora del centre escolar, sinó també en els seus moments d'oci (Shashaani, 1993).

Per últim, l'autoconfiança es defineix com la percepció personal de controlar les eines TIC, sentir-se còmode amb el seu ús i veure's capaç de superar les dificultats pels seus propis mitjans (Shashaani, 1993).

Ansietat, gaudi i autoconfiança són variables secundàries, és a dir, calculades a partir de les respostes al qüestionari relatives a les afirmacions corresponents a cadascuna de les dimensions. A partir d'aquestes variables es calcula l'índex d'actitud (veure apartat 4.6. Anàlisi de les dades)

4.4.4. Autoeficàcia

L'autoeficàcia indica la relació entre les tasques que una persona vol dur a terme però no es veu capaç de realitzar-les i les tasques per a les quals sí se sent capaç de dur-les a terme (Bandura, 1978).

Les variables primàries corresponen a diferents tasques a realitzar mitjançant l'ordinador: (a) edició digital de fotografies; (b) creació de presentacions; (c) creació de documents de text; (d) treball en documents col·laboratius; (e) llegir i respondre emails; (f) creació de bases de dades; (g) creació de presentacions amb imatges i sons; (h) disseny d'un lloc web; i (i) creació d'un blog.

A partir de l'agrupació d'aquestes variables primàries es calculen les variables secundàries: (a) operacions bàsiques (a, b, c, d, e); (b) operacions avançades (f, g, h, i); i l'índex d'autoeficàcia (a partir de totes les variables primàries d'autoeficàcia). Els càlculs corresponents s'especifiquen a l'apartat 4.6. Anàlisi de dades.

4.5. Qüestionari

La recollida de les dades es du a terme mitjançant un formulari Google [2] administrat en línia, sota la supervisió del professor o professora responsable.

El qüestionari està estructurat en quatre seccions, corresponents als quatre grups de variables descrits a l'apartat 4.4. Variables: dades personals, freqüència i hàbits d'ús dels ordinadors, actituds respecte de l'ús dels ordinadors i autoeficàcia.

4.5.1. Dades personals

Les possibles respostes a cadascuna de les preguntes es mostren en un menú desplegable amb l'objectiu de minimitzar els errors d'escriptura i evitar una depuració de dades abans del tractament estadístic. El camp "Nom del centre" no ofereix una resposta elegible en llista a causa de la gran quantitat de possibles respostes que dificultarien la selecció. S'ha valorat que aquest fet podria induir a errors difícilment detectables i que encara que es necessita depuració aquesta no és massa complexa.

4.5.2. Freqüència d'ús dels ordinadors

La pregunta plantejada és: "Indica amb quina freqüència realitzes les tasques següents amb l'ordinador". Les respostes (escala Likert de quatre opcions) poden ser "Mai o gairebé mai" (1 punt), "Una o dues vegades al mes" (2 punts), "Una o dues vegades per setmana" (3 punts) i "Gairebé cada dia" (4 punts). Les tasques plantejades i l'escala de resposta es basen en les utilitzades en els qüestionaris de PISA 2009 i 2012. S'ha inclòs la resposta "Una o dues vegades al mes" per permetre respostes a algunes accions específiques que podrien ser inusuals (p.e., "Gestió de llocs web personals").

4.5.3. Actituds

L'apartat d'actituds correspon a l'aplicació de l'escala CAS dissenyada per a la mesura de les actituds respecte de l'ús dels ordinadors en les seves tres dimensions d'ansietat, gaudi i autoconfiança i desenvolupada per Loyd i Gardner (1984).

Tot i l'antiguitat d'aquesta escala, encara és la més utilitzada en recerques que pretenen la mesura de les actituds (Francis, 1994; Selwyn, 1997; Blignaut, 2006; Powell, 2013) i ha estat revisada de forma repetida per assegurar la seva validesa (Gardner, Discenza i Dukes, 1993; Nash i Moroz, 1997; Garland i Noyes, 2008; Powell, 2013).

Tot i així, es revisen els enunciats plantejats en l'escala original per assegurar la seva adaptació a la situació actual, adequant els termes que podrien haver quedat desfasats.

[2] https://goo.gl/forms/ZNns1sVmBY2nRGJV2

Una altra de les adaptacions que s'han realitzat és la traducció al català dels enunciats de l'escala que estan redactats en anglès en l'original.

L'escala CAS està formada per trenta enunciats, deu per a cadascuna de les dimensions, no ordenats.

La pregunta plantejada és: "Indica fins a quin punt estàs d'acord amb les següents frases".

Algunes de les frases estan redactades en negatiu i corresponen a un total de quinze, cinc per a cada dimensió. D'aquesta manera s'intenten minimitzar les respostes automàtiques forçant la lectura acurada dels enunciats. Les frases redactades en negatiu es tenen en compte en el moment del procés d'anàlisi invertint els valors assignats a les possibles respostes.

Les respostes (escala Likert de quatre opcions) poden ser "Molt en desacord" (1 punt), "En desacord" (2 punts), "D'acord" (3 punts) i "Molt d'acord" (4 punts). Tot i que l'escala CAS original varia d'1 a 5, es van adoptar els rangs d'1 a 4 seguint les conclusions d'estudis que suggereixen que aquestes puntuacions són més apropiades per evitar que els estudiants evitin posicionar-se indicant majoritàriament el punt mig (Farkas i Murthy 2005; Varank 2007).

4.5.4. Autoeficàcia

El disseny d'aquest apartat es correspon al qüestionari realitzat als estudis PISA 2009 i 2012 en el qual es plantejaven diferents tasques que es classifiquen en bàsiques i avançades (veure apartat 4.4. Variables).

La pregunta plantejada correspon a l'enunciat: "Indica quin creus que és el teu nivell respecte de les següents tasques". Les respostes (escala Likert de quatre opcions) poden ser "No sé què significa" (1 punt), "No puc fer-ho" (2 punts), "Puc fer-ho amb ajut" (3 punts) i "Puc fer-ho sol/a" (4 punts).

4.5.5. Validació del qüestionari i consistència

Malgrat les quatre seccions del qüestionari corresponen a qüestionaris validats, es planteja un pilotatge previ per assegurar la coherència de l'estructura, així com la comprensió específica dels enunciats de l'escala CAS traduïts de l'anglès.

S'administra a 50 alumnes de 1r d'ESO d'un centre públic de secundària i, com a resultat, es decideix millorar la redacció d'un parell de qüestions de la secció d'actituds que no quedaven massa clares per als alumnes. També es comprova que el temps necessari per ser respost és de 20 minuts, així com l'adequació de la plataforma Google Forms com a base del qüestionari.

Per últim, es decideix redactar instruccions específiques per al professorat que havia de dur a terme la supervisió de la resposta del qüestionari i s'envien als centres implicats.

Els càlculs de consistència interna (α de Cronbach) indiquen 0.80, 0.85 i 0.80 per a les seccions de freqüència d'ús dels ordinadors, actituds i autoeficàcia, respectivament.

4.6. Anàlisi de les dades

4.6.1. Càlcul de les variables secundàries

Totes les variables secundàries estan calculades com a mitjanes dels valors de les variables primàries que inclouen, seguint el mateix procediment d'anàlisi de les escales originals validades (PISA 2009 i 2012 i escala CAS). Totes les variables primàries tenen el mateix pes en el càlcul de la variable secundària corresponent.

Les variables relacionades amb la freqüència d'ús s'han agrupat en quatre categories: freqüència d'oci, freqüència de tasques escolars, freqüència de comunicació i freqüència de joc. Aquest últim s'analitza individualment tot i que es va incloure en 'freqüència d'oci' donades les diferències de gènere reportades en aquest concepte en diversos estudis. Finalment, es calcula l'índex de freqüència a partir de l'agregació de totes les variables d'aquesta secció.

Pel que fa les variables d'actituds, les respostes negatives es recodifiquen per mantenir la coherència amb la resta de les declaracions. Posteriorment, el càlcul de cadascuna de les variables (ansietat, gaudi i autoconfiança) es realitza a partir de la mitjana de les puntuacions corresponents a les deu frases plantejades per a cada variable. El valor de l'índex d'actitud es calcula a partir de la mitjana de les tres dimensions.

Les preguntes sobre l'autoeficàcia s'agrupen en dues variables secundàries calculades a partir de la mitjana de les variables primàries corresponents: operacions bàsiques i operacions avançades. L'índex d'autoeficàcia es calcula a partir de l'agregació de totes les variables d'aquesta secció.

Els càlculs estadístics realitzats corresponen a relacions descriptives i correlacions. Totes les estadístiques s'han realitzat mitjançant el paquet estadístic Stata 13.0.

4.6.2. Relacions descriptives

Les relacions descriptives inclouen percentatges, mitjanes i els intervals de confiança del 95%, estimats tenint en compte el disseny per clústers de la mostra.

Les dades personals (primera secció del qüestionari), per tractar-se d'escales nominals, seran tractades mitjançant el càlcul de percentatges. Es calculen, també, les relacions entre la variable 'Sexe' (variable independent) i la resta de variables (variables dependents), controlant per tipologia de centre i ronda de recollida.

4.6.3. Càlculs de l'efecte de la intervenció

Pel que fa a les dades referides a la intervenció, s'analitzen tenint en compte tres enfocaments complementaris. En primer lloc, l'efecte de la intervenció es calcula com a diferències absolutes del punt inicial (ronda 1) i del punt final (ronda 5) de les diferències entre els grups d'intervenció i control (Taula 3, dIG i dCG); en segon lloc, s'analitzen els efectes de la intervenció sobre els resultats per subgrups de gènere (Taula 3, dE noies i dE nois); tercer, s'examinen els canvis absoluts sobre els resultats per sexe (Taula 3, mesura de l'efecte de la intervenció).

Taula 3. Càlculs de l'efecte de la intervenció

	Intervenció (centres eduCAT)	Control (centres no eduCAT)	Efectes per gènere
Noies	dI noies = R5 – R1	dC noies = R5 – R1	dE noies = dI noies – dC noies
Nois	dI nois = R5 – R1	dC nois = R5 – R1	dE nois = dI nois – dC nois
Diferències per gènere	dIG = dI noies – dI nois	dCG = dC noies – dC nois	Mesura de l'efecte de la intervenció a) dIG – dCG b) dE noies – dE nois

4.6.4. Regressió logística

Per establir les associacions entre les variables, es van construir models ajustats de regressió logística, per tal d'obtenir les 'Odds ratios' (OR) i els seus intervals de confiança descrivint la relació entre les variables dependents i independents. Per tal de poder aplicar aquests models, es van dicotomitzar les variables d'actituds, freqüència d'ús i edat d'inici en l'ús d'ordinadors. Posteriorment, es realitza una regressió logística multivariant, controlant els possibles efectes de terceres variables per establir les següents associacions: (a) gènere amb freqüència d'ús, actituds i autoeficàcia, controlant per tipus de centre (intervenció i control) i ronda de recollida; (b) freqüència d'ús amb actituds i autoeficàcia, controlant per tipus de centre (intervenció i control) i gènere; i (c) edat d'inici en l'ús dels ordinadors amb actituds i autoeficàcia, controlant per tipus de centre (intervenció i control) i gènere.

Les associacions entre les variables es basen en la recerca de la literatura.

5. Articles que constitueixen la tesi

5.1. Effects of intensive use of computers in secondary school on gender differences in attitudes towards ICT: A systematic review. *Education and Information Technologies, 23*(5), 2111-2139. https://doi.org/10.1007/s10639-018-9706-6

Índex SJR 2017: 0,403

Education Q2

E-learning Q2

Library and Information Sciences Q2

L'article (veure Annex 1) presenta una recerca sistemàtica de la literatura al voltant dels efectes de l'ús intensiu dels ordinadors, als centres de secundària, sobre les diferències de gènere en les actituds vers les TIC. S'especifica la metodologia emprada per a la recerca sistemàtica així com els protocols aplicats, que segueixen els estàndards per a aquesta tipologia de recull de la literatura. Es conclou que existeixen pocs estudis en aquest camp i que els que s'han localitzat presenten una baixa qualitat aplicant els criteris estandarditzats (només nou estudis passen els criteris de

selecció). Es conclou, també, la manca d'estudis longitudinals que facin un seguiment al llarg del temps dels alumnes, així com la no existència d'estudis amb grups d'intervenció i grups de control.

5.2. Are Boys and Girls still Digitally Differentiated? The Case of Catalonian Teenagers. *Journal of Information Technology Education: Research , 16*, 411-435. https://doi.org/10.28945/3879

Índex SJR 2017: 0,319

Computer Science Q2

Education Q3

E-learning Q2

El segon article (veure Annex 2) estableix una definició del punt de partida de la recerca. Tenint en compte que la primera ronda de recollida de dades correspon just a l'inici del primer curs de l'educació secundària obligatòria, tant el grup d'intervenció com el grup de control es troben en la mateixa situació. En aquest punt es du a terme una anàlisi descriptiva d'ambdós grups que ha de permetre, posteriorment, definir les diferències entre el punt inicial i les successives recollides de dades.

L'estudi conclou que existeix una prevalença entre els adolescents dels estereotips sobre la diferència d'habilitats digitals d'homes i dones i sobre les vocacions professionals d'ambdós gèneres.

Pel que fa a l'ús dels ordinadors per part dels nois i de les noies, s'observen hàbits diferenciats, més tècnics i d'oci en els nois i més comunicatius i de tasques escolars a les noies. Aquestes diferències de gènere també es reflecteixen en les actituds ja que les noies presenten un nivell d'ansietat més elevat que els nois i una menor autoconfiança i autoeficàcia.

5.3. Effects of One-to-One Computer Programs on reducing Gender Differences among Secondary School Students. Controlled Before and After Study.

L'article (veure Annex 3) ha estat enviat a la revista Computer Science Education i va estar rebutjat per no adequar-se a la línia editorial. Tot i així, els comentaris dels revisors van ser positius I ambdós van recomanar redigir l'article a una altra revista. Actualment ha estat enviat a la revista *Journal of Research on Technology in Education* i s'està a l'espera de resposta.

Índex SJR 2017: 1,313

Computer Science Applications Q1

Education Q1

L'article mesura l'efecte de la intervenció, és a dir, l'efecte de l'ús d'ordinadors personals als centres educatius sobre la reducció de les diferències de gènere en les actituds i l'autoeficàcia,

analitzant les cinc rondes de recollida de dades i establint la comparació de l'evolució de les diferències de gènere entre el grup d'intervenció i el grup de control.

L'article conclou que no hi ha efectes significatius en les dotze variables analitzades, excepte en la variable de joc i en l'índex de freqüència d'ús, que no estan relacionades amb activitats a l'aula.

5.4. Disentangling the factors that contribute to gender differences in the use of computers among teens and implications for career development.

L'article (veure Annex 4) ha estat enviat a la revista *Technology, Knowledge and Learning* i s'està a l'espera de la resposta.

Índex SJR 2017: 0,614

Computer Theory and Mathematics Q2

Computer Science Applications Q2

Education Q2

Engineering (miscellaneous) Q1

Human-Computer Interaction Q1

Mathematics (miscellaneous) Q2

Theoretical Computer Science Q2

L'article analitza les associacions entre els resultats de les variables recollits al llarg de l'estudi amb l'objectiu d'establir quines correlacions poden afavorir la disminució de la diferència de gènere en l'ús dels ordinadors.

Els resultats de l'estudi mostren associacions consistents entre gènere i gaudi en l'ús dels ordinadors així com entre gènere i els diferents usos dels ordinadors. També es troben associacions significatives entre la freqüència d'ús dels ordinadors i l'índex d'actitud així com entre l'edat d'inici en l'ús dels ordinadors i l'índex d'actitud i el d'autoeficàcia.

6. Discussió global dels resultats

La recerca sistemàtica de la literatura que s'ha dut a terme mostra que existeixen pocs estudis al voltant dels efectes que l'ús intensiu dels ordinadors en els centres escolars pot tenir sobre les actituds de noies i nois respecte dels ordinadors i la seva percepció d'autoeficàcia. Només s'han trobat nou articles basats en estudis en aquest sentit i, en ser valorats respecte de la seva qualitat metodològica, s'observa que només quatre d'ells arribaven al 50% dels criteris establerts (Critical Appraisal Skills Programme (CASP), 2017). Per exemple, cap dels estudis indica com es va dur a terme el càlcul de la mostra i només dos dels estudis van fer una selecció aleatòria dels participants. Pel que fa a la metodologia, només un estudi du a terme una recollida de dades longitudinal però no seguint als participants en el temps, sinó recollint respostes de participants

de diferents edats. El nostre estudi es diferencia dels existents en l'extensió en el temps, l'elevada quantitat de participants, la tria randomitzada d'aquests participants i l'estricte anàlisi de dades que s'ha dut a terme.

L'anàlisi de les dades es realitza des de dues perspectives d'acord amb als objectius segon i tercer de la recerca: (a) mesurar l'efecte de l'ús intensiu dels ordinadors als centres de secundària sobre la disminució de les diferències de gènere en les actituds de l'ús de les TIC i en l'autoeficàcia; i (b) identificar les associacions significatives entre les variables estudiades.

6.1. Efectes de la intervenció

Els efectes de la intervenció s'analitzen tenint en compte: (a) la mesura global de la intervenció, comparant l'evolució de les diferències de gènere al grup d'intervenció i l'evolució de les diferències de gènere al grup de control (veure Taula 3: dIG – dCG); (b) la comparació de l'evolució, separada per gènere, entre el grup d'intervenció i el grup de control (veure Taula 3: dE noies i dE nois); i (c) l'evolució de cada gènere al grup d'intervenció i al grup de control (veure Taula 3: dInoies, dInois, dCnoies i dCnois).

6.1.1. Efectes globals de la intervenció

En general, l'anàlisi de les dades sembla indicar que no es redueixen les diferències de gènere en les actituds envers l'ús dels ordinadors ni millora l'autoeficàcia (veure Taula 4).

Analitzant les variables de freqüència d'ús, s'observa que totes elles, excepte la relativa a la freqüència de deures, mostren un increment de les diferències de gènere en el grup d'intervenció, tot i que no és estadísticament significatiu, amb l'interval de confiança (95%) incloent el valor zero. Aquest fet implica que les diferències de gènere existents abans de la intervenció es mantenen i s'incrementen, és a dir, els nois tendeixen a fer servir jocs a l'ordinador més que les noies i l'efecte de la intervenció incrementa aquesta tendència. La disminució de les diferències de gènere en la freqüència de deures en el grup d'intervenció està relacionada amb l'ús dels ordinadors a les aules que implica la resolució de tasques escolars fent servir ordinadors.

Pel que fa a les actituds, és a dir, ansietat, autoconfiança i gaudi, hi ha un lleuger efecte positiu de la intervenció, especialment pel que fa a l'autoconfiança malgrat no és estadísticament significatiu. Altres estudis (Garland i Noyes, 2004; Teo, 2008) suggereixen que l'ús sistemàtic dels ordinadors pot reduir les diferències de gènere pel que fa a l'actitud en el seu ús. Aquests estudis són de caràcter observacional i es basen en mostres d'estudiants que participen en cursos específics de TIC sense avaluar el seu efecte i amb una quantitat baixa de participants.

Finalment, les variables relacionades amb l'autoeficàcia també mostren una lleugera millora de les diferències de gènere al grup d'intervenció, sense significació estadística. La variable d'operacions bàsiques és la que mostra una major disminució, possiblement pel fet que les operacions que es duen a terme a les aules amb els ordinadors personals deuen correspondre a aquesta tipologia.

Taula 4. Mesura global de l'efecte de la intervenció (mitjanes i 95% d'interval de confiança)

	Efecte	
	dIG-dCG	SE
Freqüència de comunicació	0.045	0.236
Freqüència de deures	-0.069	0.263
Freqüència de joc	0.558	0.177
Freqüència d'oci	0.231	0.206
Índex de freqüència	0.124	0.180
Ansietat	-0.014	0.154
Autoconfiança	-0.082	0.147
Gaudi	-0.020	0.119
Índex d'actituds	-0.039	0.133
Operacions bàsiques	-0.061	0.097
Operacions avançades	-0.010	0.162
Índex d'autoeficàcia	-0.035	0.121

6.1.2. Efectes per gènere

L'anàlisi dels resultats diferenciats per gènere ens permeten observar si l'increment o disminució de les diferències de gènere degudes a la intervenció afecten de la mateixa forma a nois i noies i fins i tot si poden ser de signes contraris (Figura 5).

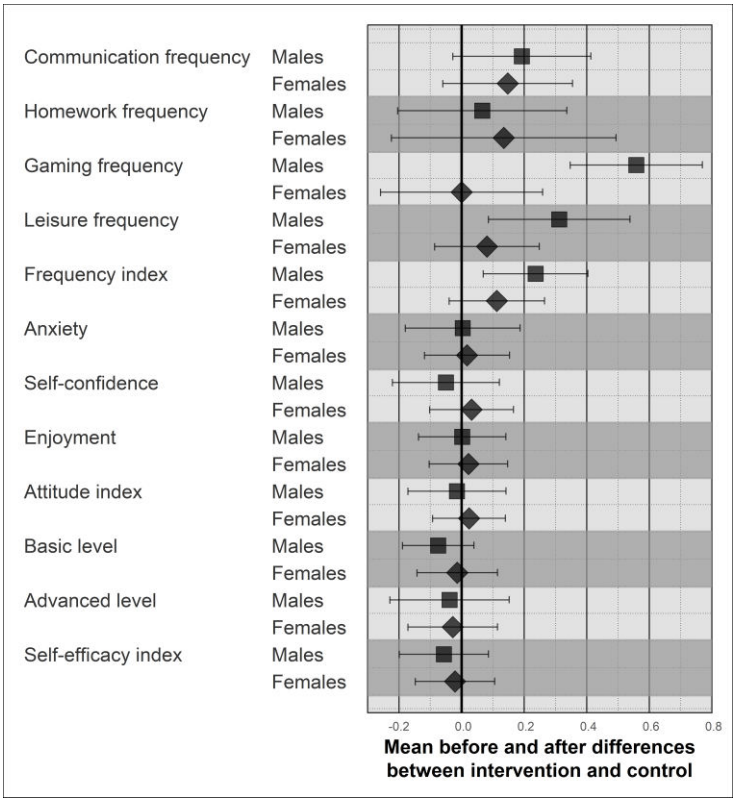


Figura 5. Efectes de la intervenció per gènere (mitjanes i 95% interval de confiança; resultats inferiors a 0 indiquen que la intervenció produeix un efecte negatiu en la disminució de les diferències de gènere)

Les variables corresponents a la freqüència d'ús dels ordinadors indiquen, tal i com s'ha descrit a l'apartat 6.1.1., efectes globals de la intervenció, un increment de les diferències de gènere al grup d'intervenció. Analitzant per gènere, s'observa que aquest efecte només és estadísticament significatiu pels nois i concretament a les variables de freqüència de joc, freqüència d'oci i índex de freqüència. La freqüència de deures, tot i no ser estadísticament significativa, mostra un efecte positiu major en les noies que en els nois. Aquest fet coincideix amb la disminució de diferències de gènere en aquesta variable comentada a l'apartat 6.1.1. Tot i així, caldria esperar que les diferències entre el grup d'intervenció i el grup de control en aquesta variable fossin majors, tant en les noies com en els nois, donat que el fàcil accés a l'ordinador i la seva propietat per part de l'alumne ha d'implicar un major ús a les aules i també, en conseqüència, en el seu ús per resoldre tasques escolars. Això es pot explicar pel fet que les metodologies de l'aula, imprescindibles per aprofitar les tecnologies digitals (Balanskat i Garoia, 2010; Bebell i O'Dwyer, 2010; Valiente, 2010; Kengwee et al., 2012) segueixen sent les mateixes malgrat els estudiants disposin d'ordinadors personals.

Les variables relatives a les actituds no indiquen resultats significatius i les diferències entre el grup d'intervenció i el de control són molt petites, tant per als nois com per a les noies. És interessant indicar que la variable d'autoconfiança és la única on s'observen diferències entre nois i noies. Mentre en els nois els resultats mostren que la intervenció produeix una disminució de l'autoconfiança, a les noies aquesta s'incrementa respecte del grup de control. Tal i com s'indica a l'apartat 6.1.1., les diferències de gènere respecte a aquesta variable disminueixen degut a la intervenció. Els resultats mostrats a la Figura 5 indiquen que aquets descens es degut a l'efecte positiu de la intervenció sobre les noies que contraresta l'efecte negatiu sobre els nois.

Respecte dels resultats de les variables d'autoeficàcia indiquen que la intervenció produeix efectes negatius als dos gèneres, malgrat no és estadísticament significatiu. Els resultats són lleugerament pitjors en els nois que en les noies, fet que explica la lleugera disminució de la diferència de gènere observada a la Taula 4. Aquests resultats no són consistents amb les conclusions de Schaumburg (2001), que indica que les noies tenen un valor més baix que els nois en aquesta variable malgrat la intervenció. El nostre estudi és diferent del disseny del de Schaumburg (2001), perquè l'autora no segueix els estudiants durant tota la intervenció, sinó que els resultats es refereixen a un moment únic de recollida de dades, fet que podria explicar la no coincidència amb els nostres resultats.

Tampoc són coherents amb altres estudis consultats que indiquen que l'autoeficàcia millora amb l'ús intensiu dels ordinadors (Papastergiou, 2008; Downes i Looker, 2011; Vekiri, 2010; UNESCO, 2017)

6.1.3. Evolució per gènere i per grup d'intervenció/control

Pel que fa a les noies, les variables de freqüència en el grup d'intervenció mostren valors constants al llarg de totes les recollides de dades, mentre que en el grup de control hi ha una lleu disminució. Aquests resultats són coherents amb els recollits a la Figura 5, que mostren un lleu efecte positiu de la intervenció. És difícil concloure si aquests resultats es deuen a l'efecte específic de la

intervenció o a què les noies que participen en iniciatives individuals tenen un ordinador de la seva propietat i, per tant, un accés més fàcil al seu ús.

Respecte de les actituds a les noies, s'observa en general que totes les variables relacionades disminueixen el seu valor al llarg de les rondes de recollida, tant en el grup d'intervenció com en el de control. És a dir, els valors disminueixen amb l'edat. Tot i així, aquesta disminució és més lleu a les noies del grup d'intervenció que a les del grup de control, la qual cosa pot explicar el petit efecte positiu de la intervenció comentat a l'apartat 6.1.2. Aquests resultats són parcialment coincidents amb Kubiatko et al. (2011), que reporten que les noies mostren un augment de l'ansietat i una disminució del gaudi al llarg del temps. Aquesta diferència es pot explicar a causa de les diferències en el disseny dels estudis, ja que la nostra recerca es basa en una metodologia de seguiment dels estudiants al llarg del temps i els autors avaluen l'efecte d'una intervenció en diferents estudiants de diferents edats.

Pel que fa a les variables d'autoeficàcia, totes mostren un lleuger increment, tant a les noies del grup d'intervenció com a les noies del grup de control. En aquest cas, però, l'increment és més gran en el grup de control, fet que explica el lleuger efecte negatiu de la intervenció recollit a la Figura 5.

En relació als nois, el valor de l'índex de freqüència incrementa en el grup d'intervenció i disminueix en el de control. Aquest fet resulta evident a la Figura 5 especialment pel que fa a la freqüència d'oci i de lleure.

Respecte de les variables d'actitud als nois, s'observa una disminució dels valors tant en el grup de control com en el d'intervenció, malgrat aquesta disminució és menor que en les noies. Tot i així, la disminució més gran correspon a l'autoconfiança, fet que es correspon amb els valors de l'efecte de la intervenció sobre aquesta variable recollits a la Taula 4.

Per últim, els valors de les variables d'autoeficàcia tendeixen a augmentar al llarg de les rondes de recollida de dades, tant en el grup d'intervenció com en el de control, tot i que en aquest últim l'increment és lleugerament major i explica l'efecte negatiu de la intervenció en els nois recollida a la Figura 5.

6.2. Associacions entre variables

L'anàlisi de les associacions entre variables ens permet concretar els efectes descrits anteriorment. Les variables de gènere, freqüència d'ús dels ordinadors i edat d'iniciació s'han relacionat amb la resta, d'acord amb el tercer objectiu de la recerca. L'anàlisi descriptiu definit a l'inici de l'estudi indica diferències de gènere clares en totes les variables estudiades, per aquest motiu s'han analitzat les correlacions corresponents. Per altra banda, la literatura indica una associació entre alta freqüència d'ús i millora de les actituds i l'autoeficàcia i, per tant, també amb l'edat d'inici en el seu ús.

Tenint en compte les actituds vers a l'ús dels ordinadors, no s'ha trobat una associació clara entre gènere i ansietat, malgrat els autors consultats indiquen que les noies mostren una major ansietat que els nois (Baloğlu i Çevik, 2008; Kaino, 2008; Adebowale et al., 2009; Kubiatko et al., 2011).

Donat que els estudis trobats no són recents, tot i que s'ha fet una cerca sistemàtica, la diferència entre els resultats obtinguts i els esperats podria ser deguda a un major accés de nois i noies a l'ús dels ordinadors amb el temps. Aquest fet, però, no és confirmat per les dades estadístiques: l'any 2007 el 94,6% dels nois i noies catalans d'entre 10 i 15 anys tenien accés a ordinadors i l'any 2018 un 93,3%. (IDESCAT, 2018). Tot i així, caldria saber si hi ha hagut canvis al llarg dels anys en la intensitat i la tipologia d'ús, fet que podria explicar les diferències observades entre els nostres resultats i la literatura consultada.

Respecte a la variable de gaudi, s'observa que els nois tenen més possibilitats de tenir una actitud positiva que les noies, fet que no coincideix amb els estudis consultats que indiquen que les taxes de gaudi de nois i noies són molt similars (Ogan et al., 2005; Fančovičová i Prokop, 2008; Kaino, 2008; Teo, 2008; Adebowale et al., 2009).

La variable d'autoconfiança també mostra una associació amb el sexe, afavorint la possibilitat que els nois tinguin valors més alts que les noies, tot i que els resultats són més baixos del que s'esperava tenint en compte els autors consultats (Volman i Van Eck, 2001; Ogan et al., 2005; Christoph et al., 2015).

Les associacions entre les variables de freqüència d'ús i gènere segueixen els patrons esperats d'acord amb la literatura consultada. Tant la variable d'oci com la de joc donen valors alts de probabilitat, afavorint la possibilitat que els nois facin un alt ús d'ordinadors per a aquests tipus d'activitats. Els resultats també confirmen l'associació positiva de les noies pel que fa a l'alt ús dels ordinadors per dur a terme tasques de comunicació i de resolució de deures escolars (Fraillon et al., 2014; OECD, 2015).

Finalment, les associacions entre variables d'autoeficàcia i gènere mostren resultats molt diferents dels estudis consultats. Si bé la majoria d'autors indiquen que les noies tenen nivells més baixos d'autoeficàcia que els nois (Miura, 1987; Durndell i Haag, 2002) i que aquesta pot ser una de les raons per les quals les noies no es plantegen cursar estudis superiors en l'àmbit de les TIC, els resultats obtinguts indiquen una major probabilitat que les noies tinguin valors positius en aquesta variable que els nois. Cal assenyalar que l'índex d'autoeficàcia reflecteix els valors de les variables en activitats de nivell bàsic i activitats de nivell avançat i que només la primera indica una major probabilitat d'actituds positives per a les noies mentre que la segona no és estadísticament significativa. L'acompliment d'activitats de nivell bàsic amb els ordinadors es pot associar a la realització de tasques escolars, fet que coincidiria amb l'alta probabilitat de les noies a fer servir l'ordinador per a resoldre deures escolars.

Pel que fa a les associacions corresponents a la freqüència d'ús dels ordinadors i les variables d'actitud i autoeficàcia, l'anàlisi indica que hi ha una correlació positiva, és a dir, com més alta sigui la freqüència d'ús de l'ordinador, major serà la possibilitat de presentar tendències positives a totes les variables, especialment aquelles relacionades amb les actituds. Els resultats són conseqüents amb els estudis consultats que indiquen que l'augment de l'ús d'ordinadors millora l'autoeficàcia (Papastergiou, 2008; Usher i Pajares, 2008; Vekiri, 2010; Downes i Looker, 2011; Tømte i Hatlevik, 2011; Scherer et al., 2017) i les actituds vers als ordinadors (Garland i Noyes, 2004; Teo, 2008).

Per últim, l'associació entre l'edat de l'inici d'ús dels ordinadors i les variables d'actitud i autoeficàcia mostra que hi ha una major probabilitat de presentar valors positius de les variables quan abans s'inicia l'ús de l'ordinador. Aquests resultats són consistents amb els obtinguts en relació a la freqüència d'ús, ja que quan més baixa és l'edat d'inici, major serà la freqüència amb què s'utilitza l'ordinador.

6.3. Limitacions i fortaleses de la recerca

El nostre estudi presenta algunes limitacions. En primer lloc, tot i la relativa gran quantitat de respostes recollides tant en el grup d'intervenció com en el de control, el disseny en clúster de la mostra, que s'ha tingut en compte en l'estimació d'efectes, pot haver limitat la capacitat de l'estudi per detectar efectes reals. Alguns resultats semblen suggerir un efecte positiu, però, com s'ha dit, no podem descartar el paper de l'atzar. Per altra banda, el fet que les escoles no segueixin el programa eduCAT no vol dir que els alumnes no utilitzin ordinadors a les aules i que, per tant, no estiguin exposats al seu ús. També és important remarcar que les escoles van decidir de forma autònoma afegir-se o no al programa eduCAT, la qual cosa fa que la tria de centres no sigui absolutament aleatòria.

Per últim, una altra limitació és la continuïtat de la mostra al llarg de totes les recollides de dades, tant pel fet que es van produir dos abandonaments de centres, cosa que va produir una davallada important de la mostra del grup d'intervenció, com pel canvi d'alumnes entre cada curs escolar, degut a repeticions, canvis de centre, noves incorporacions.

Cal indicar, també, les fortaleses de l'estudi. Es tracta d'un estudi longitudinal al llarg de tres anys, fet no habitual en la recerca educativa. A més, la quantitat de participants és molt elevada i, tot i algunes baixes, s'ha mantingut en valors alts. Per últim, cal remarcar que el tractament estadístic ha estat rigorós, duent a terme una doble comprovació utilitzant dos paquets de programes estadístics, Stata i R.

7. Conclusions

Tot i que l'ús intensiu dels ordinadors i els programes 1:1 són accions que s'han aplicat des de fa anys als centres escolars, existeix molt poca recerca al voltant de quins són els seus efectes sobre els alumnes, més enllà dels seus resultats acadèmics. Pel que fa a Catalunya, només s'ha dut a terme un estudi analitzant el programa eduCAT i des del punt de vista de rendiment acadèmic, sense tenir en compte cap altre efecte sobre els alumnes.

És necessari, per tant, aprofundir en la recerca d'aquests efectes, tal i com s'ha realitzat en el nostre estudi, però també des del punt de vista metodològic. És a dir, quin tipus d'ús de l'ordinador es fa a les aules, quines metodologies s'apliquen, com afecta a l'organització de les aules i al treball dels alumnes, i relacionar aquests factors tant amb el rendiment acadèmic com en els efectes sobre les actituds dels alumnes.

Pel que fa al segon objectiu de recerca plantejat, els resultats de l'estudi no mostren un efecte significatiu de la intervenció sobre les diferències de gènere existents en la primera ronda de

recollida. Només es poden observar petites diferències en l'anàlisi dels resultats per gènere, però cap d'elles és significativa, tret de la freqüència del joc i l'oci.

Tant el grup d'intervenció com el de control mostren tendències similars a tots els resultats, la qual cosa implica que la intervenció no té efecte. Aquest fet és especialment rellevant en el cas dels resultats de les operacions de nivell bàsic i les operacions de nivell avançat, ja que haurien de mostrar algun canvi entre el grup d'intervenció i el de control en qualsevol dels dos gèneres, tenint en compte que si realment es fa un ús intensiu dels ordinadors a les aules, aquest hauria de provocar algun efecte.

En el mateix sentit, la manca de diferència entre el grup d'intervenció i el grup de control en el resultat de la freqüència de tasques escolars també és rellevant. L'ús intensiu dels ordinadors en els centres d'intervenció hauria d'anar associat amb la realització de feines escolars fora de l'escola que impliquin utilitzar-lo amb freqüència i aquest fet hauria de veure's reflectit en una menor diferència de gènere entre els dos grups.

Aquesta manca de diferències sembla indicar que les escoles que segueixen programes 1:1 no apliquen metodologies diferents de les dels centres tradicionals, és a dir, que malgrat poden fer un ús intensiu dels ordinadors, aquest fet no es reflecteix en un canvi pedagògic real.

L'anàlisi de les associacions entre les variables de gènere, actituds respecte l'ús dels ordinadors, freqüència d'ús de l'ordinador, autoeficàcia i edat d'inici permet establir interaccions entre elles més enllà de la descripció dels valors obtinguts en els estudis observacionals.

El càlcul de l'OR ens proporciona informació sobre la probabilitat que els valors d'una variable estiguin relacionats amb certs valors d'una altra variable. Els resultats no indiquen la causalitat, però sí proporcionen pautes per al disseny d'investigacions futures que poden o no verificar aquesta causalitat.

Les correlacions entre gènere i la resta de variables mostren que els nois tenen més probabilitats que les noies de tenir un alt nivell de gaudi en l'ús d'ordinadors, una major autoconfiança i fer un major ús dels ordinadors per a l'oci i el joc. D'altra banda, les noies tenen més probabilitats de fer un ús freqüent dels ordinadors per fer tasques escolars i comunicar-se.

L'associació entre gènere i autoeficàcia denota resultats divergents amb els estudis consultats ja que els nostres resultats indiquen que la probabilitat que les noies tinguin un alt índex d'autoeficàcia és elevada. Aquest fet també es confirma al calcular l'associació entre gènere i la realització d'operacions de nivell bàsic. És probable que aquests resultats estiguin relacionats entre ells, ja que la majoria de les tasques escolars corresponen a activitats de nivell bàsic. El fet de dur a terme les tasques encomanades i realitzar-les amb èxit es pot relacionar amb la sensació de poder resoldre-les sense problemes, la qual cosa indica una alta autoeficàcia.

Els resultats de les associacions de gènere i autoeficàcia divergents amb els estudis consultats són especialment rellevants, ja que impliquen que la manca de vocacions en l'àmbit de les TIC de les noies no es pot explicar per baixos valors d'autoeficàcia, en aplicació de la teoria de Bandura (1978), donat que tant nois com noies presenten nivells similars. Cal, doncs, buscar explicacions en

aspectes de caire social, influències de l'entorn i estereotips que, juntament amb l'efecte de l'autoeficàcia percebuda, donin resposta al baix nombre de noies en els estudis tècnics.

Les correlacions entre la freqüència d'ús i la resta de variables indiquen que l'ús freqüent dels ordinadors augmenta la probabilitat de tenir valors alts de totes les variables, excepte les que fan referència a tasques de nivell bàsic i l'autoeficàcia, que no mostren cap correlació. Aquesta relació no coincideix amb la bibliografia consultada, ja que la majoria d'autors indiquen que l'autoeficàcia millora amb un ús freqüent de l'ordinador. Aquesta discrepància es pot donar en la no-diferenciació de quines tasques es realitzen. Atès que la correlació positiva es produeix en les tasques de nivell avançat, caldria analitzar una àmplia gamma de tasques per detectar quines poden augmentar l'autoeficàcia si es realitzen més freqüentment. La relació amb el gènere, com s'ha indicat anteriorment, hauria de complementar aquesta anàlisi.

Pel que fa a l'associació entre l'edat d'inici en l'ús dels ordinadors i la resta de variables, els resultats mostren que començar a edats primerenques augmenta la probabilitat de valors positius a la resta de variables. És important, doncs, analitzar l'efecte d'introduir l'ús d'ordinadors a les escoles en els primers anys de l'escolarització.

En conclusió, donada la gran implantació d'ordinadors a les escoles, és essencial analitzar com s'estan utilitzant, quins són els objectius plantejats amb el seu ús i quins efectes produeix aquesta implementació. No és suficient amb l'anàlisi dels resultats acadèmics dels alumnes que utilitzen ordinadors de forma intensiva, és necessari analitzar els efectes d'aquests ús sobre els alumnes des del punt de vista d'aprenentatge i actitudinal i, especialment, incidir en la influència que té aquest ús sobre les diferents visions que noies i nois tenen en referència a les seves habilitats digitals i a les seves perspectives futures. Però, tot i així, si no coneixem què s'està fent en realitat a les aules, difícilment podem extreure conclusions fonamentades.

És per aquest motiu que es proposen accions a realitzar per part de l'administració educativa i d'altres des de la recerca educativa.

És necessari, des del punt de vista de l'administració educativa, proporcionar als centres educatius pautes d'implementació dels ordinadors personals a les aules, específicament amb indicacions referides a com treballar les competències digitals que s'espera que tots els alumnes tinguin assolides en acabar l'educació secundària obligatòria: quin hauria de ser el procés al llarg de l'etapa; quines metodologies poden afavorir el seu assoliment; quins nivells de gradació cal fixar a cada nivell de l'etapa; i com poden col·laborar tots els docents implicats en la seva avaluació. Només d'aquesta forma es pot assegurar que noies i nois assoleixen aquestes competències des de la igualtat de gènere, superant les diferències entre les unes i els altres que el diferent tipus d'ús dels ordinadors en el seu temps de lleure poden provocar.

Proporcionar aquesta base comuna a tots els centres educatius ha de permetre avaluar els efectes. Atès l'elevat cost d'implementar programes individuals, no només a nivell d'infraestructura i maquinari, sinó també en la formació del professorat i la creació de recursos ad-hoc, és essencial dur a terme una avaluació de l'efectivitat d'aquests programes des de diferents punts de vista, inclosa la visió de l'efecte sobre les diferències de gènere.

Pel que fa a la recerca educativa, és important destacar la manca d'estudis controlats abans i després. Per tal d'avaluar els efectes reals dels programes 1:1, des de la recerca cal impulsar estudis que facin un seguiment dels estudiants implicats i que aquests efectes no només es centrin en els resultats acadèmics sinó també en factors de tipus actitudinal que han de mostrar l'efectivitat de les mesures aplicades des del punt de vista motivacional.

La manca de recerca sobre els efectes dels programes 1:1 respecte el gènere és especialment preocupant. La immersió tecnològica continuada de noies i nois, tant dins com fora dels centres educatius, fa encara més rellevant que es continuïn mantenint xifres tant baixes de dones en l'àmbit TIC. El disseny, implementació, seguiment i avaluació d'estratègies d'aula que afavoreixin un increment de l'assoliment de les competències digitals dels alumnes i un increment de la motivació de les noies en l'àmbit de les TIC és un camp de recerca clau pel que fa a entendre quines iniciatives afavoreixen la disminució de les diferències de gènere.

La futura recerca, en col·laboració amb l'administració educativa, hauria de respondre a les preguntes: què es fa a les aules?; en quin moment i com s'introdueixen els ordinadors a les aules?; i quins efectes tenen aquestes dues qüestions sobre: (a) l'assoliment de les competències digitals; (b) les actituds de noies i nois vers l'ús dels ordinadors; i (c) la seva vocació en l'àmbit de les TIC.

8. Bibliografia

Adebowale, O., Adediwura, A., & Bada, T. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research*, *3*(2), 20-30.

Balanskat, A., & Garoia, V. (2010). Netbooks on the rise and netbook initiatives in schools. European Schoolnet (EUN Partnership AISBL)

Baloğlu, M., & Çevik, V. (2008). Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students. *Computers in Human Behavior*, *24*(6), 2639-2648. http://dx.doi.org/10.1016/j.chb.2008.03.003

Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behavior Research and Therapy*, *1*(4), 139-161. http://dx.doi.org/10.1016/0146-6402(78)90002-4

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning and Assessment, 9*(1), 4–15.

Blignaut, P. (2006). Standardised instruments for measuring computer attitude and computer anxiety are not necessarily standardised. *ECIS*, 886-898.

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, *12*(2), 147-158. http://dx.doi.org/10.2190/H7E1-XMM7-GU9B-3HWR

Castaño, C., & Webster, J. (2011). Understanding women's presence in ICT: The life course perspective. *Interna- tional Journal of Gender, Science and Technology*, *3*(2), 364-386. Retrieved May 2017 from http://genderandset.open.ac.uk/index.php/genderandset/article/view/168

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, *2*, 265-282. http://dx.doi.org/10.2190/WDRY-9K0F-VCP6-JCCD

Christoph, G., Goldhammer, F., Zylka, J., & Hartig, J. (2015). Adolescents' computer performance: The role of self-concept and motivational aspects. *Computers and Education*, *81*, 1-12. http://dx.doi.org/10.1016/j.compedu.2014.09.004

Clayton, K. L., von Hellens, L. A., & Nielsen, S. H. (2009). Gender stereotypes prevail in ICT: A research review. *Public Understanding of Science*, *23*(2), 153–158. http://dx.doi.org/10.1145/1542130.1542160

Colley, A., & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed? *Educational Research*, *45*(2), 155-165. http://dx.doi.org/10.1080/0013188032000103235

Critical Appraisal Skills Programme (CASP). Retrieved from http://www.casp-uk.net/#!casp-tools-checklists/c18f8

Cussó, R. (2006). *Tecnologia: gènere I professió*. Llicència d'estudis retribuïda pel Departament d'Ensenyament. http://www.xtec.cat/sgfp/llicencies/200506/memories/1027m.pdf

Cussó, R. (2014). *Género y actitudes antes las TIC: estudio de la influencia de ordenadores personales en los centros escolares*. Treball final del Màster interuniversitari en e-learning i gestió del coneixement. Universitat de Lleida. https://repositori.udl.cat/handle/10459.1/56849

Downes, T., & Looker, D. (2011). Factors that influence students' plans to take computing and information technology subjects in senior secondary school. *Computer Science Education*, *21*(2), 175-199. http://dx.doi.org/10.1080/08993408.2011.579811

Durndell, A., & Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behav- ior*, *18*(5), 521-535. http://dx.doi.org/10.1016/S0747-5632(02)00006-7

European Comission (2006). Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning. OJ L 394, 30.12.2006, 10–18. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32006H0962

European Comission (2010). Communication from the commission to the european parliament, the council, the european economic and social committee and the committee of the regions. A Digital Agenda for Europe. COM/2010/0245. https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52010DC0245R(01)

European Comission (2018). Communication from the Comission to the European Parliament, the Council, the Eupean Economic and Social Committee and the Committee of the Regions on the Digital Education Action Plan. COM(2018) 22 final. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2018:22:FIN

Fančovičová, J., & Prokop, P. (2008). Students' attitudes toward computer use in Slovakia. *Eurasia Journal of Mathematics Science & Technology Education*, *4*(3), 255-262.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Students' use of and engagement with ICT at home and school. *Preparing for Life in a Digital Age: The IEA International*

Computer and Information Lit- eracy Study International Report, 125-166. Retrieved May 2017. http://dx.doi.org/10.1007/978-3-319-14222- 7_6

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers & Education*, *22*(4), 283–289. http://doi.org/10.1016/0360-1315(94)90050-7

Gardner, D. G., Discenza, R., & Dukes, R. L. (1993). The measurement of computer attitudes: an empirical comparison of available scales. *Journal of Educational Computing Research*, *9*, 487-507.

Garland, K. J., & Noyes, J. M. (2004). Computer experience: a poor predictor of computer attitudes. *Computers in Human Behavior, 20*, 823–840.

Garland, K. J., & Noyes, J. M. (2008). Computer attitude scales: How relevant today?. *Computers in Human Behav- ior*, *24*(2), 563-575. http://dx.doi.org/10.1016/j.chb.2007.02.005

Institut d'Estadística de Catalunya (IDESCAT) (2018). Ús de l'ordinador, d'Internet i disponibilitat de mòbil dels nens de 10 a 15 anys. Per lloc d'ús. https://www.idescat.cat/pub/?id=aec&n=937&t=2018

Kaino, L. M. (2008). Technology in learning: Narrowing the gender gap? *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 263-268.

Kengwee, J., Schnellert, G., & Mills, C. (2012). Laptop initiative: Impact on instructional technology integration and student learning. *Education and Information Technologies 17*(2), 137-146. http://dx.doi.org/10.1007/s10639-010-9150-8

Kubiatko, M. (2013). The comparison of different age groups on the attitudes toward and the use of ICT. *Educational Sciences: Theory and Practice*, *13*(2), 1263-1272. Retrieved May 2017 from http://files.eric.ed.gov/fulltext/EJ1017271.pdf

Loyd, B. H., & Gressard, C. (1984). Reliability and Factorial Validity of Computer Attitude Scales. *Educational and Psychological Measurement*, *44*, 501-505. http://dx.doi.org/10.1177/0013164484442033

Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology, 108*, 424-437. http://dx.doi.org/10.1037/edu0000061

Miura, I. T. (1987). The relationship of self-efficacy expectations to computer interest and course enrollment in college. *Sex-roles, 16*, 303-311. http://dx.doi.org/10.1007/BF00289956

Moher, D., Liberati, A., Tetzla, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annuals of Internal Medicine, 151*(4), 264–269. https://doi.org/10.1371/journal.pmed.1000097.t002

Nash, J., & Moroz, P. (1997). An examination of the factor structures of the computer attitude scale. *Journal of Educational Computing Research*, *17*(4), 341-356.

OECD (2012). PISA 2009 Technical Report, PISA, OECD Publishing. Retrieved May 2017. http://dx.doi.org/10.1787/9789264167872-en

OECD (2014). PISA 2012 Technical Report, PISA, OECD Publishing. Retrieved October 2018. https://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf

OECD (2015). *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, PISA, OECD Publishing. http://dx.doi.org/10.1787/9789264229945-en

OECD (2016). PISA 2015 Results (Volume I): Excellence and Equity in Education, PISA, OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264266490-en

Ogan, C., Herring, S. C., & Robinson, J. C. (2005). International Communications Association Conference. *The More Things Change, the More They Stay the Same: Gender Differences in Attitudes and Experiences Related to Computing Among Students in Computer Science and Applied Information Technology Programs*.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers and Education*, *51*(2), 594-608. http://dx.doi.org/10.1016/j.compedu.2007.06.009

Pechtelidis, Y., Kosma, Y., & Chronaki, A. (2015). Between a rock and a hard place: Women and computer technology. *Gender and Education*, *27*(2), 164-182. http://dx.doi.org/10.1080/09540253.2015.1008421

Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior*. http://dx.doi.org/10.1016/j.chb.2013.05.012

Sáinz, M., & López-Sáez, M. (2010). Gender differences in computer attitudes and the choice of technology- related occupations in a sample of secondary students in Spain. *Computers and Education*, *54*(2), 578-587. http://dx.doi.org/10.1016/j.compedu.2009.09.007

Sáinz, M., Pálmen, R. & García-Cuesta, S. (2012). Parental and Secondary School Teachers' Perceptions of ICT Professionals, Gender Differences and their Role in the Choice of Studies. *Sex Roles*, *66*(3-4), 235-249. http://dx.doi.org/10.1007/s11199-011-0055-9

Schaumburg, H. (2001). Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help to Level Out the Gender Differences?. National Educational Computing Conference. 1-8.

Scherer, R., Rohatgi, A., & Hatlevik, O. (2017). Students' profiles of ICT use: Identification, determinants, and relations to achievement in a computer and information literacy test. *Computers in Human Behavior, 70,* 486-499. https://doi.org/10.1016/j.chb.2017.01.034

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers and Education*, *28*(1), 35-41. http://dx.doi.org/10.1016/S0360-1315(96)00035-8

Shashaani, L. (1993). Gender-Based Differences in Attitudes. *Computers & Education, 20*(2), 169-181.

Stockdale, R., & Keane. T. (2016). Influencing the influencers: The role of mothers in IT career choices. *Journal of Information Technology Education: Innovations in Practice, 15*, 181-194. https://doi.org/10.28945/3624

Teo, T. (2008). Assessing the computer attitudes of students: An Asian perspective. *Computers in Human Behavior*, *24*(4), 1634-1642. http://dx.doi.org/10.1016/j.chb.2007.06.004

Thomas, T. & Allen, A. (2006). Gender differences in students' perceptions of information technology as a career. *Journal of Information Technology Education: Research, 5*, 165-168. https://doi.org/10.28945/241

Tømte, C., & Hatlevik, O.E. (2011). Gender-differences in Self-efficacy ICT related to various ICT-user profiles in Finland and Norway. How do self-efficacy, gender and ICT-user profiles relate to findings from PISA 2006. *Computers and Education, 57*(1), 1416-1424. https://doi.org/10.1016/j.compedu.2010.12.011

UNESCO (2017). Cracking the code. United Nations Educational, Scientific and Cultural Organization Publishing. Retrieved from http://unesdoc.unesco.org/images/0025/002534/253479e.pdf

Usher, E., & Pajares, F. (2008). Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions. *Review of Educational Research, 78*(4), 751-796. https://doi.org/10.3102/0034654308321456

Valiente, O. (2010). 1-1 in Education Current Practice, International Comparative Research Evidence and Policy Implications. *OECD Education Working Papers, 44*. OECD Publishing. http://dx.doi.org/10.1787/5kmjzwfl9vr2-en

Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter?. *Computers and Education, 55*(1), 16-23. https://doi.org/10.1016/j.compedu.2009.11.013

Volman, M., van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education*, *45*(1), 35-55. http://dx.doi.org/10.1016/j.compedu.2004.03.001

Von Hellens, L., Clayton, K., Beekhuyzen, J., & Nielsen, S. (2009). Perceptions of ICT careers in German Schools: An exploratory study. *Journal of Information Technology Education, 8*. 211-228. https://doi.org/10.28945/168

Annex 1: Are Boys and Girls still Digitally Differentiated? The case of Catalonian Teenagers

Journal of Information Technology Education: Research

An Official Publication of the Informing Science Institute InformingScience.org

JITEResearch.org

Volume 16, 2017

ARE BOYS AND GIRLS STILL DIGITALLY DIFFERENTIATED? THE CASE OF CATALONIAN TEENAGERS

Roser Cussó-Calabuig*	University of Lleida (UdL), Lleida, Spain	rcusso@xtec.cat
Xavier Carrera Farran	University of Lleida (UdL), Lleida, Spain	carrera@pip.udl.cat
Xavier Bosch-Capblanch	Swiss Tropical and Public Health Institute, Basel, Switzerland and Universität Basel, Basel, Switzerland	x.bosch@unibas.ch

* Corresponding author

ABSTRACT

Aim/Purpose	This article presents a study of ICT use and attitudes related to the computer use of girls and boys from Catalonia in order to detect which gender differences may explain the low presence of women in the ICT field and to design a proposal of actions in schools to help reduce these differences.
Background	Since the number of women in the field of ICT remains very low, this study looks into the factors that influence girls' lack of interest in ICT field.
Methodology	The study collected data from 29 randomly selected public secondary schools in Catalonia with a total of 1,920 students (972 boys and 815 girls aged between 11 and 13 years old); it analyzes socio-demographic data, frequency and type of computers use and attitudes and self-efficacy on ICT use.
Contribution	The study concludes there is a prevalence of stereotypes about the differences of skills and professional vocation among the teenagers and a gender difference when we focus on attitudes toward computers or self-efficacy.
Findings	Boys and girls face computer use in different ways and both have a stereotyped image of their mothers' and fathers' digital skills and ICT jobs. Girls present higher levels of anxiety than boys when using a computer and lower self- confidence. Boys have higher self-efficacy than girls when asked for their perception about doing tasks with computers.

Accepted by Editor Minh Huynh | Received: March 14, 2017 | Revised: July 13, September 6, October 11, 2017 | Accepted: October 24, 2017.

Cite as: Cussó-Calabuig, R., Carrera Farran, X., & Bosch-Capblanch, X. (2017). Are boys and girls still digitally differentiated? The case of Catalonian teenagers. *Journal of Information Technology Education: Research, 16,* 411-435. https://doi.org/10.28945/3879

Impact on Society	Policy makers must design strategies to minimize these gender differences in order to engage more girls in technological studies and minimize this imbalance.
Future Research	Future research is needed, in the Catalan context, about whether the intensive use of computers in schools can influence the reduction of the gender-gap and identify which interventions must be made to maximize its effect.
Keywords	gender differences, attitudes in computer use, self-efficacy, secondary students, stereotypes in ICT

INTRODUCTION

Nowadays, boys and girls are frequent users of Information and Communication Technologies (ICT). According to the European Union Statistical Office (Eurostat, n.d., year searched 2015), 83% of EU households have Internet access, 82% have at least one computer, 84% of the youth between 16 and 24 years old commonly use smartphones to access the Internet, and 80% of them use the computer on a daily basis. Access to technology is, hence, common and easy.

However, there are substantial gender differences in the use of ICT. Reports from the International Computer and Information Literacy Study (ICILS) (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014) and the Organization for Economic Co-operation and Development (OECD, 2015b), based on the Programme for International Student Assessment (PISA) tests, suggest that while girls have a more intensive use of ICT for communication, social networks included, than boys. Boys more often use ICT for leisure and gaming.

These differences in the use of ICT suggest a different approach to technology between boys and girls. While boys are focused more directly on programming and the technical aspects of computers, girls tend to focus on the end-use of software and applications, as has been shown in the report by the OECD (2015a) about gender and education.

Gender differences related to ICT can also be analyzed from other perspectives, for example, from the perception of gender stereotypes regarding the very nature of ICT, identified as a male field.

Another perspective, related to gender differences in relation to ICT, focuses on the attitudes expressed in its use and on the self-efficacy perceived by boys and girls. Girls show more anxiety than boys, as well as less confidence in their potential, and show less enjoyment carrying out tasks beyond those of a basic user.

These gender differences in the use of ICT, stereotypes, lack of models, attitudes, and self-efficacy may lead to differences in what they expect from technologies and how they approach them in their future. The fact is that there is a significant difference between the number of girls and boys enrolled in ICT careers. According to the Organization for Economic Co-operation and Development (OECD, 2015a), the average percentage of women holding a Bachelor qualification or equivalent in the field of ICT (International Standard Classification of Education, ISCED2011 level 6) across all OECD member countries is 19.1%. In Catalonia, where this study was carried out, women represented only 14.77% of all ICT graduates in 2016.

This article investigates gender differences related to ICT in a sample of randomly selected secondary students from public schools in Catalonia. Our objective is to assess whether gender differences persist or not despite the increasing use of computers in schools in order to provide robust evidence to inform educational policies supporting the intensive use of computers in classrooms, taking into account gender issues.

Similar studies carried out in the Catalan context mainly focused on final-year secondary school students and had serious methodological limitations, such as using purposive rather than random samples, which can seriously bias findings (Everis, 2012; Sáinz, Meneses, Fàbregues, & López, 2016). Our study is based on randomly selected students who had just begun the secondary school stage and can therefore provide findings of gender differences in early ages, precisely when there is a larger decision space for future professional orientations. The results show that these gender differences exist and that in some cases, as in the stereotypical vision of ICT professions or in the lack of confidence of girls in their own abilities, are remarkable.

The results of this study could inform the development of strategies to implement ICT along all secondary levels in order to reduce gender differences, allowing girls and boys (i) to achieve similar digital skills, (ii) to have the same possibilities of choosing their professional future, and (iii) to reverse the disproportionate low number of girls studying in this field.

LITERATURE REVIEW OF FACTORS DETERMINING GENDER DIFFERENCES

The gender gap in choosing ICT careers actually starts at very young ages, as suggested by Sjøberg and Schreiner (2010) in the ROSE Project (Relevance of Science Education). The ROSE project was based on a survey of 40,000 fifteen years old students from 40 countries carried out between the years 2003 and 2006. To the question asking students about their intention to develop their professional future in the field of ICT, around 50% of European boys responded that they were interested in jobs related to technology, but only 20% of girls did so. It is necessary to establish the reasons that lead to the difference in the decisions of boys and girls to eliminate the barriers that prevent them from making a free choice based only on their professional preferences.

INFLUENCE OF FAMILY AND TEACHERS

There is a wealth of research evidence on factors associated with the lack of girls' attraction to studying ICT and girls' low value given to a professional career in this field. Some studies (Sáinz & López- Sáez, 2010; Sáinz, Pálmen, & García-Cuesta, 2012; Stockdale & Keane, 2016) suggest the relationship within the family and teachers as key factors.

Sainz et al. (2012) examine parents' and teachers' opinions about male and female career and occupational aspirations using focus groups in five secondary Spanish schools. They conclude that parents (particularly mothers) tend to view ICT professionals in a generally negative manner, as individualistic people, lacking social skills. The authors suggest that it is hard to believe that those parents would encourage their daughters to pursue an ICT career. In the same way, teachers tend to understand ICT as a typically male field. This means that the attention given to boys and girls in the classroom is likely biased and that any career advice given to students would also be stereotyped.

In order to address these perceptions, Stockdale and Keane (2016) carried out a pilot study targeting mothers of school children in Australia in order to change their views about ICT as being a non-female field. Mothers attended a training course to be introduced to basic ICT tools and learnt about the scope of ICT careers in order to be made aware of future possibilities for their children, especially girls. After the course, their views were recorded using a questionnaire and informal interviews.
The authors conclude that there was a change in the gendered misconception of ICT careers, suggesting that this could be an effective intervention, at least in the short run.

STEREOTYPES AND ROLE MODELS

Another known factor that influences gender differences are stereotypes of girls in relation to ICT studies and jobs and their lack of knowledge about the particularities of the jobs in this sector (Castaño & Webster, 2011; Clayton, von Hellens, & Nielsen, 2009; Master, Cheryan, & Meltzoff, 2016; Pechtelidis, Kosma, & Chronaki, 2015; Thomas & Allen, 2006; von Hellens, Clayton, Beekhuyzen, &

Nielsen, 2009).

It is important to point out that these stereotypes are fully embedded in social perceptions about the male nature of ICT related jobs (Clegg, 2001). Accordingly, Cheryan, Plaut, Handron, and Hudson (2013) expose in their paper how media give an image of masculinity in this field, which reinforces the girls' perceptions.

Thomas and Allen (2006) carried out exploratory research on boys' and girls' perceptions about ICT careers. The survey concluded that girls are far more negative about stereotypes in ICT jobs than boys. They consider people working in ICT as "geeks", asocial, primarily men who do a very technical job far from the real social needs. These misconceptions about the real attributions of technological jobs seem to prevent girls from getting involved in ICT careers.

Master et al. (2016) show in their paper how stereotypical environments can influence boys' and girls' choice. They suggest that girls in a non-stereotypical classroom are more interested in taking computer science courses than those who are in a stereotypical classroom. They conclude that redesigning the classroom can project a different image about ICT that can encourage girls to enrol in this area by making them feel like belonging to this environment.

The absence of female role models in the ICT field (Carrington, Tymms & Merrell, 2008; Clayton, 2007) reinforces the perceptions of girls that ICT jobs are male dominated.

ATTITUDES AND SELF-EFFICACY

Another study area focuses on boys' and girls' attitudes about the use of ICT and their self-perceptions about their skills, problem solving strategies, learning, and the usefulness of digital tools. Gender differences in self-efficacy and attitudes may influence the ways boys and girls face ICT or how they conceive their academic and vocational projection (Colley & Comber, 2003; Kubiatko, 2013; Volman, van Eck, Heemskerk & Kuiper, 2005).

Girls' attitudes in the use of ICT are slightly lower than boys' (Adebowale, Adediwura & Bada, 2009; Busch 1995; Chen, 1986; Ogan, Herring & Robinson, 2005; Shashaani, 1993; Volman & Van Eck, 2001). The term attitude has, however, different dimensions: anxiety, enjoyment, and self-confidence.

Anxiety is defined as fear to interact with ICT and showing overall negative attitudes towards ICT, which leads to a deterioration of tasks and their accomplishment (Shashaani, 1993). In relation to anxiety, there is a disparity of findings among different authors. Some of them (Teo, 2008) found no differences between boys and girls, while others (Adebowale et al., 2009; Baloğlu & Çevik, 2008; Kaino 2008; Kubiatko, Haláková, Nagyová, & Nagy, 2011) report higher anxiety in girls as compared with boys.

Enjoyment is defined as interest in the use of ICT, not only in the academic context within or out- side the school, but also during leisure time (Shashaani, 1993). The level of enjoyment has been widely reported as being similar for boys and girls (Adebowale et al., 2009; Fančovičová & Prokop, 2008; Kaino, 2008; Ogan et al., 2005; Teo, 2008). However, some authors point at higher levels of enjoyment in boys than in girls (Fraillon et al., 2014). On the other hand, Kubiatko et al. (2011) found that enjoyment in the use of computers among girls was higher than among boys and that mean values of enjoyment decreased with age in girls and increased in boys. A factor that could explain these differences between studies may be the differences in ages in the samples of subjects included and differences in the use of computers in schools and at home.

Self- confidence is defined as the personal perception of controlling ICT tools, feeling comfortable when using them and feeling able to overcome difficulties by one's own means (Shashaani, 1993). Self-confidence is consistently lower in girls (Christoph, Goldhammer, Zylka, & Hartig, 2015; Ogan et al., 2005; Volman & Van Eck, 2001). Boys tend to perceive themselves as "experts" in ICT, even when their objective knowledge is low, while girls seem to perceive themselves as less skillful and with less knowledge even if their objective knowledge shows no difference from boys' (Volman & Van Eck,

2001).

It is worth noting that computer use, which tends to be a rather informal and basic use, is predominant at home. However, self-confidence is assessed against tasks which are more specific and which require a relatively advanced computing level. In summary, the low self-confidence in girls seems to be associated with girls' tendency to undervalue themselves, boosted by informal self-learning (Vol- man & Van Eck, 2001).

Self-efficacy is the conviction of one's own ability to successfully carry out a given task (Busch, 1995). Psychological studies relate self-efficacy to the likelihood of selecting or being interested in a task, the level of effort and the persistence in completing tasks (Bandura, 1978; Bandura & Schunk, 1981). Bandura (1978) suggests several factors affecting self-efficacy perceptions; e.g. the experience of being successful in carrying out a task increases the self-efficacy related to that task; observing someone else's success or failure influences self-efficacy; verbal persuasion may have an impact on the possibilities of success; and the issue of one's emotional status. Self-efficacy is lower among girls (Durndell & Haag, 2002; Miura, 1987). Downes and Looker (2011) established a correlation between self-efficacy and the intention of students to enroll in ICT studies in the future. Findings suggested that students with a high level of self-perceived computer ability were more likely to consider pursuing an ICT career. Again, some evidence suggests other factors such as frequent use of computers, parental support and teachers' roles may increase self-efficacy (Downes & Looker, 2011; Papastergiou, 2008; Vekiri, 2010).

RESEARCH CONTEXT

Our research has developed from the current knowledge on the factors influencing gender differences in the use of ICT, as indicated in the Literature Review section, in the context of public secondary schools of Catalonia. This section discusses the research questions, the research context in the area of Catalonia, and the structure of the proposed questionnaire.

RESEARCH QUESTIONS

The research questions we address are:

- What is the socio-demographic context of boys' and girls' in relation to the use of computers in Catalonia and how does this influence their perception of ICT?
- How do boys and girls in Catalonia differ in relation to their habits in the use of computers?
- What are the gender differences between boys and girls in relation to their attitudes and perceived self-efficacy facing their work with computers?

CONTEXT OF THE RESEARCH

Catalonia is a region in Spain with a population of about 7 million. Most of the population lives in the capital cities of the four main sub-regions. Barcelona, Catalonia's capital, is the largest urban center, with more than a quarter of the population.

Education services were devolved to the Catalonia's government in the late 70s and since then the Catalan government, remaining in Spanish state the more generic constitutional issues, has increasingly dictated education policies. Educational centers are quite uniformly distributed across the whole Catalonian territory, including the most remote rural areas in the Pyrenees. Schools are bound to Catalonian law, including budgeting, although they have some degree of self-direction in the areas of management.

ICT content are included in Technology, a compulsory subject that has been taught in secondary schools in Catalonia since 1996. In primary education, there is not a formal Technology or ICT subject and computers are used or not by students depending on the pedagogical trends of each school. The number of girls studying ICT in Catalonia is very low and the trend in recent years has been

maintained, with a slight increase in the last two years as shown in Figure 1.

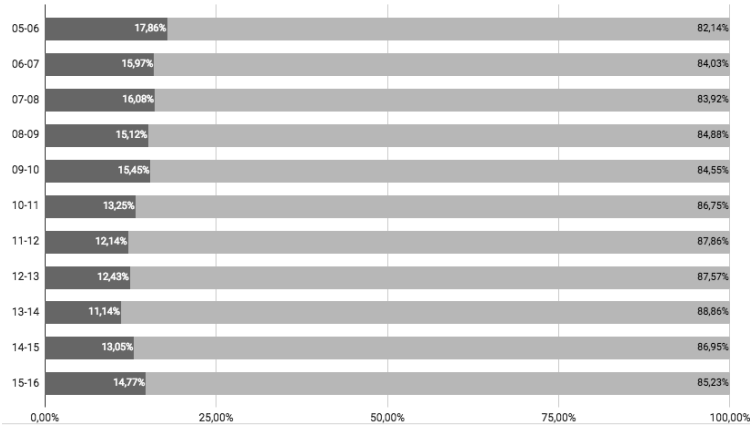


Figure 1. Percentage of females (in dark grey) and males (in light grey) graduated in ICT fields in Catalonia in the last ten years

In the research arena, some studies carried out in Catalonia have addressed this issue trying to find explanatory factors in undergraduate students (Everis, 2012; Sáinz et al., 2016). These studies suggest that stereotypes, attitudes, self-efficacy as well as family and teachers roles may influence gender differences in ICT career paths. However, participants in these studies were secondary school boys and girls, at an age at which it is well known that key future career choices have already been made (Sjøberg & Schreiner, 2010). On the other hand, these studies had a high risk of bias due to the use of purposive rather than random samples of individuals or mixing very different age ranges (e.g., 13 to 20 years old). Our research focuses on students in the first course of secondary school, between 11 and 14 years (mean 12.2 years), when career choices have not yet been made and just when students start the formal curriculum content of ICT. At these ages, we are able to capture their perceptions before students start ICT formal training and before they formally conceive their choices for their future jobs. Furthermore, by researching in an earlier age group, lessons learned from this re- search can still be considered when devising interventions in the secondary school period.

The data were collected through a questionnaire applied to secondary students of Catalan public schools. Its structure corresponds to the research questions, and the included variables were socio-demographical data, attitudes in the use of ICT (i.e., anxiety, enjoyment and self-confidence), and self-efficacy. See the Literature Review section for more details.

The socio-demographic section describes personal and contextual features of students, following similar approaches in previous studies (Busch, 1995; Chen, 1986; Durndell & Haag, 2002; Ogan et al., 2005; Shashaani, 1993). Sáinz and López-Sáez (2010), and Stockdale and Keane (2016) indicate the importance of the influence of the family in the stereotypical perception of the ICT jobs and in the choice of studies and the professional orientation of the girls and boys. Accordingly, this section of the questionnaire aimed at capturing the perceptions of the boys and girls about family stereotypes regarding their parents' digital competencies.

The frequency of use of computers section includes a series of routine tasks carried out with computers outside schools. Tasks were drawn from the PISA 2003 (OECD, 2005) and PISA 2009 (OECD, 2012) questionnaires.

Attitudes in relation to computer use are classified into three domains (anxiety, self-confidence, and enjoyment), following the CAS scale (Computer Attitude Scale) defined by Loyd and Gressard (1984).

As indicated by Colley and Comber (2003), Volman et al. (2005), and Kubiatko (2013), attitudes may influence the ways boys and girls face ICT and their professional projection in this field. High anxiety in girls, as reported by Baloğlu and Çevik (2008), Kaino (2008), Adebowale et al. (2009), and Kubi-

atko et al. (2011), and girls' low self-confidence, as reported by Volman and Van Eck (2001), Ogan et al. (2005), or Christoph et al. (2015), may contribute to a low achievement of digitals skills. On the other hand, enjoyment seems to be similar for both genders, according to Ogan et al. (2005), Fančovičová and Prokop (2008), Kaino (2008), Teo (2008), and Adebowale et al. (2009) but higher in girls than in boys at early ages (Kubiatko et al., 2011). We believe it is relevant to know whether this is also the situation of the Catalan students at the beginning of secondary education or not and to consider taking advantage of this enjoyment to develop more entertaining and effective ICT activities.

Self-efficacy is estimated based on (a) the tasks that someone wants to carry out while perceiving incapacity to complete them, and (b) the tasks that are perceived as being attainable. The details of the tasks proposed in this section of the questionnaire were drawn from the PISA 2003 (OECD, 2005) and PISA 2009 (OECD, 2012) questionnaires. As pointed out by Downes and Looker (2011), the level of self-efficacy is correlated with the intention of students to enroll in ICT careers. According to Durndell and Haag (2002), low levels of self-efficacy shown by girls may explain the low numbers of girls enrolling in ICT studies.

MATERIAL AND METHODS

Gender differences related to demographic context, frequency of use of computers, attitudes, and self-efficacy in relation to ICT have been typically measured in the literature using quantitative methods applied to indicators from validated questionnaires. Some examples of quantitative studies include Kubiatko (2013), Kaino (2008), Fraillon et al. (2014), Christoph et al. (2015) and OECD (2015a). In order to address the gap of evidence on gender differences in early ages in Catalonia and to allow a meaningful discussion with existing evidence worldwide, we decided to follow a quantitative approach, in which we carried out a quantitative, observational, cross-sectional, school-based study in a random sample of public schools in Catalonia. This approach allowed us to use validated questionnaires and to suggest comparisons with the findings of similar studies.

SAMPLE

The public Catalan education system consists of 537 secondary schools. In 2010, the Government of Catalonia defined a programme focused on an intensive use of computers in schools. This one-to- one programme with students owning personal netbooks was not mandatory for schools.

The sample of selected schools was drawn from all 537 governmental secondary schools in Catalonia, some of them enrolled in the intensive use of computers programme. Because we knew that there could be differences in individuals attending schools with and without intensive use of computers, we used a stratified sampling technique to include a balance sample of individuals from both types of schools. Anticipating a low response rate, we included all 175 schools not following the intensive use of computers programmes; and then the same number of 175 schools randomly select- ed from the 362 schools following the intensive use of computers programme. No school was excluded on the grounds of geographical location, size, or any other reason. Figure 2 shows the distribution of participating schools. It is worth noting that points with a high-density of schools correspond to high-density population areas (see Figure 2). Schools were considered as clusters and all eligible students were selected in each school or cluster.

All selected schools were approached by an email addressed to the school headmaster. One reminder was sent to non-respondents two weeks after the first one.

We received 1920 responses, 972 for boys and 948 for girls from 29 schools; 13 (45%) followed the intensive use of computers programme and 16 (55%) did not. Students were 11 to 14 years old (mean 12.2 years).

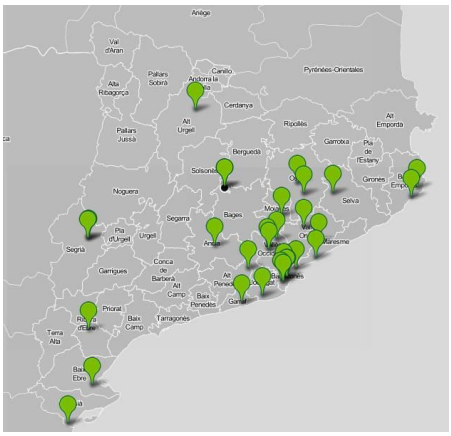


Figure 2. Distribution of schools

QUESTIONNAIRE

The questionnaire was structured into four sections, following the research questions: socio-demographic context, frequency of use, attitudes while using computers, and self-efficacy. Except for the first section, which is general and context-specific, the other sections were drawn from validated questionnaires and used a four-categories Likert scale (further described below). Where applicable, responses were codified and shown through a drop-down box to minimise entry errors. The questionnaire contained the following categories.

1. What is the boys' and girls' socio-demographic context in relation to the use of computers in Catalonia and how does this influence their perception of ICT?

This section includes information about (a) gender, (b) age, (c) school, (d) starting age in the use of computers, (e) place where computer use began, (f) reference place for computers use learning, (g) computing knowledge level of father and (h) mother, and (i) reference person to address computer problems.

2. How do boys and girls in Catalonia differ in relation to their habits in the use of computers?

The frequency of computer use section includes questions about a series of routine tasks carried out with computers outside schools: (a) on-line gaming, (b) social networks participation, (c) homework, (d) email use, (e) participation in chats, (f) Internet browsing, (g) downloads of media, and (h) management of personal web sites. The statement in the questionnaire is, "Tell us how often you carry out the following tasks using a computer". Responses (in 4 levels Likert scale) ranged from "Never or hardly ever" (1 point), "Once or twice per month" (2 points), "Once or twice per week" (3 points) and "Almost daily (4 points). This scale is based on that used in PISA questionnaires. We included "Once or twice a month" to allow responses for some specific actions that could be unusual (e.g., "Management of personal web sites").

3. What are the gender differences between boys and girls in relation to their attitudes and perceived self-efficacy facing their work with computers?

This research question is addressed in two separate sections in the questionnaire: attitudes and self-efficacy.

The section about attitudes in relation to computer attitude includes questions related to the three domains of anxiety, self-confidence and enjoyment, following the CAS scale (Computer Attitude Scale) defined by Loyd and Gressard (1984). The CAS scale has 30 items groups in three sub- scales corresponding to the three domains, although statements are mixed and not structured around domains. We decided to use the CAS scale because it is one of the most used in similar studies (Blignaut, 2006; Francis, 1994; Powell, 2013; Selwyn, 1997) and because it has been widely validated (Gardner, Discenza, & Dukes, 1993; Garland & Noyes, 2008; Nash & Moroz, 1997; Powell, 2013).

Yet, we adapted some question statements, which were out of use, to the context of this study. The scale was translated into Catalan, which is the vehicular language in the schools of Catalonia.

The introductory explanation to the questions in this section is "Indicate the extent to which you agree or disagree with the ideas expressed". Five questions in each domain are formulated in a negative sense to minimize automatic answering and to stimulate a careful reading of the questions. Responses (4 Likert levels) ranged from "Strongly disagree" (1 point), "Disagree" (2 points), "Agree" (3 points) and "Strongly agree" (4 points). Although the former CAS scale ranges from 1 to 5, we have adopted ranges from 1 to 4 after findings from recent studies suggesting that these scores are more appropriate to prevent students from overusing the neutral middle score (Farkas & Murthy, 2005; Varank, 2007)

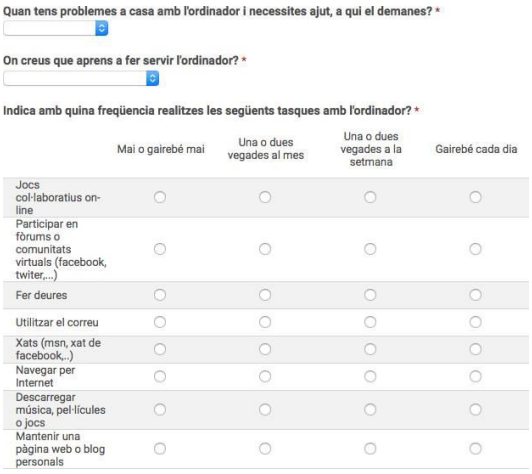
Self-efficacy is addressed asking the perceived capacity to complete specified tasks using computers classified into basic and advanced. The first tasks include (a) digital edition of pictures, (b) production of a presentation, in general, (c) creation of a text document, (d) working with collaborative documents, and (e) reading and responding to emails; the latter include (f) database creation, (g) use of spread sheets, (g) production of a presentation with images and sound, (h) designing a web site, and (i) creating a blog. The question statement is: "Tell us what you think your level of expertise is in the following tasks". The scale (4 levels Likert) ranged from "I don't know what it means" (1 point) to, "I can't do it" (2 points), "I can do it with help" (3 points) and "I can do it on my own" (4 points).

Internal consistencies of the questionnaires (Cronbach's α) were 0.80, 0.85 and 0.8, for the three domains frequency of use of computers, attitudes and self-efficacy, respectively. All the questions can be found in Appendix A.

PROCEDURE

The questionnaire was on-line using Google Form platform (see Figure 3) and self-administered (https://goo.gl/forms/h5yeMezoyc45fUJw2)

Once the questionnaire was completed and translated it was piloted to ensure the coherence of the structure and the understanding of the specific terms of the CAS scale. The questionnaire was administered to 50 first-year, secondary school students in a school, resulting in the rephrasing of two questions in the section of attitudes. Other aspects, such as data consistency and completeness using the Google Form platform, were also verified. It was estimated that it would take around 20 minutes to fill in the questionnaire. The extensive application was undergone during the first term of the academic year, when the ICT programs were introduced and hardly any impact on attitudes and self-efficacy could be expected. The questionnaire was accompanied by instructions for the teachers who would support students in responding to the questionnaire in the classrooms.


Quan tens problemes a casa amb l'ordinador i necessites ajut, a qui el demanes? *

On creus que aprens a fer servir l'ordinador? *

Indica amb quina freqüencia realitzes les següents tasques amb l'ordinador? *

	Mai o gairebé mai	Una o dues vegades al mes	Una o dues vegades a la setmana	Gairebé cada dia
Jocs col·laboratius on-line				
Participar en fòrums o comunitats virtuals (facebook, twiter,..)				
Fer deures				
Utilitzar el correu				
Xats (msn, xat de facebook,..)				
Navegar per Internet				
Descarregar música, pel·lícules o jocs				
Mantenir una pàgina web o blog personals				

Figure 3. Screen-shot of the on-line questionnaire

DATA ANALYSIS

All variables were analysed individually. Furthermore, certain variables were combined to build the indicators defined in the questionnaires (PISA 2003, PISA 2009, CAS), as follows.

Variables related to frequency of use were grouped in four categories: leisure (i.e., on-line gaming, Internet browsing, downloading of media, management of personal Web sites), homework, communication (i.e., participation in social networks, use of email, participation in chats), and games. The latter was analysed individually despite being included in 'leisure' given the gender differences reported in several studies.

Negative statements in the attitudes domain were recoded to maintain consistency with the rest of the statements. The overall attitude score was estimated adding the values of each question and sub- scale. All questions had the same weight.

Self-efficacy questions were grouped according to the two categories: basic (i.e., digital edition of pictures, production of a presentation, creation of a text document, working with collaborative documents and reading and responding to emails) and advanced (i.e., database creation, use of spread sheets, production of a presentation with images and sound, designing a web site and creating a blog). The overall score was obtained averaging the scores across questions.

Descriptive statistics included percentages, means and their 95% confidence intervals, estimated by taking into account the clustering design of the sample. Results are presented disaggregated by gender. All statistics were carried out using Stata 13.0.

RESULTS

The results are shown for each of the four sections of the questionnaire related to the research questions as exposed in the Material and Methods section of this paper.

SOCIO-DEMOGRAPHIC CONTEXT

Factors related to the start in the use of computers and learning of their use

Boys have an earlier start in the use of computers than girls: 37.9% of boys report having used computers when they were younger than six years old, as compared with 34% of girls. From nine years of age, there is hardly any difference (see grey areas in Table1).

Both boys and girls report that they started using computer mainly at home (grey area in Table 1). The school was the second most often reported place of initiation, in a remarkable lesser proportion of cases.

When asked about where boys and girls learned to use computers, the answers suggested no differences between genders; both reported learning at home (see grey area in Table 1), typically without any help in very similar proportions. The school was the second most often reported place of learning. Details on these answers can be found in Table 1.

Table 1. Results of social-demographic context

(Grey areas indicate the higher values for each variable; note that for "Age of initiation" there are two grey areas, due to similar values in two responses)

	BOYS		GIRLS	
	Percentage	SE	Percentage	SE
AGE OF INITIATION				
Before 6	37.91%	2.24	34.00%	1.98
Between 6 and 8	42.42%	1.48	46.90%	1.57
Between 9 and 11	18.44%	1.76	17.94%	1.66
12 and more	1.23%	0.32	1.15%	0.50
PLACE OF INITIATION				
At home	71.00%	1.51	70.20%	1.69
At school	18.14%	1.67	20.04%	1.72
Relative's home	5.23%	0.78	4.41%	0.72
Friend's home	2.66%	0.62	1.78%	0.43
Others	2.97%	0.68	3.57%	0.75
PLACE OF LEARNING				
Alone at home	51.33%	2.39	52.78%	2.18
At school	26.64%	2.16	24.55%	2.17
At home with help	15.78%	1.51	16.89%	1.54
With friends	6.25%	0.80	5.77%	0.84

Skills in fathers' and mothers' use of ICT

Both boys and girls feel that the level of their fathers' computer knowledge is higher than that of their mothers. Taking into account the responses "Very high" and "High", 58.6% of boys and 63.3% of girls report that their fathers' computer knowledge is very high or high; and 44% of boys and 47.2% of girls reported that their mothers' computer knowledge is very high or high (see grey areas in Table 2).

As shown in Table 2, these findings are consistent with students' responses in relation to the resolution of computer challenges. Both girls and boys reported that their reference resource to address computer challenges are fathers (see grey area in Table 2), followed by their siblings and finally by their mothers. Girls reported mothers as reference person relatively more often than boys. Boys more often than by girls reported friends as reference person.

Table 2. Results of perception about fathers' and mothers' computer skills

(Grey areas indicate the high levels for mothers' and fathers' computer skills and the higher value for the variable References)

	BOYS		GIRLS	
	Percentage	SE	Percentage	SE
FATHER'S LEVEL				
Very high	22.54%	1.45	23.82%	1.89
High	36.07%	1.69	39.56%	1.56
Low	26.64%	2.01	23.09%	1.59
None	7.68%	1.07	7.35%	1.01
No response	7.07%	0.96	6.19%	1.04
MOTHER'S LEVEL				
Very high	12.70%	1.28	12.59%	1.16
High	31.35%	1.61	34.73%	1.54
Low	40.37%	1.70	42.71%	1.65
None	10.45%	1.40	6.61%	0.97
No response	5.12%	1.03	3.36%	0.65
REFERENCES				
Father	42.01%	2.39	41.34%	2.11
Mother	16.91%	1.39	20.25%	1.31
Brother/Sister	30.33%	2.23	30.43%	2.01
Friends	10.76%	1.21	7.97%	0.85

FREQUENCY AND HABITS IN THE USE OF ICT

Data related to frequency and habits in the use of ICT, attitudes towards the use of ICT, and self-efficacy in the use of computers can be seen in Figure 4. Variables with non-overlapping 95% confidence intervals are highlighted, suggesting significant differences between genders. We have numbered the key variables in the text and in Figure 4 to ease the narrative of the findings.

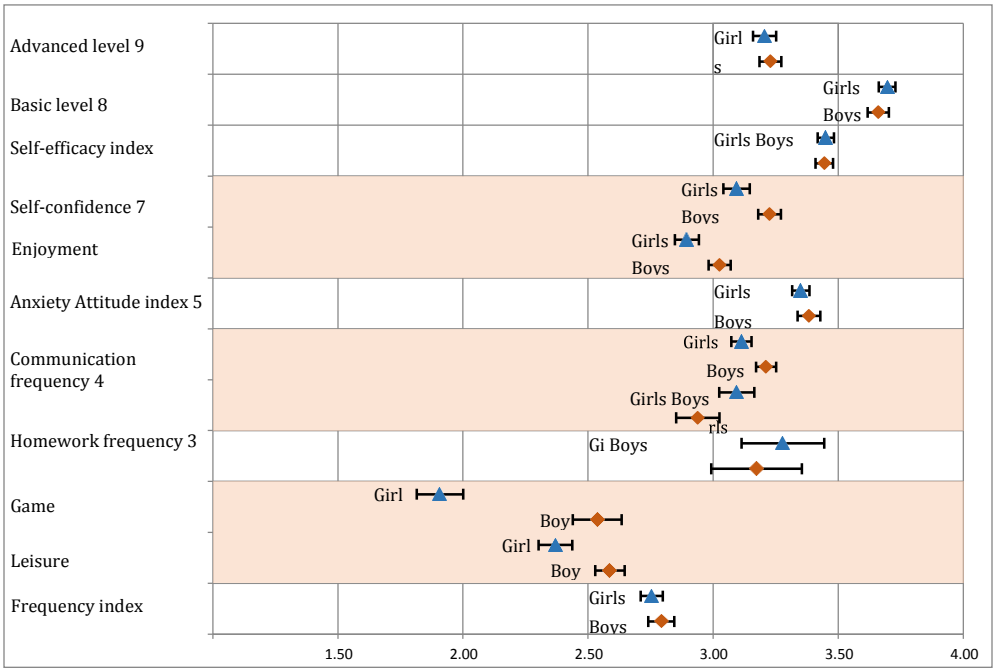


Figure 4. Results of Frequency of use, Attitudes and Self-efficacy

(Numbers corresponds to explanation in text and to relevant results; Colored areas means variables with 95% confidence interval not overlapping)

There were no differences between boys and girls in the computers' frequency use index, both reporting using computers more than once or twice a month (means: boys = 2.79, SE = 0.025; girls = 2.75, SE = 0.021). Differences became apparent when looking at the specific habits in the use of computers and their frequency of use (i.e., leisure, gaming, homework and communication, see the Questionnaire section).

In relation to leisure, there were slight gender differences: the frequency in the use of computers by girls was below boys and also in the lower range of use (means: boys = 2.59, SE = 0.028; girls = 2.34, SE = 0.033), with non-overlapping 95% confidence intervals, as seen in Figure 4 (number 1 and colored area).

These gender differences were larger in the computers' frequency of use for gaming. Girls reported lower frequency of use below the mid-point in the score scale (mean = 1.91, SE = 0.045); and boys a frequency slightly above the middle point (mean = 2.54, SE = 0.048). These gender differences are the largest of all features studied, without overlapping confidence intervals (see Figure 4, number 2 and colored area).

The use of computers for homework was very similar in boys and girls, the latter being marginally higher in girls (means: boys = 3.17, SE = 0.088; girls = 3.28, SE = 0.080). Confidence intervals are substantially larger than those measured in the other parameters, which suggest larger variability between individuals of the same gender group (see Figure 4, number 3).

Differently from the patterns described above, the use of computers for communication was slightly

higher in girls (mean= 3.09, SE = 0.034) than in boys (mean = 2.94, SE = 0.042) with hardly overlapping 95% confidence intervals (see Figure 4, number 4 and colored area).

The full set of results can be found in Appendix B.

ATTITUDES TOWARDS THE USE OF ICT

Boys and girls showed some differences in their attitudes towards the use of computers measured with the 'Attitudes index'. We report separately the three dimensions of this feature: anxiety, enjoyment, and self-confidence. 95% confidence intervals for the overall index did not overlap, suggesting that underlying differences in attitudes features may be significant (means: boys = 3.21, SE = 0.019; girls = 3.11, SE = 0.019); see Figure 4, number 5 and colored area).

Anxiety reported by girls was marginally higher than that reported by boys and it was very low in both groups (means: boys = 3.38, SE = 0.022; girls = 3.35, SE = 0.017), which is consistent with the early start and high intensity in the use of computers, as shown in previous sections. Higher values mean a lower anxiety level.

Enjoyment was somehow lower for girls. Boys showed high values (mean = 3.03, SE = 0.022) and girls' values close to the mid-point in score scale (mean= 2.89, SE = 0.017) (Figure 4, number 6 and colored area). Self-confidence in girls was below boys' as well, yet above the mid-point in both groups (means: boys = 3.22, SE = 0.022; girls = 2.89, SE = 0.023) (Figure 4, number 7 and colored area). 95% confidence intervals did not overlap in any of these two dimensions as seen in Figure 4.

The full set of data can be found in Appendix B.

SELF-EFFICACY IN THE USE OF COMPUTERS

The self-efficacy index in both genders was very close and in the higher end of the score scale (means: boys = 3.44, SE = 0.017; girls = 3.45, SE = 0.016). We report on the two levels of self- efficacy: basic level and advanced level.

In relation to basic self-efficacy, there was hardly any difference between genders. Values were in the higher end of the scale in both groups (means: boys = 3.66, SE = 0.021; girls = 3.69, SE = 0.016) (Figure 4, number 8).

Similarly, in the advanced level self-efficacy score, both genders reported values in the higher end of the scale (means: boys = 3.23, SE = 0.021; girls = 3.21, SE = 0.022) (Figure 4, number 9).

95% confidence intervals overlapped in these two dimensions, as seen in Figure 4, suggesting very slight differences between boys and girls. Interestingly, and as expected, overall advanced level of self-efficacy was overall lower than basic-level self-efficacy. Although boys and girls reported almost the same values in both dimensions, it is remarkable that girls score above boys in the basic level and that the situation was the opposite for the advanced level of self-efficacy.

The full set of data can be found in Appendix B.

DISCUSSION

SOCIO-DEMOGRAPHIC CONTEXT

Our findings relating to the start of computer use (more than 80% before 8 years old, both boys and girls; see Table 1) are consistent with those in the OECD (2015a) report on gender and education, based on the PISA 2012 findings. This report shows that the average age when students start using computer is 6.9 years, boys starting earlier than girls.

Both boys and girls responded that they started using computers at home, similar to the findings from the ICILS report (Fraillon et al., 2014) and from the OECD gender and education report (2015a).

Indeed, the availability of computers in most households can explain the relatively early initiation age and the fact that they start at home. This is well illustrated in the OECD (2015b) report on students and computers showing an increasing trend in the use of computers from the year 2009 to 2012. Indeed, only 4% of 15 year-old students in 2012 reported not having a computer at home in this report.

However, one question remains: to what extent are computers used in schools and, more importantly, how can this use impact on ICT perceptions in both genders, given that the use at household level is already very prominent? Taking into account that these are students starting secondary school, they could have reported on their computer use in primary education. The lack of relevance of past experience in schools with computers, compared with household use, was striking. This finding seems to suggest that, as currently designed, ICT approaches in schools do not really bring an added value to what students already experiment at home.

The 2015 annual statistical report from the Education Department of the Government of Catalonia on digital equipment and their use at schools (Generalitat of Catalonia, 2017) shows that in 67.7% of primary schools there are less than five students per computer. This is a relatively low proportion as compared with secondary schools. Furthermore, 79% of primary schools report that the use of computers is mainly of academic nature, which actually includes the use of computers for tasks, which do not really involve capacity building of computer skills by students. What this suggests is that students hardly value schools as the ICT primary learning sites for ICT. In other words, data on the availability of ICT equipment and on generic use of computers do not necessarily portray or correlate with activities focusing on real ICT learning. Our data confirms this observation and calls for the need to revise the indicators reported by the government on the use of computers in schools.

Both boys and girls suggest that their fathers' digital skills are stronger than those of their mothers, overall in seeking help to solve computer problems. We have compared these perceptions with the digital knowledge levels of men and women between 25 and 54 years in Spain (the age range which typically includes the parents of children in our sample), information that is available in the Euro- stat's Digital Economy and Society database (European Union Statistical Office, n.d., year searched 2015). In relation to fathers, there is some consistency between students' perceptions and the Euro- stat data. However, mothers are heavily undervalued, with fewer students giving high values to their mothers' skills and also more students giving low values to mothers (see Table 3). In other words, teenagers' perceptions do not seem to be rooted in differences in the real skills of their parents.

A possible explanation could be that fathers spend more time at home using computers than mothers. However, there is no evidence to support this statement; according to Eurostat's Digital Economy and Society database (European Union Statistical Office, year searched 2015), 72% of men and 71% of women aged between 25 and 54 in Spain use computers at home, and 83% of men and 83% of women have used computers at home within the last three months.

If there are no real differences between fathers and mothers in their ICT skills and use of computers at home, it could be that teenagers have a gender stereotype which our data support, showing an undervaluation of mothers by both boys and girls.

Table 3. Informatics knowledge level (rates) by gender, for men and women between 26 and 54 years old in Spain (European Union Statistical Office, n.d., year searched 2015), compared with boys' and girls' perceptions about fathers' and mothers' knowledge.

FATHER					MOTHER		
Measured in adults		Perceived by boys	Perceived by girls		Measured in adults	Perceived by boys	Perceived by girls
Very high	36	22.5	23.8	Very high	33	12.7	12.6
High	27	36.1	39.6	High	28	31.3	34.7
Low	24	26.6	23.1	Low	28	40.4	42.7
None	3	7.7	7.3	None	2	10.4	6.6
High or very high	63	58.6	63.4	High or very high	61	44	47.3
Low or none	27	34.3	30.4	Low or none	30	50.8	49.3

FREQUENCY AND HABITS IN THE USE OF ICT

Our findings related to the frequency in the use of computers are consistent with data from other sources (Instituto Nacional de Estadística, n.d., year searched 2015; Institut d'Estadística de Catalunya, n.d., year searched 2015; European Union Statistical Office, n.d., year searched 2015), which suggest that 50% of girls and 62% of boys in the same age range as our sample use computers on a daily basis. This relatively high frequency in the use of computers may correlate with easiness in accessing computers, commonly in the households.

Girls use computers for leisure less often than boys, as shown in ICILS (Fraillon et al., 2014) and OECD (2015a, 2015b) reports. This is also the case of the use of computers for online gaming, being more prevalent in boys than in girls as shown in the OECD (2015a) report on gender and education. The same reports also suggest a similar level of use for school activities in both genders and a more intense use for communication activities by girls (e.g., social networking). These findings are consistent with our results suggesting that Catalonian girls and boys share the trends of the OECD countries.

Why are gender differences in gaming and communication the most remarkable ones? Likely gaming use may be influenced by aggressive computer games marketing, which clearly target boys in the design and underlying strategies of games (Kafai, Heeter, Denner, & Sun, 2008). Girls tend to not identify themselves with games entailing fighting and strong competition, which are the most com- mon in the market and which link computers with male stereotypes.

It is worth noting that the use of computers in gaming may lead to a greater interest in the technicalities of ICT, such as programming or hardware, and to a higher self-confidence in the use of computers. This can contribute to the differences between boys and girls in self-confidence, as shown in our results. Furthermore, it could contribute to the predominance of ICT studies as a professional career in boys as compared to girls, as self-confidence has been shown to be a predictor of choices of future studies (Abiss, 2011; Shashaani,1993)

On the other hand, gender difference in the use of computers for communication may reflect girls' needs to establish links with their peers in the adolescent period. This would be consistent with the lack of engagement of girls in computer gaming, which is usually individualistic in nature.

ATTITUDES IN THE USE OF ICT

Overall girls' attitudes were slightly lower than boys', consistent with findings in other studies (Adebowale et al., 2009; Busch 1995; Chen, 1986; Ogan et al., 2005; Shashaani, 1993; Volman & Van Eck, 2001). However, some of the attitude dimensions showed interesting discrepancies. For example, we did not find remarkable differences in anxiety between boys and girls. Although another study pointed in the same direction (Teo, 2008), most of the studies suggest gender differences (Adebowale et al., 2009; Baloğlu & Çevik, 2008; Durndell & Haag, 2002; Kaino, 2008; Kubiatko et al., 2011; Shasshaani, 1993).

What could explain the lack of gender differences in anxiety? One explanation could be that anxiety is inversely related to early previous use. In our sample, computers were frequently used and at early stages in life, and anxiety was very low in both groups without gender differences. Socio-cultural con- text may also influence directly or indirectly influence anxiety in relation to ICT. Most of the studies showing high levels of anxiety were relatively old (from 2002 to 2010), and some were carried out in countries where computer use was less widespread.

The ICILS report (Fraillon et al., 2014) found, as we do, higher values in the dimensions of enjoyment for boys than girls. This finding, that boys enjoy ICT more than girls, however, is not consistent with the reviewed literature (Adebowale et al., 2009; Busch, 1995; Fančovičová & Prokop 2008; Kaino, 2008; Ogan et al., 2005; Shashaani, 1993; Teo, 2008). We believe that a factor explaining dif- ferences

in these studies and our results may actually reflect differences in ages in the samples studied and differences in the use of computers in schools and at home.

Self-confidence is marginally lower in girls, as compared with other studies (Christoph et al., 2015; Ogan et al., 2005; Volman & Van Eck, 2001), probably due to the earlier age of the participants in our study. Clearly, the tendency is that boys tend to perceive themselves as 'experts' in ICT, even when their objective knowledge is low, while girls seem to perceive themselves as less skilful and with less knowledge, even if their objective knowledge shows no difference with boys' (Volman & Van Eck, 2001). The low self-confidence level in girls seems to be associated with girls' tendency to undervalue themselves, boosted by informal, self-learning (Volman & Van Eck, 2001).

SELF-EFFICACY IN THE USE OF ICT

There are hardly any differences in self-efficacy between boys and girls, contrary to what has been described in other studies pointing at less self-efficacy in girls as compared with boys (Adebowale et al., 2009; Busch, 1995; Downes & Looker, 2011; Durndell & Haag, 2002; Miura, 1987; Papastergiou, 2008).

However, it is important to study self-efficacy, not only as an overall index, but rather taking into account the different tasks that may determine perceptions of self-efficacy. We have reported mild gender differences in self-efficacy in different types of tasks. For example, girls report higher self-efficacy than boys in basic tasks, which is the reverse for advanced tasks, as shown as well in the ICILS report (Fraillon et al., 2014).

Both boys and girls show overall high levels of self-efficacy, which may be related to frequency of use. On the other hand, gender differences in basic and advanced tasks seem to be consistent with the types of use of computers, predominantly for advanced tasks in boys (e.g.. web creation, media management) and for basic tasks in girls (presentations, text document, emailing). Girls feel safe while doing simple and mechanical tasks, while boys tend to develop more complex and technical tasks. Interestingly, self-efficacy differences are consistent with the findings in self-confidence, so we believe there is a pervasive effect of our study's age range sample.

CONCLUSIONS

Our study addresses the research questions providing fundamental insights into the underlying factors explaining the large gender differences in ICT professional choices by students in Catalonia.
First, students report household as their formal place of ICT learning rather than the school. Second, students' stereotyped perception on parents' abilities is heavily biased towards fathers in detriment of mothers. Finally, other gender differences were hardly detected except in certain types of computer use.

Related to the first research question (i.e., the socio-demographical context of boys' and girls' use of computers), our study showed that the formal place for students' ICT learning is the household rather than the school. Indeed, the role of schools in ICT seems to be relatively meagre and students do not take advantage of that formal learning environment despite the fact that Catalan schools have a reasonable computer-student ratio. This is a lost opportunity for the educational system to promote ICT learning and to contribute to the reduction of gender differences in their use. However, the availability of ICT equipment is not enough to ensure its proper use. It is striking that despite the increasing predominance of ICT in all sectors of society, there is hardly any guidance targeting teachers and students on how to optimize and adapt to the use of existing innovative and ever- changing ICT technologies.

In this regard, the Catalan government (Generalitat of Catalonia, 2015) has recently started to take actions, such as the definition of students' and teachers' digital competences (both in primary and secondary education) and the implementation of a digital framework for schools. In order to help teachers to reinforce their ICT skills, a large teacher-training programme has been developed, focusing

on methodologies, technical contents, and the pedagogical uses of ICT. Although these actions are mandatory, official educational policies, there are no proper monitoring and evaluation mechanisms to ensure that they are widely disseminated, accurately applied, and that the results meet the targets set. Our findings suggest that these actions have had hardly any impact on students' perceptions (i.e., the educational system is not the place of reference for ICT learning). Since our study participants were students just starting the secondary school, we can say that we could not show any evidence that actions taken so far in primary schools have led to a noticeable impact at the start of secondary school. Provided that the Catalan government's policy is to strengthen ICT learning in schools, this policy will have to be deployed paying more attention to implementation challenges (e.g., designing adequate pedagogical approaches accompanying equipment updates) and developing evaluation strategies that allow prompt corrective actions. The Office for Standards in Education, Children's Services and Skills (Ofsted), the evaluation organism of the UK on education, is an example of how to implement a follow up about governmental policies. Attending to ICT implementation at schools, Ofsted had published a report into information and communication technology (ICT) and its effect on achievement and standards in schools. This report draws on evidence from the inspection of ICT in primary, secondary, and special schools between 2008 and 2011 (Ofsted, 2013).

Secondly, boys' and girls' perceptions about their fathers' and mothers' ICT skills seem to be related to their personal context at home as well as to stereotyped perceptions about the gendered bias of ICT. This is actually not a problem unique to the educational sector, but rather one that affects the society as a whole; hence, actions to revert this situation have to involve not only schools but house- holds and other sectors, as well. In Catalonia, for example, some initiatives targeting girls and also parents have been implemented, although only on an informal level and often as part of wider inter- national initiatives. For instance, the Technovation Challenge or Girls in ICT Day consists of a series of workshops that are conducted by female professional experts in ICT. Currently, these types of actions are carried out on a voluntarily basis and are of very limited scope. Furthermore, they target an audience that is already sensitized to the need to promote the use of ICT by girls.

But, what has been specifically done from the Catalan educational sector? Again, not much and not in a very formal way. There are some actions, showing evidence-based results, that can be implemented: (a) training for families in the use of ICT, including technical and security issues (Stockdale & Keane, 2016); (b) organizing sessions on vocational guidance and information on the ICT sector with the participation of professionals from the sectors, specifically women (Clayton, Beekhuyzen, & Nielsen, 2012); and (c) sharing with families the tasks based on the use of ICT made by their children (Becta, 2008)

Finally, in relation to our two other research questions, our study found that reported gender differences in attitudes and self-efficacy are somehow smaller in our Catalan subpopulation than in other similar studies from elsewhere.

One factor that could explain this reduced gender differences may be related to the fact that our participants tended to be younger than those in other studies. Both boys and girls in our study, who have just finished primary school, show the same level of self-efficacy. This is an excellent opportunity to consider actions that maintain or even further reduce these gender differences throughout the secondary school, given that self-efficacy is closely related to the intention of continuing ICT studies in the future (Downes & Looker, 2011). Interventions must ensure that appropriate access to equip- ment is granted for both boys and girls. The 1:1 projects implemented in different countries (Va- liente, 2010) allow this individualised access to computers. However, these initiatives have to be cou- pled with an ICT integrated use plan in all areas in a transversal way, across subjects. Since the implementation of these projects has a high financial burden to education agencies, schools, and families, they are not always feasible or sustainable. In Catalan schools, the computer per student ratio facilitates an individual use of computers during most of the school timetable.

Despite the reduced gender differences in attitudes and self-efficacy, we did find significant gender

difference in the frequency of computers use. In order to design engaging activities to reduce these differences, our study provides useful insights on promoting specific activities for boys and girls (i.e., boys carry out more technical activities (e.g., gaming) while girls use computers for communication). It is common practice that teachers design ICT activities without taking into account these differences. Current evidence suggests that schools should redesign ICT training in a more transversal way in which both boys and girls (a) access the whole scope of ICT applications activities, (b) engage in collaborative activities, and (c) are exposed to significant ICT contents that relate to the improvement of social needs (Ofsted, 2013). Activities must ensure that students take full advantage of their ICT skills and that they become digitals creators and critical users.

REFERENCES

Abbiss, J. (2011). Boys and machines: gendered computer identities, regulation and resistance. *Gender and Education*, *23*(5), 601-617. http://dx.doi.org/10.1080/09540253.2010.549108

Adebowale, O., Adediwura, A., & Bada, T. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research*, *3*(2), 20-30.

Baloğlu, M., & Çevik, V. (2008). Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students. *Computers in Human Behavior*, *24*(6), 2639-2648. http://dx.doi.org/10.1016/j.chb.2008.03.003

Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behavior Research and Therapy*, *1*(4), 139-161. http://dx.doi.org/10.1016/0146-6402(78)90002-4

Bandura, A., & Schunk, D. H. (1981). Cultivate competence, self- efficacy and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41(*3), 586-598. http://dx.doi.org/10.1037/0022-3514.41.3.586

Becta (2008). *Exploiting ICT to improve parental engagement, moving towards online reports*. Retrieved October 2017. https://www.education.gov.uk/publications/eOrderingDownload/Exploiting ICT.pdf

Blignaut, P. (2006). Standardised instruments for measuring computer attitude and computer anxiety are not necessarily standardised. *ECIS*, 886-898.

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, *12*(2), 147-158. http://dx.doi.org/10.2190/H7E1-XMM7-GU9B-3HWR

Carrington, B., Tymms, P., & Merrell, C. (2008). Role models, school improvement and the "gender gap" – Do men bring out the best in boys and women the best in girls? *British Educational Research Journal*, *34*(3), 315- 327. http://dx.doi.org/10.1080/01411920701532202

Castaño, C., & Webster, J. (2011). Understanding women's presence in ICT: The life course perspective. *International Journal of Gender, Science and Technology*, *3*(2), 364-386. Retrieved May 2017 from http://genderandset.open.ac.uk/index.php/genderandset/article/view/168

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, *2*, 265-282. http://dx.doi.org/10.2190/WDRY-9K0F-VCP6-JCCD

Cheryan, S., Plaut, V.C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women. *Sex Roles, 69,* 58-71. http://dx.doi.org/10.1007/s11199-013-0296-x

Christoph, G., Goldhammer, F., Zylka, J., & Hartig, J. (2015). Adolescents' computer performance: The role of self-concept and motivational aspects. *Computers and Education*, *81*, 1-12. http://dx.doi.org/10.1016/j.compedu.2014.09.004

Clayton, K. L. (2007). *The influence of metropolitan Brisbane middle-school ICT experiences on girls' ICT study and career choices.* PhD dissertation, Griffith University, December 2007.

Clayton, K. L., von Hellens, L. A., & Nielsen, S. H. (2009). Gender stereotypes prevail in ICT: A research review. *Public Understanding of Science*, *23*(2), 153–158. http://dx.doi.org/10.1145/1542130.1542160

Clayton, K. L., Beekhuyzen, J., & Nielsen, S. (2012), Now I know what ICT can do for me!. *Information Systems*

Journal, 22, 375–390. http://dx.doi.org/10.1111/j.1365-2575.2012.00414.x

Clegg, S. (2001). Theorising the machine: Gender, education and computing. *Gender and Education*, *13*(3), 307-324. http://dx.doi.org/10.1080/09540250120063580

Colley, A., & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed? *Educational Research*, *45*(2), 155-165. http://dx.doi.org/10.1080/0013188032000103235

Downes, T., & Looker, D. (2011). Factors that influence students' plans to take computing and information technology subjects in senior secondary school. *Computer Science Education*, *21*(2), 175-199. http://dx.doi.org/10.1080/08993408.2011.579811

Durndell, A., & Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behav- ior*, *18*(5), 521-535. http://dx.doi.org/10.1016/S0747-5632(02)00006-7

European Union Statistical Office (Eurostat). (n.d.). *Survey on Digital Economy and Society*. Retrieved from http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database

Everis. (2012). *Factores influyentes en la elección de estudios científicos, tecnológicos y matemáticos. Visión de los estudiantes de 3º y 4º de ESO y Bachillerato*. Retrieved May 2017. http://s3-eu-west-1.amazonaws.com/e17r5k-datap1/everis_documents_downloads/estudio+vocaciones.pdf

Fančovičová, J., & Prokop, P. (2008). Students' attitudes toward computer use in Slovakia. *Eurasia Journal of Mathematics Science & Technology Education*, *4*(3), 255-262.

Farkas, D., & Murthy, M. (2005). Attitudes toward computers, the introductory course and recruiting new majors: Preliminary results. *Proceeding of Programming Interest Group 17*, 268-277.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Students' use of and engagement with ICT at home and school. *Preparing for Life in a Digital Age: The IEA International Computer and Information Lit- eracy Study International Report*, 125-166. Retrieved May 2017. http://dx.doi.org/10.1007/978-3-319-14222- 7_6

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers and Education*, *22*(4), 283-289. http://dx.doi.org/10.1016/0360-1315(94)90050-7

Gardner, D. G., Discenza, R., & Dukes, R. L. (1993). The measurement of computer attitudes: an empirical comparison of available scales. *Journal of Educational Computing Research*, *9*, 487-507.

Garland, K. J., & Noyes, J. M. (2008). Computer attitude scales: How relevant today?. *Computers in Human Behav-ior*, *24*(2), 563-575. http://dx.doi.org/10.1016/j.chb.2007.02.005

Generalitat of Catalonia (2015). Core competencies in the digital field. Retrieved June 2017 from http://ensenyament.gencat.cat/web/.content/home/departament/publicacions/colleccions/competencie s-basiques/eso/eso-ambit-digital-angles.pdf

Generalitat of Catalonia. (2017). *Survey on ICT equipment and use in schools*. Retrieved from http://ensenyament.gencat.cat/ca/departament/estadistiques/equipaments-usos-tic/curs-actual/

Institut d'Estadística de Catalunya (IDESCAT). (n.d.). *Survey on ICT equipment and use in households*. Retrieved from http://www.idescat.cat/estad/ticl?lang=en

Instituto Nacional de Estadística (INE). (n.d.). *Survey on Equipment and Use of Information and Communication Tech-nologies in Households*. Retrieved from http://www.ine.es/dyngs/INEbase/en/operacion.htm?c=Estadistica_C&cid=1254736176741&menu=re sultados&secc=1254736194579&idp=1254735576692

Kafai, Y.B., Heeter, C., Denner, J., & Sun, J. Y. (2008). Beyond Barbie® and Mortal Kombat: New perspectives on gender and gaming. *Games and Culture*,*1*(1), 83-88.

Kaino, L. M. (2008). Technology in learning: Narrowing the gender gap? *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 263-268.

Kubiatko, M., Haláková, Z., Nagyová, S., & Nagy, T. (2011). Slovak high school students' attitudes toward computers. *Interactive Learning Environments*. http://dx.doi.org/10.1080/10494821003612232

Kubiatko, M. (2013). The comparison of different age groups on the attitudes toward and the use of ICT. *Educational Sciences: Theory and Practice*, *13*(2), 1263-1272. Retrieved May 2017 from http://files.eric.ed.gov/fulltext/EJ1017271.pdf

Loyd, B. H., & Gressard, C. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, *44*, 501-505. http://dx.doi.org/10.1177/0013164484442033

Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology, 108*, 424-437. http://dx.doi.org/10.1037/edu0000061

Miura, I. T. (1987). The relationship of self-efficacy expectations to computer interest and course enrollment in college. *Sex-roles, 16*, 303-311. http://dx.doi.org/10.1007/BF00289956

Nash, J., & Moroz, P. (1997). An examination of the factor structures of the computer attitude scale. *Journal of Educational Computing Research*, *17*(4), 341-356.

OECD. (2005). PISA 2003 Technical Report, 425. Retrieved May 2017. http://www.oecd.org/edu/school/programmeforinternationalstudentassessmentpisa/35188570.pdf

OECD. (2012). PISA 2009 Technical Report, PISA, OECD Publishing. Retrieved May 2017. http://dx.doi.org/10.1787/9789264167872-en

OECD. (2015a). *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, PISA, OECD Publishing. Retrieved May 2017. http://dx.doi.org/10.1787/9789264229945-en

OECD. (2015b). *Students, Computers and Learning: Making the Connection*, OECD Publishing, Paris. Retrieved May 2017. http://dx.doi.org/10.1787/9789264239555-en

Ofsted. (2013). *ICT in schools 2008–11. An evaluation of information and communication technology education in schools in England 2008–11*. Ofsted. Retrieved October 2017 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/181223/110134.pdf

Ogan, C., Herring, S. C., & Robinson, J. C. (2005). International Communications Association Conference. *The More Things Change , the More They Stay the Same : Gender Differences in Attitudes and Experiences Related to Compu- ting Among Students in Computer Science and Applied Information Technology Programs*.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers and Education*, *51*(2), 594-608. http://dx.doi.org/10.1016/j.compedu.2007.06.009

Pechtelidis, Y., Kosma, Y., & Chronaki, A. (2015). Between a rock and a hard place: Women and computer technology. *Gender and Education*, *27*(2), 164-182. http://dx.doi.org/10.1080/09540253.2015.1008421

Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior*, *29*(6), 2337-2381. http://dx.doi.org/10.1016/j.chb.2013.05.012

Sáinz, M., & López-Sáez, M. (2010). Gender differences in computer attitudes and the choice of technology-related occupations in a sample of secondary students in Spain. *Computers and Education*, *54*(2), 578-587. http://dx.doi.org/10.1016/j.compedu.2009.09.007

Sáinz, M., Pálmen, R. & García-Cuesta, S. (2012). Parental and Secondary School Teachers' Perceptions of ICT Professionals, Gender Differences and their Role in the Choice of Studies. *Sex Roles*, *66*(3-4), 235-249. http://dx.doi.org/10.1007/s11199-011-0055-9

Sáinz, M., Meneses, J., Fàbregues, S., & López, B. (2016). Adolescents' gendered portrayals of information and communication technologies occupations. *International Journal of Gender, Science and Technology 8*(2), 81-201.

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers and Education*, *28*(1), 35-41. http://dx.doi.org/10.1016/S0360-1315(96)00035-8

Shashaani, L. (1993). Gender-based differences in attitudes. *Computers and Education*, *20*(2), 169-181.

Sjøberg, S., & Schreiner, C. (2010). The ROSE project: An overview and key findings. *Oslo: University of Oslo*, 1-31. Retrieved May 2017 from http://www.uv.uio.no/ils/english/research/projects/rose/publications/the- rose-project.pdf

Stockdale, R., & Keane. T. (2016). Influencing the influencers: The role of mothers in IT career choices. *Journal of Information Technology Education: Innovations in Practice, 15*, 181-194. https://doi.org/10.28945/3624

Teo, T. (2008). Assessing the computer attitudes of students: An Asian perspective. *Computers in Human Behavior*, *24*(4), 1634-1642. http://dx.doi.org/10.1016/j.chb.2007.06.004

Thomas, T. & Allen, A. (2006). Gender differences in students' perceptions of information technology as a career. *Journal of Information Technology Education: Research, 5*, 165-168. https://doi.org/10.28945/241

Valiente, O. (2010). 1-1 in education current practice, International comparative research evidence and policy implications. *OECD Education Working Papers, 44*. OECD Publishing. http://dx.doi.org/10.1787/5kmjzwfl9vr2-en

Varank, I. (2007). Effectiveness of quantitative skills, qualitative skills, and gender in determining computer skills and attitudes: A causal analysis. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 81*(2), 71-80

Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter?. *Computers and Education, 55*(1), 16-23. https://doi.org/10.1016/j.compedu.2009.11.013

Volman, M., & van Eck, E. (2001). Gender equity and information technology in education: The second dec- ade. *Review of Educational Research*, *71*(4), 613-634. http://dx.doi.org/10.3102/00346543071004613

Volman, M., van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education*, *45*(1), 35-55. http://dx.doi.org/10.1016/j.compedu.2004.03.001

Von Hellens, L., Clayton, K., Beekhuyzen, J., & Nielsen, S. (2009). Perceptions of ICT careers in German Schools: An exploratory study. *Journal of Information Technology Education, 8*. 211-228. https://doi.org/10.28945/168

APPENDIX A: QUESTIONNAIRE

SOCIO-DEMOGRAPHIC CONTEXT

QUESTIONS	ANSWERS
Gender	Boy / Girl
Age	11/12/13/14/15
Name of school	Open answer
Dou you have a computer at home?	Yes, mine/Yes, shared/No
When do you start using a computer?	Before 6/Between 6 and 8/Between 9 and 11/After 12
Where did you use a computer for the first time?	At home/At school/At a relative's home/At a friend's home
Which level of ICT skills do you think having your father?	Very high/High/Low/Very low/NA
Which level of ICT skills do you think having your mother?	Very high/High/Low/Very low/NA
Who do you ask for help when you have a computer problem?	Father/Mother/Brother-Sister/Friends
Where do you think you learn to use computers?	On my own at home/At school/At home with some help/With friends

FREQUENCY OF USE: Indicate how often you perform the following tasks with your computer

(Possible answers: Almost never/Once or twice a month/Once or twice a week/Almost every day)

QUESTIONS
Gaming
Forums/Social networks
Schools homework
Email
Chats
Surfing the Internet
Downloading music, games, films
Maintaining a personal web or blog

ATTITUDES: Indicate the extent to which you agree or disagree with the ideas expressed

(Possible answers: Strongly disagree/Disagree/Agree/Strongly agree)

QUESTIONS	RELATED VARIABLE
Computers do not scare me at all	Anxiety
I would like working with computers	Enjoyment
Working with a computer would make me very nervous (*)	Anxiety
I do not feel threatened when others talk about computers	Anxiety
It wouldn't bother me at all to take computer courses	Anxiety
I'm no good with computers (*)	Self-confidence
The challenge of solving problems with computers does not appeal to me (*)	Enjoyment
Computers make me feel uncomfortable (*)	Anxiety
Generally, I would feel OK about trying a new problem on the computer	Self-confidence
I would feel at ease in a computer class	Anxiety
I think working with computers would be enjoyable and stimulating	Enjoyment
I don't think I would do advanced computer work (*)	Self-confidence
Figuring out computer problems does not appeal to me (*)	Enjoyment
I get a sinking feeling when I think of trying to use a computer (*)	Anxiety
I am sure I could do work with computers	Self-confidence
I would feel comfortable working with a computer	Anxiety
When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer	Enjoyment
I'm not the type to do well with computers (*)	Self-confidence
I don't understand how some people can spend so much time working with computers and seem to enjoy it (*)	Enjoyment
I am sure I could learn a computer language	Self-confidence
Once I start to work with the computer, I would find it hard to stop	Enjoyment
I think using a computer would be very hard for me (*)	Self-confidence
I will do as little work with computers as possible (*)	Enjoyment
Computers make me feel uneasy and confused (*)	Anxiety
If a problem is left unsolved in a computer class, I would continue to think about it afterward	Enjoyment
I could get good grades in computer courses	Self-confidence
I do not enjoy talking with others about computers (*)	Enjoyment
I do not think I could handle a computer course (*)	Self-confidence
I have a lot of self-confidence when it comes to working with computers	Self-confidence
I feel aggressive and hostile toward computers (*)	Anxiety

Note: (*) Items for which score is reversed

SELF-EFFICACY: Indicate what you think is your level with respect to the following tasks

(Possible answers: I don't know what it means/I can't do it/I can do it with help/I can do it on my own)

QUESTIONS
Edit digital images
Create a database
Use a spread sheet
Create a presentation
Create a multimedia presentation with images, sounds and videos
Create a text document
Work in collaborative documents
Create a web page
Create a blog
Read and answer email

APPENDIX B: TABLE OF RESULTS

Results of Frequency of use, Attitudes and Self-efficacy

	BOYS		GIRLS	
	Mean	SE	Mean	SE
ATTITUDES				
Anxiety	3.38	0.022	3.35	0.017
Enjoyment	3.03	0.021	2.89	0.023
Self-confidence	3.23	0.022	3.09	0.026
Attitude Index	3.21	0.020	3.11	0.020
FREQUENCY OF USE				
Leisure frequency	2.59	0.029	2.37	0.033
Game frequency	2.54	0.048	1.91	0.045
Communication frequency	2.94	0.042	3.09	0.034
Homework frequency	3.17	0.089	3.28	0.081
Frequency Index	2.79	0.025	2.75	0.022
SELF-EFFICACY				
Basic level	3.66	0.021	3.70	0.016
Advanced level	3.23	0.021	3.21	0.023
Self-efficacy index	3.44	0.017	3.45	0.016

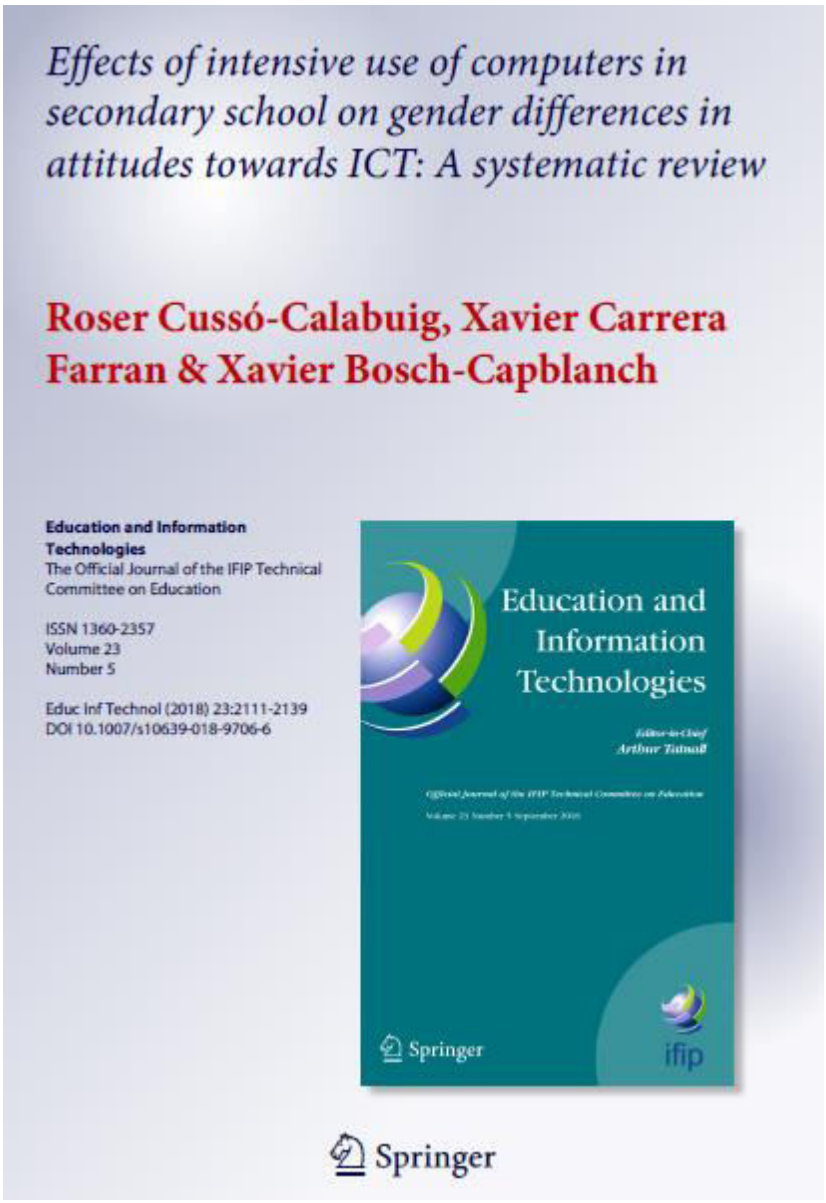
BIOGRAPHIES

Roser Cussó-Calabuig is an Associate Professor of Master's Degree in Secondary and Upper Secondary Education at the Universitat Politècnica de Catalunya (BarcelonaTech). She holds a Master's Degree in Technological Education and she is carrying on her PhD investigation focused on Gender and Technology (Universitat de Lleida, UdL). She has worked as a Technology and ICT teacher at Secondary Education and currently she is working as a technological advisor at the Department of Education of the Catalan Government.

F. Xavier Carrera Farran is an Associate Professor of Educational Technology in the Department of Pedagogy and Psychology at the University of Lleida (UdL), Spain. PhD in Psychopedagogy. Extraordinary Doctorate Award. Member of COMPETECS (Competences, Education, Technology and Society) research group. Coordinator at the University of Lleida in the Interuniversity Doctorate Program in Educational Techno- logy. His research interests are Technology in Education, the application of active methodologies in education and the training based on competences.

Xavier Bosch-Capblanch is a Medical Doctor, with an official medical speciality in Public Health (Spain), MSc in Tropical Medicine and Hygiene (Spain) and PhD (evidence on unvaccinated children in LMIC and policy implication, University of Amsterdam). He is Group Leader (Data- Evidence-Evaluation-Policy') at the Swiss Tropical and Public Health Institute (Basel, Switzerland). He is also Honorary Lecturer at the Liver- pool School of Tropical Medicine. He has been involved in several initiatives to bridge the gap between research evidence and management and policy making.

Annex 2: Effects of intensive use of computers in secondary schools on gender differences in attitudes towards ICT: A systematic review



Educ Inf Technol (2018) 23:2111–2139
https://doi.org/10.1007/s10639-018-9706-6

Effects of intensive use of computers in secondary school on gender differences in attitudes towards ICT: A systematic review

Roser Cussó-Calabuig[1] · Xavier Carrera Farran[1] · Xavier Bosch-Capblanch[2,3]

Received: 25 November 2017 / Accepted: 19 March 2018 / Published online: 28 March 2018

Abstract There is a wealth of interventions focusing on the intensive use of computers in secondary schools, largely aiming at improving students' performance. However, global evidence on the effects of the use of computers on attitudinal outcomes has not been synthesised so far. Taking into account that the differences in the attitudes of boys and girls regarding the use of computers are one of the factors described as causes of the low number of girls following ICT studies, the aim of this article is to review the evidence on the effects of intensive use of computers in schools on gender differences in attitudes outcomes: anxiety, enjoyment, self-confidence and self-efficacy. Searches generated a total of 740 citations of which 59 were identified as relevant and nine were finally included. The methodological quality of included studies was poor to moderate. The results suggest that despite the intensive use of computers, boys are favoured in computer anxiety, self-confidence and self-efficacy; and suggest no differences in computer enjoyment. There is no evidence that intensive use of computers reduce gender differences in these outcomes. Further policy recommendations should be rooted on robust evaluations, which take into account implementations parameters, as well.

✉ Roser Cussó-Calabuig
rcusso@xtec.cat

Xavier Carrera Farran
carrera@pip.udl.cat

Xavier Bosch-Capblanch
x.bosch@unibas.ch

[1] Department of Pedagogy and Psychology, University of Lleida. Faculty of Education, Avda. Estudi General, 4, 25001 Lleida, Spain

[2] Swiss Tropical and Public Health Institute, Socinstrasse 57, 4002 Basel, Switzerland

[3] Universität Basel, Petersplatz 1, 4003 Basel, Switzerland

Keywords Gender differences · Secondary education · ICT · Computer anxiety · Computer self-efficacy · Computer self-confidence · Computer enjoyment

1 Introduction

1.1 Background

The number of girls enrolled in technological fields, especially those related to Information and Communication Technology (ICT) is much less than the number of boys. According to the Organisation for Economic Co-operation and Development (OECD 2015), the average percentage of women holding a Bachelor or equivalent qualification level in the field of ICT (International Standard Classification of Education, ISCED2011 level 6) across all member countries is 19.1%. The three countries with the highest proportion of women having completed Information Technology (IT) superior studies are Colombia (69.6%), Mexico (39.9%) and Greece (36.6%). Some countries below the OECD average are: the USA (17.8%), Spain (17.0%) and with the lowest percentage: Switzerland (6.8%) and Belgium (6.0%).

Schreiner and Sjøberg (2010), coordinators of the ROSE Project (Relevance Of Science Education), provided further evidence on this imbalance. The ROSE project is based on a survey involving 40,000 fifteen years old students from 40 countries carried out between the years 2003 and 2006. To the question asking students about their intention to develop their professional future in the field of ICT, around 50% of European boys responded that they were interested in jobs related to technology, but only 20% of girls did so.

The low presence of women in jobs related to ICT is partially the result of this low enrolment in technological careers. Furthermore, data on European ICT jobs uptake from the report e-Skills Manifesto (Tapscott 2012) showed that 32.7% and 31.6% of people working in ICT related jobs were women in 2008 and 2010, respectively, suggesting a slight decrease over a two years period.

1.2 Factors related to gender differences

There is an extensive research on which might be the reasons why girls do not feel attracted to ICT studies or why they do not think about their future career in this field. These factors can be included in three categories: families and teachers influence, professional stereotypes and personal attitudes.

1.2.1 Families and teachers influence

Some studies (Sáinz and López-Sáez 2010; Sáinz et al. 2012; Stockdale and Keane 2016) suggest factors such as the influence of families and teachers or the lack of female role models in the field of ICT (Carrington et al. 2008).

Sáinz et al. (2012) carried out their study targeting parents and teachers of secondary schools in Catalonia in order to examine parents' and teachers' opinions about male and female career and occupational aspirations. The authors used a focus discussion (four with parents and three with secondary teachers) to explore perceptions of both

groups about ICT professionals and gender differences in professional choice. The authors conclude that parents (particularly mothers) tend to view ICT professionals in a generally negative manner, as individualistic people, lacking social skills. The authors suggest that it is hard to believe that those parents would encourage their daughters to pursue an ICT career. In the same way, teachers tend to understand ICT as a typically male field. This means that the attention given to boys and girls in the classroom is likely biased and that any career advice given to students would also be stereotyped.

Stockdale and Keane (2016) carried out a pilot study targeting mothers of school children in Australia in order to change their views about ICT as being a non-female field. Mothers were introduced to basic ICT tools and learnt about the scope of ICT careers in order to be aware of future possibilities for their children, especially girls. After the course, their views were recorded and the authors concluded that there was a change on the gendered misconception on ICT careers, suggesting that this could be an effective intervention, at least in the short run.

1.2.2 Professional stereotypes

Other factors include the stereotypical view that girls have about studies and jobs related to ICT and their unfamiliarity about what really means to work in this field (Castaño and Webster 2011; Clayton et al. 2009; Klapwijk and Rommes 2009; Master et al. 2016; Pechtelidis et al. 2015; Schott and Selwym 2000; Thomas and Allen 2006; Von Hellens et al. 2009).

Thomas and Allen (2006) carried out an exploratory research on boys' and girls' perceptions about ICT careers. The survey concluded that girls considered people working on ICT as "geeks", asocial, mostly men and doing a very technical job far from the real social needs. These misconceptions about the real social needs to which technological jobs can contribute seem to auto-exclude girls from ICT careers.

Tipically, these stereotypes are fully embedded in social perceptions about the male nature of ICT related jobs. Accordingly, Cheryan et al. (2013) exposed in their paper how media gave an image of masculinity to this field, which reinforces girls' perceptions.

Some of these factors are also reported in a study by the European Schoolnet consisting on an analysis of different views of high school students, boys and girls, about ICT and their projection as a future profession, in several European countries (Gras-Velazquez et al. 2009).

1.2.3 Personal attitudes

A complementary approach to the gender imbalances is to consider differences on the attitudes strategies in problem solving, learning and use of IT tools (Marcoulides 1988; Varma 2009). These gender differences may influence how boys and girls face the use of ICT or consider following computer-related careers and jobs, in their academic or professional life (Colley and Comber 2003; Kubiatko 2013; Volman et al. 2005).

Girls' attitude in the use of ICT is slightly lower than boys' (Adebowale et al. 2009; Busch 1995; Chen 1986; Shashaani 1993; Volman and van Eck 2001). Attitudes toward computer can been classified in different dimensions, anxiety, enjoyment and self-confidence (Delcourt and Kinzie 1993; Loyd and Gressard 1984; Spanos and Sofos 2015). Some authors add other subcategories like utility of computers (Pelton and Pelton

1996) and cognition (Kay 1993) as the self-perception of skills to do some specific tasks using computers. This one can be assimilated to self-efficacy.

Anxiety is defined as fear to interact with ICT and showing overall negative attitudes towards ICT, which leads to a deterioration of tasks and their accomplishment (Shashaani 1993). In relation to anxiety, there is a disparity of findings among different authors. Some of them (Teo 2008) found no differences between boys and girls, while others (Adebowale et al. 2009; Baloğlu and Çevik 2008; Kaino 2008; Kubiatko et al. 2011) report higher anxiety in girls as compared with boys.

The dimension of enjoyment refers to the interest in the use of ICT, not only within the academic context of schools but also during leisure time (Shashaani 1993). The level of enjoyment has been widely reported as being similar for boys and girls (Adebowale et al. 2009; Fančovičová and Prokop 2008; Kaino 2008; Teo 2008). However, Fraillon et al. (2014) pointed at higher levels of enjoyment in boys than in girls and Kubiatko et al. (2011) suggested the opposite. A factor that could explain these differences between studies may be the differences in ages in the samples of subjects included and differences in the use of computers in schools and at home.

Perceived personal control of ICT tools corresponds to the dimension of self-confidence, and includes feeling comfortable when using them and feeling able to overcome difficulties by one's own means (Shashaani 1993). This dimension is consistently lower in girls (Christoph et al. 2015; Volman and van Eck 2001). Boys tend to perceive themselves as 'experts' in ICT, while girls seem to perceive themselves as less skilful and with less knowledge (Volman and van Eck 2001). The low self-confidence in girls seems to be associated with girls' tendency to undervalue them, boosted by informal self-learning (Volman and van Eck 2001).

Finally, self-efficacy is defined as the belief in the ability of oneself to successfully carry out some actions (Busch 1995) and is typically measured by estimating the number of tasks that an individual wants to accomplish believing that he or she is not able to complete, and the number of tasks that the individual considers that he or she can perform without problems. Self-efficacy may affect not only the degree of success in accomplishing tasks using computers but not to consider pursuing and ICT career (Galpin and Sanders 2007).

1.3 Objectives of the review

As described in the introduction section, there are three main groups of factors influencing gender differences on ICT: families and teachers, professional stereotypes, and personal attitudes. Attitudes may be the most vulnerable to interventions carried out in school settings, where interventions can be more feasibly implemented with a potentially greater impact on students.

It has been hypothesised that the systematic use of computers in schools could reduce gender differences in attitudes and self-efficacy (Downey and Kher 2015; Blignaut 2006; Teo and Noyes 2008). In the recent years, the use of computers in schools has increased and initiatives, such as one-to-one programmes (intensive computer use facilitated by the fact that each pupil has his/her own computer as a fundamental learning tool) or intensive use of computers in all subjects, have been adopted in a large number of countries. Evaluations of the effects of these initiatives have focused on students' achievements, on closing the digital divide between students

with different economic backgrounds, on changes over methodological practices or on implementation issues (Bebell and Kay 2010; Shapley et al. 2009; Silvernail and Gritter 2007). These evaluations do not disaggregate the observed effects by gender.

However, there is overwhelming evidence suggesting that gender differences persist, which urges for an evaluation of these interventions from a gender perspective.

There are four systematic literature reviews on the effects of one-to-one initiatives (Fleischer 2012; Harper and Milman 2016; Islam and Grönlund 2016; Penuel 2006), which report on estimates of pupils' learning performance and teachers' tasks. However, none of these reviews report on gender differences or on outcomes related to attitudes towards ICT.

Hence, the focus of our literature review is on school settings and attitudes (anxiety, enjoyment, self-confidence) and self-efficacy outcomes.

We aim at addressing two research questions through a systematic literature review:

1. What are the effects of the intensive use of computers on gender differences in attitudes and self-efficacy, in secondary schools settings?
2. Does current evidence provide insights on other factors that can influence these differences and to what extent?

2 Methods

This systematic review is reported following the systematic reviews standard reporting conventions described in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA; Moher et al. 2009) and the inclusion criteria follow the PICOTS strategy (Population, Intervention, Comparator, Outcomes, Times, Study design).

2.1 Study inclusion criteria

2.1.1 Types of participants

Participants should be students, boys and girls, from 12 to 18 years old (i.e. equivalent to secondary education), enrolled in schools, without distinction of funding type (e.g. public or private schools), location (e.g. rural, urban) or educational style. We have decided to focalise the review at secondary education because at this level the intensive use of computers is more extensive than in primary schools.

2.1.2 Types of interventions

We have considered interventions consisting in the intensive use of computer devices (e.g. laptops, personal computers (PC) or tablets) in the classrooms within school hours. Mobile phones were excluded.

The interventions consist on the use of one-to-one programmes (i.e. one device for each student) or shared devices among pupils, to carry out classroom activities using digital tools (e.g. collaborative tools to create documents, simulators, virtual learning environments, digital books).

Intensive use of computers refers to an inclusive and daily use in all or almost all of school topics or subjects, where computers are used "transparently" as a standardized

resource within the classroom's own dynamics. However, computer use complexity may vary from routine use for daily tasks to more comprehensive use when ICT itself is the learning activity.

We have included interventions with more than one school enrolled.

2.1.3 Types of outcomes

There is a wide range of different validated scales to measure attitudes towards the use of computers. For example, Shaft et al. (2004) reported 31 different instruments since the year 1966.

The Computer Attitude Scale (CAS), developed by Loyd and Gressard (1984), is one of the most used in the literature and it has been validated in different settings (Francis 1994; Selwyn 1997; Blignaut 2006; Powell 2013). The CAS scale has 30 item groups in three sub-scales corresponding to the three attitude's dimensions: anxiety, enjoyment and self-confidence. Statements are mixed and not structured around domains. Each item corresponds to a phrase on what students must indicate to what extent (from 1 to 5) they agree. Five questions in each domain are formulated in a negative sense to minimize automatic answering and to stimulate a careful reading of the questions. Some examples of these questions are: Working with a computer would make me very nervous (anxiety); Once I start to work with the computer, I would find it hard to stop (enjoyment); Generally, I would feel OK about trying a new problem on the computer (self-confidence).

In this review we have considered the outcomes of interest as defined in the CAS: anxiety, enjoyment and self-confidence, adding self-efficacy along with the study of Kay (1993).

These outcomes are separately reported by gender or reported as gender differentials.

2.1.4 Range of studies

We have screened studies published in peer-reviewed journals and also grey literature (i.e. reports, dissertations, proceedings) between 2005 and 2015. Articles before the year 2005 were excluded because intensive use of computers was hardly introduced in schools before these dates.

2.1.5 Types of studies

Experimental, quasi-experimental and observational studies, or mixed methods studies with quantitative estimates.

Although the capacity of observational and mixed methods studies to report effect estimates is limited, we decided to include them as well anticipating a small amount of experimental and quasi-experimental studies.

2.1.6 Types of instruments

We have considered studies using validated scales and instruments. These instruments can have been validated in previous studies or the authors have justified the process of validation when the instrument has been created specifically for the study.

2.2 Search strategy

We developed a comprehensive search strategy, which was adapted to each literature database. Search terms included: computer, ICT, gender, attitude, self-efficacy, anxiety, education, secondary and high school, and their synonymous terms (see Appendix 1 for search terms).

The following literature sources were searched: TESEO, DART-Europe, ERIC, Taylor and Francis, SAGE and Science Direct. Considering the speedy evolution of IT and their use in the last years, it seems reasonable to restrict the search to the last 10 years.

References of included studies were manually scrutinised in order to detect potentially relevant studies. Articles known to the authors of this review were also considered for inclusion.

2.3 Selection of studies

All articles were codified according to their source and stored in a conventional reference manager application. Duplicates were identified and removed.

A single author scrutinised titles and abstracts for relevance being rather inclusive in the decisions. Full texts of relevant articles were retrieved to apply the inclusions criteria, using a coded spreadsheet to record compliance of each study with each inclusion criteria that was piloted in a sample of articles to ensure consistency and accuracy. The main author applied these criteria to maximise inclusion (i.e. no study was excluded if there was an unclear assessment). Studies with unclear assessments were discussed with a senior research fellow and agreement was achieved by consensus.

Although single reviewer study selection is prone to bias, there seem to be an acceptable alternative if mitigation measures are in place (e.g. piloting the inclusion criteria in a small sample of studies).

Findings from included studies are reported below; and excluded studies and reasons for exclusion are listed in Table 6 in Appendix 2.

2.4 Data extraction

The following data items were extracted from the articles included in the present study: first author name, journal, year of publication, educational systems setting, age of participants, sample size, number of schools included, subjects or topics where computers are used, outcomes, quantitative instrument used, qualitative instruments, times of intervention and methodologies applied (see Table 1).

Estimates have been extracted and are reported as found in the articles, including precisions estimates when available (e.g. standard deviation (SD), standard error (SE) or confidence intervals (CI)).

The methodological quality of the studies has been assessed using the checklist of the Critical Appraisal Skills Programme (CASP), adapted to the study designs included in this review. The Better Value Healthcare, a training organisation whose objective is to develop tools for critical appraisal to quality research, has created this tool.

Table 1 Characteristics of the included studies (sorted by type of outcome)

Author, year and country	Type schools	Number schools	Sample size (age)	Subjects or topics	Outcomes type	Outcomes detail	Instruments	Times	Qualitative[b]
Baloğlu and Çevik (2008) Turkey	Not indicated	Not indicated	715 (14 to 19)	Computer course	Anxiety	Ownership Frequency of computer use	CAS scale	1	No
Kaino (2008) Botswana	Not indicated	10	72 (12 to 15)	Diverse[a]	Anxiety Enjoyment	Usefulness of using computers in learning Student's comfort Types of learning	Ad hoc	1	Close open-ended questions in interviews
Kubiatko et al. (2011) Slovakia	Not indicated	14	659 (14 to 19)	All subjects use ICT	Anxiety Enjoyment	Age	CAQ scale	4	No
Teo (2008) Singapore	Not indicated	1	183 (18)	ICT subjects	Anxiety Enjoyment	Computer importance Ownership	CAQ adapted	1	No
Fančovičová and Prokop (2008) Slovakia	Not indicated	4	214 (10 to 14)	Diverse[a]	Enjoyment	Frequency of computer use Types of use	ATICTQ scale	1	No
Papastergiou (2008) Greece	State	5	358 (17 to 18)	Diverse[a]	Self-efficacy	Intention to pursue studies in ICT Perception of ICT professions Frequency of use Family ICT skills Teacher' role	Ad hoc	1	Questions included in questionnaire
Vekiri (2010) Greece	Not indicated	4	301 (12 to 16)	Diverse[a]	Self-efficacy	Value beliefs Perceived parental support Perceived teacher expectations	Ad hoc	1	No

Table 1 (continued)

Author, year and country	Type schools	Number schools	Sample size (age)	Subjects or topics	Outcomes type	Outcomes detail	Instruments	Times	Qualitative[b]
Christoph et al. (2015) Germany	Not indicated	4	445 (14 to 17)	Not indicated	Computer self-concept	Computer interest ICT engagement Basic computer skills Computer knowledge	Ad hoc	1	No
Downes and Looker (2011) Australia	Not indicated	11	722 (15)	ICT subjects	Perceived ability	Plans to take ICT subjects Attitudes toward ICT subjects Frequency of use Parental education	Ad hoc	1	42 discussion groups

[a] The term "Diverse" in column "Subjects or topics" is referred to the use of computers in ICT subjects and other subjects not specified

[b] "Qualitative" column indicates whether studies reported qualitative findings as well, besides quantitative estimates

2.5 Data analysis

The variety of study designs, outcomes reported and measurement methods precluded any attempt to use meta-analytical methods. We have calculated the effect size as ratios of means where disaggregated means for boys and girls were reported; and as relative risks where proportions of boys and girls presenting a given feature were reported. 95% confidence intervals were calculated if the sample sizes by gender were available and, for means, if standard deviations or standard errors were reported. We estimated effect sizes by subgroups where data was available in the studies (see Table 3).

Given the disparity of outcomes, we did not attempt to carry out meta-analyses of the effects; instead, we present narrative syntheses of the effects for each outcome. Quantitative analyses were carried out in R for Windows, version 3.2.2.

3 Results

The databases searches generated a total of 740 citations (see Appendix 1, Table 5) 59 studies were identified as relevant and nine were finally included based on our inclusion criteria (see Appendix 3, Table 7). The study flow diagram is shown in Fig. 1 and reasons for exclusion are listed in Appendix 2, Table 6.

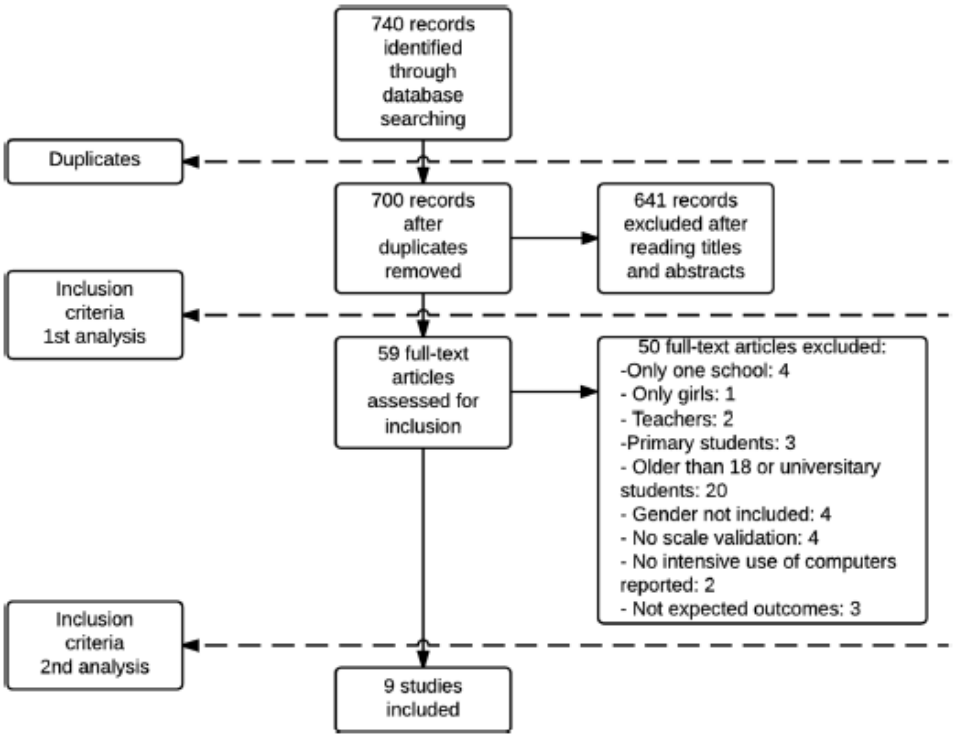


Fig. 1 Study flow diagram

3.1 Description of included studies

All nine studies were cross-sectional studies. Three of them used mixed methods: questionnaires with open questions (Papastergiou 2008), structured interviews with close- and open-ended questions (Kaino 2008) or discussion groups (Downes and Looker 2011).

The years of the publication of the studies ranged from 2008 to 2015. Five of the nine studies are from 2008 (Baloğlu and Çevik 2008; Fančovičová and Prokop 2008; Kaino 2008; Papastergiou 2008; Teo 2008), one study is from 2010 (Vekiri 2010), two of them are from 2011 (Downes and Looker 2011; Kubiatko et al. 2011), and one study is from 2015 (Christoph et al. 2015).

The countries where interventions were assessed were: Australia (Downes and Looker 2011), Botswana (Kaino 2008), Germany (Christoph et al. 2015), Greece (two studies: Papastergiou 2008; Vekiri 2010), Singapore (Teo 2008), Slovakia (two studies: Fančovičová and Prokop 2008; Kubiatko et al. 2011) and Turkey (Baloğlu and Çevik 2008).

The descriptors for each study are shown in Table 1.

Tools to measure outcomes consisted of questionnaires, which varied from those developed specifically for the study to standardized or validated scales widely used, with or without modifications. Standard scales used were: Computer Attitude Scale (CAS) (Baloğlu and Çevik 2008), Attitudes Toward ICT Questionnaire (ATICTQ) (Fančovičová and Prokop 2008) and Computer Attitude Questionnaire (CAQ) (Kubiatko et al. 2011; Teo 2008). The remaining five studies applied ad hoc questionnaires without indications on how where they developed or whether they were validated or not.

The number of schools included in the studies varied from 4 (Christoph et al. 2015; Fančovičová and Prokop 2008) to 14 (Kubiatko et al. 2011). Schools selection was randomised only in one study (Papastergiou 2008). In the rest of studies, selection was purposive considering all schools in a given geographical area (Downes and Looker 2011), or according to certain schools features albeit these were not further detailed (Kubiatko et al. 2011; Vekiri 2010); or more often, the selection process was not reported (Baloğlu and Çevik 2008; Christoph et al. 2015; Fančovičová and Prokop 2008; Kaino 2008; Teo 2008).

It is relevant that the type of participating schools according to their funding source was only reported in one study being state schools (Papastergiou 2008). In two studies, it was stated that the education administration collaborated with the researchers, either providing data (Downes and Looker 2011) or as being part of the study (Christoph et al. 2015).

The number of students enrolled in the studies varied from 72 (Kaino 2008) to 722 (Downes and Looker 2011). The selection of students within schools was randomised in one study (Kaino 2008), in three studies (Christoph et al. 2015; Downes and Looker 2011; Papastergiou 2008) all students in selected schools were included and in another study students participated on a voluntary basis (Teo 2008).

The age range of students participating in the studies was 10 to 19 years old. All students attended secondary schools, including both compulsory and post-compulsory education. Education levels had different age ranges, depending on the country.

Interventions are related to the intensive use of computers in classrooms in all school subjects. This means that students use computers as a frequent tool for learning and creating digital content. However, all authors stated that the actual use of computers in most of the schools was much lower than what is suggested in education policies.

Studies do not differentiate between schools running one-to-one models and schools where computers are used in the IT or other classrooms. The intensity in the use of computers varied across the included studies. This variation mimics real-life situations where these types of interventions may be applied differently across contexts, which increase the relevance of this review for concrete settings. We have taken into account this variability, where reported, in the interpretation of our findings.

None of the studies assessed interventions based on tablets or mobile phones.

Outcomes definitions differed among studies. For example, anxiety was defined slightly differently (Baloğlu and Çevik 2008; Kaino 2008; Kubiatko et al. 2011; Teo 2008) as we will detail when reporting the outcomes below.

All studies but Kubiatko et al. (2011) measured outcomes only once. In these authors' study, outcomes were separately measured in four levels in the same academic year in order to obtain age-specific estimates.

Some studies looked at the association between outcomes and certain factors, such as family factors (e.g. parental education, expectations in relation to the offspring), teachers (e.g. gender, expectations related to students), use of computers at home (e.g. ownership, frequency of use, types of use), expectations related to ICT (e.g. continuity in the studies, professional projection, interest in ICT subjects, knowledge about professions), ability in the use of computers (e.g. basic digital skills, advance IT knowledge) or factors related to the influence of the use of computers in the learning processes.

3.2 Methodological quality of studies

The methodological quality of the studies has been assessed using the checklist of the Critical Appraisal Skills Programme (CASP), adapted to the study designs included in this review.

Quality criteria were applied (in brackets, number of studies which successfully rated in each criteria): studies addressed a clearly focused issue (7), participants were recruited in an acceptable way (2), outcomes were accurately measured to minimise bias (4), authors identified important confounding factors (4), authors had taken into confounding factors in the design and/or analyses (4), follow up of subjects was complete enough (4), results were consistent with the objectives (7), results were precise (6), results were considered as reliable (6), results seemed applicable to several contexts (1), results fitted with other available evidence (6), and results provided robust evidence for recommendations to policy and practice (7). Additional criteria included specifying that consent had been requested to subjects (1), sample sizes calculations (0) and analytical methods description and appropriateness (6). It is worthwhile noting that none of the studies indicated how the sample size was estimated and that in only two studies the selection of participants was at random.

Compliance with the quality criteria by study is shown in Table 2. Interestingly, five of the nine studies complied with less than half criteria, and the best quality studies did not reach three quarters of the criteria.

3.3 Outcome computer anxiety

The definitions of anxiety varied between studies. Baloğlu and Çevik (2008) established three components related to Computer Anxiety: Affective Anxiety, referring to negative

Table 2 Results of the quality of studies included in the review

CASP items (CASP Cohort Study Checklist)	Baloğlu and Çevik (2008)	Christoph et al. (2015)	Downes and Looker (2011)	Fančovičová and Prokop (2008)	Kaino (2008)	Kubiatko et al. (2011)	Papastergiou (2008)	Teo (2008)	Vekiri (2010)
The study addressed a clearly focused issue	Y	Y	Y	Unclear	Y	Y	Y	Y	Unclear
The cohort was recruited in an acceptable way	Unclear	Unclear	Unclear	Unclear	Y	Unclear	Y	N	N
The outcome was accurately measured to minimise bias	Y	Y	Unclear	N	N	Y	Y	Unclear	N
The authors have identified all important confounding factors	Y	Y	Y	N	N	Y	Unclear	N	Unclear
The authors have taken account of the confounding factors in the design and/or analysis	Y	Y	Y	N	N	Y	Unclear	N	Unclear
The follow up of subjects was complete enough	Y	Unclear	Unclear	Unclear	Unclear	Y	Y	Y	Unclear
The follow up of subjects was long enough	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear	Unclear
The results are consistent with the objectives	Y	Y	Y	Unclear	Y	Y	Y	Y	Unclear
The results are precise (CI/SD/SE)	Y	Y	N	Y	N	N	Y	Y	Y
Do you believe the results?	Y	Y	Y	Unclear	Unclear	Y	Y	Unclear	Y
The results can be applied to several contexts	N	N	N	N	N	N	N	N	Y
The results of this study fit with other available evidence	Y	Y	Y	N	Unclear	Y	Y	N	Y
Are there implications for practice or policy?	N	N	Y	Y	Y	Y	Y	Y	Y
Additional criteria									
Consent of subjects	Y	N	N	N	N	N	N	N	N
Sample size estimate reported	N	N	N	N	N	N	N	N	N
Analytical methods described and appropriate	Y	Y	Unclear	Unclear	Unclear	Y	Y	Y	Y
Summary									
Y	73%	60%	47%	13%	27%	67%	67%	40%	40%
Unclear	7%	13%	27%	40%	27%	7%	13%	13%	33%
N	20%	27%	27%	47%	47%	27%	20%	47%	27%

emotions toward computers, Damaging Anxiety, referring to the fear of damaging computers and/or to the work being done on computers, and Learning Anxiety, referring to the fear of learning computers or computer applications. In the study of Kaino (2008), anxiety is the state of comfort or confusion related to computers use, whereas Kubiatko et al. (2011) defined anxiety as the fear in the use of computers. Finally, in Teo (2008) anxiety is defined as the lack of confidence in the use of computers.

Baloğlu and Çevik (2008) suggested that girls showed more anxiety than boys in all components of anxiety. The difference between boys and girls was higher in Learning Anxiety (low means mean low anxiety and vice versa) (boys: 10.39, SD 3.03; girls: 11.06, SD 3.20) and lower in Affective Anxiety (boys: 17.22, SD 4.63; girls: 18.48, SD 6.20).

Kaino (2008) differentiated between students' concerns in computer learning and students' anxiety in computers use, similarly to the Learning Anxiety and Affective Anxiety found in Baloğlu and Çevik (2008), respectively. The findings were similar: in Kaino (2008), the largest difference between boys and girls was found in Learning Anxiety (higher percentages meaning lower anxiety) (boys: 61%; girls: 33%) and to a lesser extent in Affective Anxiety (boys: 76%; girls: 50%).

Similarly, Kubiatko et al. (2011) suggested differences in mean anxiety between boys and girls (high values mean low anxiety) (boys: 3.93 and girls: 3.61).

In Teo's study (2008) there was no significant difference in mean anxiety between genders (higher values meaning lower anxiety) (boys: 3.93; girls: 3.61), despite that the mean for girls was lower than the one for boys. The study suggested that increasing access to computers owned by students could explain the relative similarities in anxiety between genders.

Some authors have reported factors decreasing anxiety, such as ownership of computer (Baloğlu and Çevik 2008; Teo 2008); high frequency of use of computers (Baloğlu and Çevik 2008; Kaino 2008); younger age of students (Kubiatko et al. 2011); and collaborative learning methodologies (Kaino 2008). Only Baloğlu and Çevik (2008) reported data disaggregated by gender (see Table 3) suggesting that anxiety decreased when taking into account ownership of computers and frequency of use, particularly in girls and for Affective Anxiety.

In summary, most of the evidence suggests that gender differences in anxiety seem to be reduced by the intensive use of computers (high risk of bias).

3.4 Outcome computer enjoyment

Fančovičová and Prokop (2008) reported on attitudes related to ICT measured with the ATICTQ scale, which has three dimensions: behavioural, cognitive and affective. The study showed no gender differences in the mean of the affective dimension that is equivalent to the term of enjoyment.

Kaino (2008) suggested that boys and girls showed similar levels of enjoyment in the use of computers (boys: 86%; girls: 84%) and in their views on the utility of computers in several situations (e.g. job seeking, access to information).

Findings in Teo (2008), reported as mean enjoyment, were similar to those of Kaino (2008): (boys: 3.74, SD 0.69; girls: 3.58, SD 0.66).

Kubiatko et al. (2011) showed somehow different findings suggesting that enjoyment in the use of computers among girls was higher than among boys (boys: 3.95;

Table 3 Findings of the review by type of outcome and study, disaggregated by gender

Outcomes	Authors	Dimensions	Type of estimate	Boys	SD	Girls	SD
Computer anxiety	Baloğlu and Çevik (2008)	Affective Anxiety[1]	Mean	17.22[3]	4.63	18.48[3]	6.20
		Damaging Anxiety		13.11[3]	4.17	15.23[3]	5.76
		Learning Anxiety[2]		10.39[3]	3.03	11.06[3]	3.20
	Kaino (2008)	Student's anxiety in using computers[1]	Percentage	76[4]	NA	50[4]	NA
		Students' worries in learning using computers[2]		61[4]	NA	33[4]	NA
	Kubiatko et al. (2011)	Computer anxiety	Mean	3.93[4]	NA	3.61[4]	NA
	Teo (2008)	Computer anxiety	Mean	4.00[4]	0.79	3.65[4]	0.77
	[1,2]Analogue outcomes [3]Low value means low anxiety [4]High value means low anxiety						
Computer enjoyment	Fančovičová and Prokop (2008)	Behavioural	Mean	35.3	0.49	33.15	0.47
		Cognitive		NA	NA	NA	NA
		Affective[5]		NA	NA	NA	NA
	Kaino (2008)	Enjoyment[6]	Percentage	86	NA	84	NA
	Teo (2008)	Enjoyment[6]	Mean	3.74	0.69	3.58	0.66
	Kubiatko et al. (2011)	Enjoyment[6]	Mean	3.95	NA	4.20	NA
	[5,6]Analogue outcomes						
Computer self-confidence	Christoph et al. (2015)	Computer self-concept vs. computer interest	Regression coefficients	0.62		0.35	
		Computer self-concept vs. ICT related social engagement		0.57		0.36	
		Computer self-concept vs. basic computer skills		0.32		0.29	
		Computer self-concept vs. computer knowledge		0.53		0.33	
Computer self-efficacy	Downes and Looker (2011)	Self-ability: disagree	Percentage	19	NA	31	NA
		Self-ability: neutral		38	NA	43	NA
		Self-ability: agree		44	NA	26	NA
	Papastergiou (2008)	Computer self-efficacy		NA	NA	NA	NA
	Vekiri (2010)	Computer self-efficacy	Mean	5.23	1.29	5.02	1.08
		Female teachers		4.82	1.22	4.82	0.74
		Male teachers		5.36	1.22	4.51	1.08

girls: 4.20) was the only study reporting factors that may influence enjoyment (e.g. age of students), but not disaggregated by gender.

In summary, there is no conclusive evidence supporting any effect of intensive use of computers on computer enjoyment (high risk of bias).

3.5 Outcome computer self-confidence

Christoph et al. (2015) addressed the issue of computer self-concept, which is equivalent to self-confidence to the extent that it involves the self-perceptions of one's own skills in the use of ICT tools. Findings suggested that boys perceived themselves as being more skilful in the use of computers than girls. In addition, regression analyses showed that among boys there was a direct association between self-confidence levels, their basic ICT knowledge and their strong interest in ICT.

Authors suggested that the more intense the use of computers, the higher levels of self-concept, which may be due to the fact that increasing basic ICT knowledge improves the perceptions of skilfulness in the use of computers.

There is some evidence (only one study with high risk of bias) that the intensive use of computers may reduce self-confidence gender differentials.

3.6 Outcome computer self-efficacy

The study of Downes and Looker (2011) estimates self-ability levels, which is equivalent to self-efficacy, measuring the participants' self-perception when carrying out certain activities with computers. The study reported that boys showed higher self-efficacy in school tasks than girls (boys: 44%; girls: 26%). Answers obtained from group discussions were consistent with these findings.

Papastergiou (2008) showed findings somehow similar to those of Downes and Looker (2011): the author reported that self-efficacy among girls was lower than among boys (boys: 37.11, SD 6.64; girls: 32.35, SD 6.61) and she established a positive relation between high scores of self-efficacy and the intention to continue with ICT superior studies.

Vekiri (2010) did not show gender differences in mean self-efficacy levels (boys: 5.23, SD 1.29; girls: 5.02, SD 1.08).

Some authors have reported on factors increasing self-efficacy levels, such as: teachers' roles (Papastergiou 2008; Vekiri 2010); parental support (Vekiri 2010), frequency of use of computers (Downes and Looker 2011; Papastergiou 2008; Vekiri 2010); and specific methodologies (Vekiri 2010). Only Papastergiou (2008) reported gender disaggregated data (see Table 3). In relation to teachers', the author reported that girls having a female teacher showed lower differences on self-efficacy level compared to boys than in classrooms with male teachers. The author concluded that girls were more strongly influenced by teachers' expectations than boys (see Table 3).

Vekiri (2010) reported data related to seven teachers (four females and three males) and reported gender disaggregated self-efficacy levels. Although data are not conclusive, they suggest similar trends than those of Papastergiou (2008): schools have to be a reference for the girls in ICT matters, in order to improve their self-efficacy level through female teachers' models.

Downes and Looker (2011) established correlations between self-efficacy and the intention of students to enrol in ICT studies in the future, but not disaggregated by gender. Findings suggested that students with a high level of self-perceived computer ability were more likely to consider pursuing an ICT career.

There is some evidence (high risk of bias) that the intensive use of computers may reduce self-efficacy gender differentials.

4 Discussion

We have reviewed all available evidence on the effects of the intensive use of computers in schools on students' attitudinal outcomes. We have found only nine studies, none of them experimental and any with optimal methodological quality. The reasons why the methodological quality of studies was generally low is due to the fact that most of the studies were observational, without controls, which limits their capacity to produce unbiased effects estimates.

We acknowledge that complex interventions in the educational sector pose methodological challenges to implement experimental or quasi-experimental study designs, which are appropriate to estimate the effects of interventions. However, there are examples of robust evaluations that suggest that this is possible. We encourage the use of robust designs to evaluate the effects of interventions to better inform policy and practice. Future research should focus on good quality study designs, including comparators and random allocation of study subjects.

Studies suggested that intensive use of computers might reduce gender differences in some outcomes and not in others. As in any intervention, contextual and implementation issues may play a role in the observed effects. Often, these issues are hardly reported. However, we extracted all available data on factors, which might explain the effects or lack of effects (see Table 4). The findings in this review have to be interpreted with caution given the high risk of bias of included studies.

All studies suggested higher anxiety levels on using computers in girls than in boys. These findings are consistent with other studies (Chen 1986; Durndell and Haag 2002; Shashaani 1993). But did studies suggest reasons for gender differences? Included studies provide limited evidence to ascertain whether gender differences in anxiety are related to the interventions, such as the frequency of use (Baloğlu and Çevik 2008; Kaino 2008) or to other factors, such as age (Kubiatko et al. 2011) and ownership of computers (Baloğlu and Çevik 2008; Teo 2008). It seems also reasonable to assume the interventions aiming at increasing the frequency of use may reduce anxiety (Kaino 2008; Baloğlu and Çevik 2008) especially if combined with other measures, which reinforce student's self-confidence in the use of computers. However, the evidence supporting this is weak and inconclusive.

It is worth noting that the definition of anxiety it's not standardized across the studies. Some authors have even defined sub-categories (Baloğlu and Çevik 2008; Kaino 2008). The differences on the meaning of the term of anxiety may be related to the instruments used to measure it in each study. It is paramount to agree on standardized methods for measuring anxiety that would allow a meaningful comparison between studies and meta-analyses of effects estimates.

Table 4 Factors influencing outcomes; bold authors reporting effects

	Anxiety	Enjoyment	Self-confidence	Self-efficacy
Parental support and education				**Vekiri (2010)** Downes and Looker (2011) Papastergiou (2008)
Teacher roles				**Vekiri (2010)** **Papastergiou (2008)**
Ownership	**Teo (2008)** **Baloğlu and Çevik (2008)**			Downes and Looker (2011)
Frequency of use	**Baloğlu and Çevik (2008)** **Kaino (2008)**			**Downes and Looker (2011)** **Papastergiou (2008)**
Age	**Kubiatko et al. (2011)**	**Kubiatko et al. (2011)**		
Expectations related to ICT			**Christoph et al. (2015)**	**Papastergiou (2008)** **Downes and Looker (2011)**
Types of learning	**Kaino (2008)**			**Vekiri (2010)**

No gender differences were reported in two of the three studies reporting the outcome 'enjoyment' (Kaino 2008; Teo 2008); and a third study (Kubiatko et al. 2011) suggests that girls have a larger enjoyment level tan boys, especially at younger ages.

Self-confidence was even lesser reported with only one study (Christoph et al. 2015) which suggested that boys were more self-confident than girls, consistently with other findings as well (Chen 1986; Shashaani 1993). These authors reported effects of frequency of use and positive perceptions on ICT professions on increasing self-confidence levels in both genders.

Self-efficacy seemed to be lower among girls, as already suggested by others (Durndell and Haag 2002; Miura 1987). Again, some evidence suggests that another factors as frequent use of computers, parental support and teachers' roles may increase self-efficacy (Downes and Looker 2011; Papastergiou 2008; Vekiri 2010).

Anxiety and self-efficacy are the most reported outcomes and they are directly linked with the interest on pursuing an ICT career (Baloğlu and Çevik 2008; Downes and Looker 2011; Papastergiou 2008). The reported effects were mild and subject to high risk of bias. However, this evidence is neither strong enough to advice against the intensive use of computers in schools. We believe that intensive use of computers in schools, besides having some effects on attitudinal gender differences, might have other advantages, such as ensuring access to ICT technologies, especially for those children who have hardly any access to computers outside the school settings. Implementations issues cannot be neglected either and use of computers should be reinforced by appropriate teaching methodologies.

What methodologies do influence gender differences and to what extent? Interventions to reduce gender differences in the use of computers are complex in nature (Sáinz and López-Sáez 2010). It has been widely recognised that what happens during school years and particularly in schools, greatly determines the professional orientation of students (Papastergiou 2008) and ultimately the development of societies. Schools are a rich environment where all sorts of inputs are targeted towards students. Therefore, interventions promoting the use of computers never go alone and have to be embedded in this complexity, which may boost or minimise their potential effects.

Only two studies in our review did actually look at the influence of educational methods into the gender differentials in the use of ICT (Kaino 2008; Vekiri 2010) suggesting that student-centred learning and a social constructivist perspective in the collaborative work may help in reducing anxiety among girls.

The role of teachers may also influence the effects of interventions. For example, activities that girls perceive as useful favour the reduction of anxiety levels (Kaino 2008) and students in classrooms where teachers set up ICT activities which are really meaningful to them, show higher self-efficacy, consistently with other studies looking at teachers' roles (Volman and van Eck 2001). Teachers also act as role models (Papastergiou 2008; Vekiri 2010), which may influence gender differences in the use of ICT. Papastergiou (2008) also suggested strengthening the use of computers by increasing the number of female teachers specialised in ICT in schools, so as to become role models for the girls and revert the stereotyped perception of both genders.

What are the implications for policy and practice? In 2007 the European Union issued an educational policy to promote the use of computers among secondary students called 'eLearning Programme' (European Commission 2007). This policy explicitly suggested the potential effects of computers use in gender differentials on attitudes towards ICT and professional choices. However, we could not find any study specifically assessing the effects over reducing gender differences of this kind of intervention. This suggests that one-to-one strategies were implemented without a strong body of evidence supporting them.

Strikingly, none of the included studies addressed implementation issues such as procurement, time consumption or resources consumption, factors which may jeopardise the implementation of computer use interventions and which would have been very valuable to inform decision makers considering this type of interventions.

It is also important to note that, although it has been indicated that seven of the studies provide robust evidence to recommend implications for policy or practice, the fact is that observational studies are prone to bias and therefore can hardly provided robust enough evidence.

Our review had several limitations. First of all, studies were scrutinised for inclusion by a single reviewer due to resources constraints. However, to reduce the chances of excluding relevant studies, we maximised sensitivity in the application of the criteria and discussed doubtful studies with a senior research fellow reaching agreement by consensus.

We limited the search to the last 10 years. This was justified on the grounds of the level of implementation of computers in schools and on IT developments in recent years, which made computers widely available in school settings. We believe that previous evidence, if available, would be scanty and less relevant to the interventions currently being considered and to be developed in the future.

We cannot rule out publication bias, although we have made all efforts to widen the literature database searched and the sensitivity of the search strategies. However, it does not seem likely to us that robust experimental studies, which we did not find, could be found in other literature sources.

5 Conclusions

The intensive use of computers in schools is a global tendency in the educational sector and elsewhere. Its potential effects on computer literacy in general but also on reducing gender differences and empowering women to access ICT jobs on equal grounds as men cannot be overemphasised. Educational policies have the challenge to be responsive to these facts and need to be based on the best available evidence.

In relation to the first research question, our systematic review highlights the very limited and low quality evidence on the effects of intensive use of computers in schools on gender differences in attitudinal outcomes and reinforces the need to carry out more robust evaluations of existing and future interventions. It was striking the absence of comparative studies measuring these effects, which would allow more robust estimates of the effects of interventions and better-informed policies. Furthermore, evidence on implementation issues, context and resource consumption for families and governments was largely missing. These issues have been described as influencers of boys and girls attitudes (Cussó-Calabuig et al. 2017) and are equally important in formulating policies, which have to be rooted in specific budget constraints and socio-economic and cultural contexts.

This lack of evidence-informed decisions is consistent with the repeatedly confirmed lack of ICT professional women in many settings and the continued decline in the number of girls who choose ICT related studies, as shown by statistics from the OECD; not to mention, the consequences for the social and economical development of gender-equitable societies increasingly based on ICT.

As four our second research question, the relative lack of evidence on factors that may contribute to the reduction of gender differences was also striking. Specifically, we could not find data on the influence of the methodologies used by teachers to accompany the use of computers. This evidence is paramount to establish which are the most appropriate pedagogical and organisational arrangements to favour the reduction of gender gaps and increase girls' engagement on ICT.

Robust research on interventions to reduce gender differences related to ICT has to be actively promoted and adequately funded. Decision makers, responsive to societal needs, are required to demand good quality evidence to guide the implementation of ICT policies in the educational community and to evaluate the effects of this

implementation on the improvement of students' assessments, digital literacy and gender equality measures on attitudes and professional choices.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix 1

Table 5 Search results

Database	Search terms	Keywords	Search result	Duplicated	First review	Second review
TESEO (TESEOnnn)	ordenador género		5			
ACM Digital Library (ACMnnn)	(computer or ICT) and gender and (attitude or self-efficacy or anxiety) and education and (secondary or high school)	women student education computer	78		3	
DART-Europe (DARTnnn)	(computer or ICT) and gender and (attitude or self-efficacy or anxiety) and education and (secondary or high school)		3			
ERIC (ERICnnn)	(computer or ICT) and gender and (attitude or self-efficacy or anxiety) and education and (secondary or high school)		380		21	5
Taylor and Francis (TAYnnn)	computer Keyword: education		10		3	
SAGE (SAGEnnn)	(computer use or ICT) and (attitude or self-efficacy) and (secondary or high school) and gender		17		1	1
Science Direct (SDnnn)	(computer or ICT) and gender and (attitude or self-efficacy or anxiety) and education and (secondary or high school)	women student education computer	247		31	3
TOTAL			740	40	59	9

Appendix 2: Studies not included after first review

Table 6 Studies not included and causes of exclusion

Authors	Country	Cause of no inclusion
Abbiss, J. (2011). Boys and machines: gendered computer identities, regulation and resistance. *Gender and Education*, *23*(5), 601–617.	New Zealand	No quantitative
Abbiss, J. (2008). Rethinking the "problem" of gender and IT schooling: discourses in literature. *Gender and Education*, *20*(2), 153–165.	New Zealand	No quantitative
Anderson, N., Lankshear, C., Timms, C., & Courtney, L. (2008). 'Because it's boring, irrelevant and I don t like computers': Why high school girls avoid professionally-oriented ICT subjects. *Computers and Education*, *50*(4), 1304–1318.	Australia	Only girls
Arigbabu, A. A. (2009). Examining psychometric characteristics of the computer anxiety scale. *Computers in Human Behavior*, *25*(1), 229–232.	Nigeria	Teachers
Asil, M., Teo, T. & Noyes, J. (2014). Validation and measurement invariance of the computer attitude measure for young students (CAMYS). *Journal of Educational Computing Research*, *51*(1), 49–69.	Singapore	Primary
Ballantine, J. A., McCourt Larres, P., & Oyelere, P. (2007). Computer usage and the validity of self-assessed computer competence among first-year business students. *Computers and Education*, *49*(4), 976–990.	New Zealand	University
Barron, B., Walter, S. E., Martin, C. K., & Schatz, C. (2010). Predictors of creative computing participation and profiles of experience in two Silicon Valley middle schools. *Computers and Education*, *54*(1), 178–189.	USA	No gender
Beyer, S. (2014). Why are women underrepresented in Computer Science? Gender differences in stereotypes, self-efficacy, values, and interests and predictors of future CS course-taking and grades. *Computer Science Education*, *24*(2–3), 153–192.	USA	University
Cázares, A. (2010). Proficiency and attitudes toward information technologies use in psychology undergraduates. *Computers in Human Behavior*, *26*(5), 1004–1008.	Mexico	University
Ertl, B., & Helling, K. (2011). Promoting gender equality in digital literacy. *Journal of Educational Computing Research*, *45*(4), 477–503.	Germany	No quantitative
Galpin, V. C., & Sanders, I. D. (2007). Perceptions of computer science at a South African university. *Computers and Education*, *49*(4), 1330–1356.	South Africa	University
Gansmo, H. J. (2009). Fun for all = digital competence for all? *Learning, Media, & Technology*, *34*(4), 351–355.	Norway	No quantitative

Table 6 (continued)

Authors	Country	Cause of no inclusion
Garland, K. J., & Noyes, J. M. (2008). Computer attitude scales: How relevant today? *Computers in Human Behavior*, *24*(2), 563–575.	UK	Scale validation
Gaudreau, P., Miranda, D., & Gareau, A. (2014). Canadian university students in wireless classrooms: What do they do on their laptops and does it really matter? *Computers and Education*, *70*, 245–255.	Canada	University
Gibson, P. A., Stringer, K., Cotten, S. R., Simoni, Z., O Neal, L. J., & Howell-Moroney, M. (2014). Changing teachers, changing students? the impact of a teacher-focused intervention on students computer usage, attitudes, and anxiety. *Computers and Education*, *71*, 165–174.	USA	No gender
Gokhale, A. A., Brauchle, P. E., & Machina, K. F. (2013). Scale to measure attitudes toward information technology. *International Journal of Information and Communication Technology Education*, *9*(3), 13–26.	USA	Scale validation
Hou, W., Kaur, M., Komlodi, A., Lutters, W. G., Boot, L., Cotten, S. R., ... & Tufekci, Z. (2006). Girls don't waste time. *CHI '06 extended abstracts on Human factors in computing systems - CHI EA '06* (p. 875).	Canada	No quantitative
Imhof, M., Vollmeyer, R., & Beierlein, C. (2007). Computer use and the gender gap: The issue of access, use, motivation, and performance. *Computers in Human Behavior*, *23*(6), 2823–2837.	Germany	Adults
Jara, I., Claro, M., Hinostroza, J. E., San Martín, E., Rodríguez, P., Cabello, T., Ibieta, A., & Labbé, C. (2015). Understanding factors related to chilean students Digital Skills: A Mixed Methods Analysis. *Computers and Education*, *88*, 387–398.	Chile	No gender
Koch, S. C., Müller, S. M., & Sieverding, M. (2008). Women and computers. Effects of stereotype threat on attribution of failure. *Computers and Education*, *51*(4), 1795–1803.	Germany	No intensive use of computers
Korobili, S., Togia, A., & Malliari, A. (2010). Computer anxiety and attitudes among undergraduate students in Greece. *Computers in Human Behavior*, *26*(3), 399–405.	Greece	University
Maricutoiu, L. P. (2014). A meta-analysis on the antecedents and consequences of computer anxiety. *Procedia - Social and Behavioral Sciences*, *127*, 311–315.	Romania	No gender
McLachlan, C., Craig, A., & Coldwell, J. (2010). Student perceptions of ICT: A gendered analysis. *Conferences in Research and Practice in Information Technology Series*, *103*, 127–136.	Australia	Older than 18
Meelissen, M. R. M., & Drent, M. (2008). Gender differences in computer attitudes: Does the school	Netherlands	Primary

Table 6 (continued)

Authors	Country	Cause of no inclusion
matter? *Computers in Human Behavior*, *24*(3), 969–985.		
Morris, S. A., Gullekson, N. L., Morse, B. J., & Popovich, P. M. (2009). Updating the attitudes toward computer usage scale using American undergraduate students. *Computers in Human Behavior*, *25*(2), 535–543.	USA	University
Papastergiou, M. (2010). Enhancing physical education and sport science students self-efficacy and attitudes regarding information and communication technologies through a computer literacy course. *Computers and Education*, *54*(1), 298–308.	Greece	University
Pau, R., Hall, W., & Grace, M. (2011). 'It 's boring': female students' experience of studying ICT and computing. *School Science Review*, *92*(341), 89–94.	UK	University
Popovich, P. M., Gullekson, N., Morris, S., & Morse, B. (2008). Comparing attitudes towards computer usage by undergraduates from 1986 to 2005. *Computers in Human Behavior*, *24*(3), 986–992.	USA	University
Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior*.	USA	Scale validation
Poynton, T. A. (2005). Computer literacy across the lifespan: a review with implications for educators. *Computers in Human Behavior*.	USA	No quantitative
Purvanova, R. K., & Muros, J. P. (2010). Gender differences in burnout: a meta-analysis. *Journal of Vocational Behavior*, *77*(2), 168–185.	USA	Older than 18
Rosson, M. B., Carroll, J. M., & Sinha, H. (2011). Orientation of undergraduates toward careers in the computer and information sciences. *ACM Transactions on Computing Education*, *11*(3), 1–23.	USA	University
Sáinz, M., & López-Sánchez, M. (2010). Gender differences in computer attitudes and the choice of technology-related occupations in a sample of secondary students in Spain. *Computers and Education*, *54*(2), 578–587.	Spain	Not expected outcomes
Sáinz, M., & Eccles, J. (2012). Self-concept of computer and math ability: gender implications across time and within ICT studies. *Journal of Vocational Behavior*, *80*(2), 486–499.	Spain	No intensive use of computers
Schroeders, U., & Wilhelm, O. (2011). Computer usage questionnaire: structure, correlates, and gender differences. *Computers in Human Behavior*, *27*(2), 899–904.	Germany	Not expected outcomes
Shank, D. B., & Cotten, S. R. (2014). Does technology empower urban youth? The relationship of technology use to self-efficacy. *Computers and Education*, *70*, 184–193.	USA	Older than 18

Table 6 (continued)

Authors	Country	Cause of no inclusion
Sieverding, M., & Koch, S. C. (2009). (Self-)Evaluation of computer competence: How gender matters. *Computers and Education*, *52*(3), 696–701.	Germany	University
Simsek, A. (2011). The relationship between computer anxiety and computer self-efficacy. *Contemporary Educational Technology*, *2*(3), 177–187.	Turkey	Teachers
Spanos, D., & Sofos, A. (2015). The views and attitudes of students participating in a one-to-one laptop initiative in Greece. *Education and Information Technologies*, *20*(3), 519–535.	Greece	One school
Tang, T. L. P., & Austin, M. J. (2009). Students perceptions of teaching technologies, application of technologies, and academic performance. *Computers and Education*, *53*(4), 1241–1255.	USA	University
Teo, T. (2006). Attitudes toward computers: A study of post-secondary students in Singapore. *Interactive Learning Environments*, *14*(1), 17–24.	Singapore	One school
Teo, T., & Noyes, J. (2008). Development and validation of a computer attitude measure for young students (CAMYS). *Computers in Human Behavior*, *24*(6), 2659–2667	Singapore	Scale validation
Tømte, C., & Hatlevik, O. E. (2011). Gender-differences in self-efficacy ICT related to various ICT-user profiles in Finland and Norway. How do self-efficacy, gender and ICT-user profiles relate to findings from PISA 2006. *Computers and Education*, *57*(1), 1416–1424.	Norway	No quantitative
Tuncer, M., Doğan, Y., & Tanaş, R. (2013). Investigation of vocational high-school students computer anxiety. *Turkish Online Journal of Educational Technology*, *12*(4), 90–95.	Turkey	One school
Varank, I. (2007). Effectiveness of quantitative skills, qualitative skills, and gender in determining computer skills and attitudes: a causal analysis. *The Clearing House*, *81*(2), 71–80.	Turkey	University
Varma, R. (2009). Gender differences in factors influencing students towards computing. *Computer Science Education*, *19*(1), 37–49.	USA	University
Vekiri, I., & Chronaki, A. (2008). Gender issues in technology use: perceived social support, computer self-efficacy and value beliefs, and computer use beyond school. *Computers and Education*, *51*(3), 1392–1404	Greece	Primary
Verhoeven, J. C., Heerwegh, D., & De Wit, K. (2010). Information and communication technologies in the life of university freshmen: An analysis of change. *Computers and Education*, *55*(1), 53–66.	Belgium	University
Von Hellens L., Clayton K., Beekhuyzen J., & Nielsen, S. (2009). Perceptions of ICT careers in german	Germany	Not expected outcomes

Table 6 (continued)

Authors	Country	Cause of no inclusion
schools: an exploratory study. *Journal of Information Technology Education*, *8*, 211–228.		
Wade, M. (2010). *Laptops and the gender gap: An investigation of a high school core curriculum program. Dissertation Abstracts International*. ProQuest Information & Learning; US.	USA	One school

Appendix 3

Table 7 Studies included in the review

Authors	Title
Baloğlu M. and Çevik. V (2008)	Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students,
Christoph G., Goldhammer F., Zylka J. and Hartig J. (2015)	Adolescents' computer performance: The role of self-concept and motivational aspects
Downes T. and Looker D. (2011)	Factors that Influence Students' Plans to Take Computing and Information Technology Subjects in Senior Secondary School
Fančovičová J. and Prokop P. (2008)	Students' Attitudes toward Computer Use in Slovakia
Kaino L.M. (2008)	Technology in Learning: Narrowing the Gender Gap?
Kubiatko et al. (2011)	Slovak high school students' attitudes toward computers
Papastergiou M. (2008)	Are Computer Science and Information Technology Still Masculine Fields? High School Students' Perceptions and Career Choices
Teo T. (2008)	Assessing the computer attitudes of students: An Asian perspective
Vekiri I. (2010)	Boys' and Girls' ICT Beliefs: Do Teachers Matter?

References

Adebowale, O., Adediwura, A., Bada, T. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research, 3*(2), 20–30.

Baloğlu, M., & Çevik, V. (2008). Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students. *Computers in Human Behavior, 24*(6), 2639–2648. https://doi.org/10.1016/j.chb.2008.03.003.

Bebell, D., & Kay, R. (2010). One to one computing: A summary of the quantitative results from the Berkshire wireless learning initiative. *Journal of Technology, Learning, and Assessment, 9*(2).

Blignaut, P. (2006). Standardised instruments for measuring computer attitude and computer anxiety are not necessarily standardised. *ECIS 2006 Proceedings, 58*. Retrieved from http://aisel.aisnet.org/ecis2006/58

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research, 12*(2), 147–158. https://doi.org/10.2190/H7E1-XMM7-GU9B-3HWR.

Carrington, B., Tymms, P., & Merrell, C. (2008). Role models, school improvement and the gender gap – do men bring out the best in boys and women the best in girls? *British Educational Research Journal, 34*(3), 315–327. https://doi.org/10.1080/01411920701532202.

Castaño, C., & Webster, J. (2011). Understanding Women's presence in ICT: the life course perspective. *International Journal of Gender, Science and Technology, 3*(2), 364–386 Retrieved from http://genderandset.open.ac.uk/index.php/genderandset/article/view/168.

Chen, M. (1986). Gender and computers: the beneficial effects of experience on attitudes. *Journal of Educational Computing Research, 2*, 265–282. https://doi.org/10.2190/WDRY-9K0F-VCP6-JCCD.

Cheryan, S., Plaut, V. C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: gendered media representations as a barrier to inclusion for women. *Sex Roles, 69*, 58–71. https://doi.org/10.1007/s11199-013-0296-x.

Christoph, G., Goldhammer, F., Zylka, J., & Hartig, J. (2015). Adolescents computer performance: the role of self-concept and motivational aspects. *Computers in Education, 81*, 1–12. https://doi.org/10.1016/j.compedu.2014.09.004.

Clayton, K. L., von Hellens, L. A., & Nielsen, S. H. (2009). Gender stereotypes prevail in ICT: a research review. *Public Understanding of Science, 23*(2), 153–158. https://doi.org/10.1145/1542130.1542160.

Colley, A., & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed? *Educational Research, 45*(2), 155–165. https://doi.org/10.1080/0013188032000103235.

Critical Appraisal Skills Programme (CASP) (2017). Retrieved from http://www.casp-uk.net/#!casp-tools-checklists/c18f8.

Cussó-Calabuig, R., Carrera Farran, X., & Bosch-Capblanch, X. (2017). Are boys and girls still digitally differentiated? The case of Catalonian teenagers. *Journal of Information Technology Education: Research, 16*, 411–435. https://doi.org/10.28945/3879.

Delcourt, M. A. B., & Kinzie, M. B. (1993). Computer technologies in teacher education: the measurement of attitudes and self-efficacy. *Journal of Research and Development in Education, 27*(1), 35–41.

Downes, T., & Looker, D. (2011). Factors that influence students' plans to take computing and information technology subjects in senior secondary school. *Computer Science Education, 21*(2), 175–199. https://doi.org/10.1080/08993408.2011.579811.

Downey, J. P., & Kher, H. V. (2015). A longitudinal examination of the effects of computer self-efficacy growth on performance during technology training. *Journal of Information Technology Education: Research, 14*, 91–111. https://doi.org/10.28945/2114.

Durndell, A., & Haag, Z. (2002). Computer self efficacy, computer anxiety, attitudes towards the internet and reported experience with the internet, by gender, in an east european sample. *Computers in Human Behaviour, 18*, 521–535. https://doi.org/10.1016/S0747-5632(02)00006-7.

European Commission (2007). E-learning Programme. Retrieved from http://eacea.ec.europa.eu/static/en/elearning/index.htm.

Fančovičová, J., & Prokop, P. (2008). Students attitudes toward computer use in Slovakia. *Eurasia Journal of Mathematics Science & Technology Education, 4*(3), 255–262. https://doi.org/10.12973/ejmste/75347.

Fleischer, H. (2012). What is our current understanding of one-to-one computer projects: a systematic narrative research review. *Educational Research Review, 7*(2), 107–122. https://doi.org/10.1016/j.edurev.2011.11.004.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Students' use of and engagement with ICT at home and school. Preparing for life in a digital age: The IEA International Computer and Information Literacy Study International Report, 125–166. https://doi.org/10.1007/978-3-319-14222-7_6.

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers in Education, 22*(4), 283–289. https://doi.org/10.1016/0360-1315(94)90050-7.

Galpin, V. C., & Sanders, I. D. (2007). Perceptions of computer science at a South African university. *Computers in Education, 49*(4), 1330–1356. https://doi.org/10.1016/j.compedu.2006.02.008.

Gras-Velazquez, A., Joyce, A., & Debry, M. (2009). Why girls are still not attracted to ICT studies and careers. *European Schoolnet*.

Harper, B., & Milman, N. B. (2016). One-to-one technology in K–12 classrooms: a review of the literature from 2004 through 2014. *Journal of Research on Technology in Education, 48*(2), 129–142. https://doi.org/10.1080/15391523.2016.1146564.

Islam, M. S., & Grönlund, A. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change, 17*(2), 191–222. https://doi.org/10.1007/s10833-016-9271-y.

Kaino, L. M. (2008). Technology in learning: narrowing the gender gap? *Eurasia Journal of Mathematics, Science and Technology Education, 4*(3), 263–268. https://doi.org/10.12973/ejmste/75347.

Kay, R. H. (1993). A practical research tool for assessing ability to use computers: the computers ability survey (CAS). *Journal of Research on Computing in Education, 26*(1), 16–27. https://doi.org/10.1080/08886504.1993.10782074.

Klapwijk, R., & Rommes, E. (2009). Career orientation of secondary school students (m/f) in the Netherlands. *International Journal of Tecnology and Design Education, 19*, 403–418. https://doi.org/10.1007/s10798-009-9095-7.

Kubiatko, M. (2013). The comparison of different age groups on the attitudes toward and the use of ICT. *Educational Sciences: Theory and Practice, 13*(2), 1263–1272 Retrieved from http://files.eric.ed.gov/fulltext/EJ1017271.pdf.

Kubiatko, M., Haláková, Z., Nagyová, S., & Nagy, T. (2011). Slovak high school students' attitudes toward computers. *Interactive Learning Environments, 19*(5), 537–550. https://doi.org/10.1080/10494821003612232.

Loyd, B. H., & Gressard, C. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement, 44*(2), 501–505.

Marcoulides, G. A. (1988). The relationship between computer anxiety and computer achievement. *Journal of Educational Computing Research, 4*(2), 151–158. https://doi.org/10.2190/J5N4-24HK-567V-AT6E.

Master, A., Cheryan, S., & Meltzoff, A. N. (2016). Computing whether she belongs: Stereotypes undermine girls' interest and sense of belonging in computer science. *Journal of Educational Psychology, 108*, 424–437. https://doi.org/10.1037/edu0000061.

Miura, I. T. (1987). The relationship of self-efficacy expectations to computer interest and course enrollment in college. *Sex Roles, 16*, 303–311.

Moher, D., Liberati, A., Tetzla, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annuals of Internal Medicine, 151*(4), 264–269. https://doi.org/10.1371/journal.pmed.1000097.t002.

OECD (2015). The ABC of gender equality in education: Aptitude, behaviour, Confidence. PISA. *OECD Publishing*. https://doi.org/10.1787/9789264229945-en.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers in Education, 51*(2), 594–608. https://doi.org/10.1016/j.compedu.2007.06.009.

Pechtelidis, Y., Kosma, Y., & Chronaki, A. (2015). Between a rock and a hard place: women and computer technology. *Gender and Education, 27*(2), 164–182. https://doi.org/10.1080/09540253.2015.1008421.

Pelton, L., & Pelton, T. W. (1996). Building attitudes: How a technology course affects preservice teachers' attitudes about technology. In B. Robin, J. Price, J. Willis, & D. Willis (Eds.), *Proceedings of Society for Information Technology & Teacher Education International Conference 1996* (pp. 199–204). Chesapeake: Association for the Advancement of Computing in Education (AACE).

Penuel, W. R. (2006). Implementation and effects of 1:1 computing initiatives: a research synthesis. *Journal of Research on Technology in Education, 38*, 329–348. https://doi.org/10.1080/15391523.2006.10782463.

Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior, 29*(6), 2337–2381. https://doi.org/10.1016/j.chb.2013.05.012.

Sáinz, M., & López-Sáez, M. (2010). Gender differences in computer attitudes and the choice of technology-related occupations in a sample of secondary students in Spain. *Computers in Education, 54*(2), 578–587. https://doi.org/10.1016/j.compedu.2009.09.007.

Sáinz, M., Pálmen, R., & García-Cuesta, S. (2012). Parental and secondary school teachers' perceptions of ICT professionals, gender differences and their role in the choice of studies. *Sex Roles, 66*(3–4), 235–249. https://doi.org/10.1007/s11199-011-0055-9.

Schott, G., & Selwym, N. (2000). Examining the "male, antisocial" stereotype of high computer users. *Journal of Educational Computing Research, 23*(3), 291–303. https://doi.org/10.2190/V98R-5ETX-W9LY-WD3J.

Schreiner, C., & Sjøberg, S. (2010). The ROSE project. An overview and key findings, 1–31. Retrieved from https://roseproject.no/network/countries/norway/eng/nor-Sjoberg-Schreiner-overview-2010.pdf

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers in Education, 28*(1), 35–41. https://doi.org/10.1016/S0360-1315(96)00035-8.

Shaft, T. M., Sharfinan, M. P., & Wu, W. W. (2004). Reliability assessment of the attitude towards computers instrument (ATCI). *Computers in Human Behavior, 20*(5), 661–689. https://doi.org/10.1016/j.chb.2003.10.021.

Shapley, K., Sheehan, D., Sturges, K., Caranikas-Walker, F., Huntsberger, B., & Maloney, C. (2009). Evaluation of the Texas technology immersion pilot: Final outcomes for a four-year study (2004–05 to 2007–08). *Austin: Texas Center for Educational Research.*

Shashaani, L. (1993). Gender-based differences in attitudes toward computers. *Computers in Education, 20*(2), 169–181. https://doi.org/10.1016/0360-1315(93)90085-W.

Silvernail, D. L., & Gritter, A. K. (2007). Maine's middle school laptop program: Creating better writers. *Portland: Center for Education Policy, Applied Research, and Evaluation, University of Southern Maine.*

Spanos, D., & Sofos, A. (2015). The views and attitudes of students participating in a one-to-one laptop initiative in Greece. *Education and Information Technologies, 20*(3), 519–535. https://doi.org/10.1007/s10639-013-9299-z.

Stockdale, R., & Keane, T. (2016). Influencing the influencers: the role of mothers in IT career choices. *Journal of Information Technology Education: Innovations in Practice, 15*, 181–194 Retrieved from http://www.informingscience.org/Publications/3624.

Tapscott, D. (2012). The e-skills manifesto. European Schoolnet reports.

Teo, T. (2008). Assessing the computer attitudes of students: an asian perspective. *Computers in Human Behavior, 24*(4), 1634–1642. https://doi.org/10.1016/j.chb.2007.06.004.

Teo, T., & Noyes, J. (2008). Development and validation of a computer attitude measure for young students (CAMYS). *Computers in Human Behavior, 24*(6), 2659–2667. https://doi.org/10.1016/j.chb.2008.03.006.

Thomas, T., & Allen, A. (2006). Gender differences in students' perceptions of information technology as a career. *Journal of Information Technology Education, 5*, 165–168 Retrieved from http://www.jite.org/documents/Vol5/v5p165-178Thomas157.pdf.

Varma, R. (2009). Gender differences in factors influencing students towards computing. *Computer Science Education, 19*(1), 37–49. https://doi.org/10.1080/08993400902819006.

Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter? *Computers in Education, 55*(1), 16–23. https://doi.org/10.1016/j.compedu.2009.11.013.

Volman, M., & van Eck, E. (2001). Gender equity and information technology in education: the second decade. *Review of Educational Research, 71*(4), 613–634. https://doi.org/10.3102/00346543071004613.

Volman, M., van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers in Education, 45*(1), 35–55. https://doi.org/10.1016/j.compedu.2004.03.001.

Von Hellens, L., Clayton, K., Beekhuyzen, J., & Nielsen, S. (2009). Perceptions of ICT careers in german schools: an exploratory study. *Journal of Information Technology Education, 8*, 211–228. https://doi.org/10.28945/168.

Annex 3: Effects of One-to-One Computer Programs on reducing Gender Differences among Secondary School Students. Controlled Before and After Study.

AUTHORS
Roser Cussó-Calabuig (1) (corresponding author)
https://orcid.org/0000-0003-1720-8097
rcusso@xtec.cat
Xavier Carrera Farran (1)
https://orcid.org/0000-0003-3420-4215
carrera@pip.udl.cat
Xavier Bosch-Capblanch (2) (3)
https://orcid.org/0000-0002-4469-0395
x.bosch@unibas.ch
(1) University of Lleida. Faculty of Education
Department of Pedagogy and Psychology
Avda. Estudi General, 4
25001 Lleida. Spain

(2) Swiss Tropical and Public Health Institute
Socinstrasse 57
4002 Basel, Switzerland

(3) Universität Basel
Petersplatz 1
4003 Basel, Switzerland
Conflict of Interest: The authors declare that they have no conflict of interest.
Abstract

Gender differences with regard to attitudes and self-efficacy related to ICT is one of the reasons that explain the low number of girls in higher education in this field. Catalonia has adopted a one-to-one strategy to achieve digital skills in secondary schools. We have carried out a controlled, before and after study in 29 schools, involving more than 1900 children over three academic years, to assess the effects of this intervention on attitudes and self-efficacy differential between genders. We found no significant effects in any of the twelve outcomes studied, except for gaming and frequency, which are actually not related to school activities. Our study suggests that one-to-one strategies, as currently applied, may not affect gender differentials on ICT skills. Future evaluations should include implementation issues.

Keywords: gender differences in ICT, attitudes in ICT, self-efficacy, one-to-one programs, secondary students

1. INTRODUCTION

Boys and girls are frequent users of Information and Communication Technologies (ICT). According to the European Union Statistical Office (Eurostat, n.d., year searched 2015), 80% of the youth between 16 and 24 years old use the computer on a daily basis.

However, there are evident gender differences in the use of ICT as shown in reports from the International Computer and Information Literacy Study (ICILS) (Fraillon, Ainley, Schulz, Friedman, & Gebhardt, 2014) and the Organisation for Economic Co-operation and Development (OECD, 2015b) based on the Programme for International Student Assessment (PISA) tests. Data suggest that girls have a more intensive use of ICT for communication, included social networks, than boys. Boys more often use ICT for leisure and gaming.

These gender differences also exist when focusing in what is the approach of boys and girls towards technology. According to the OECD report focused in gender equality in Education (OECD, 2015a), boys are interested more directly into programming and into the technical aspects of computers, and girls tend to focus on the end-use of software and applications.

The low number of girls in ICT studies and the low number of women in companies in the sector reflect the consequences of these gender differences. It is worth noting to consider to what extent these differences between boys and girls referring to the use of ICT and their interests with regard to computers affect their professional projection in this field and, therefore, what are the factors that can explain these differences.

2. GENDER DIFFERENCES: FACTORS

Some studies (Sáinz & López-Sáez, 2010; Sáinz et al, 2012; Stockdale & Keane, 2016) suggest that parents' and teachers' opinions about boys and girls occupational aspirations are key factors. Particularly mothers, tend to consider ICT jobs as focused on men so it's hard to believe that they would encourage their daughters to pursue an ICT career.

Girls' stereotype in relation to ICT related studies and jobs, and their lack of knowledge about the particularities of the jobs in this sector are other known factors that influences gender differences (Castaño & Webster, 2011; Clayton, Hellens & Nielsen, 2009). These stereotypes are fully embedded in social and media perceptions about male nature of ICT related jobs (Cheryan et al, 2013; Clegg, 2001). In the same way, other studies point at the absence of female role models in the ICT field as a factor that reinforces girls' perception (Carrington, Tymms & Merrell, 2008; Clayton 2007).

Boys' and girls' attitudes about the use of ICT and their self-perceptions about their skills, problem solving strategies, learning, and usefulness of digital tools are clearly differentiated. Gender differences in self-efficacy and attitudes may influence the ways boys and girls face ICT or how they conceive their academic and vocational projection (Colley & Comber, 2003; Kubiatko, 2013; Volman, van Eck, Heemskerk & Kuiper, 2005).

Girls' attitude in the use of ICT is slightly lower than boys' (Adebowale, Adediwura & Bada, 2009; Ogan, Herring & Robinson, 2005; Volman & Van Eck, 2001). Attitude, however, includes different dimensions: anxiety, enjoyment and self-confidence.

Anxiety is defined as fear to interact with ICT and showing overall negative attitudes towards ICT, which leads to a deterioration of tasks and their accomplishment (Shashaani 1993). Authors report higher anxiety in girls as compared with boys (Baloğlu and Çevik, 2008; Kaino 2008; Adebowale et al, 2009; Kubiatko et al, 2011).

Enjoyment is defined as interest in the use of ICT in the academic context but also during leisure time (Shashaani, 1993). Most of the authors reported levels of enjoyment similar for boys and girls (Ogan et al, 2005; Fančovičová and Prokop 2008; Kaino 2008; Teo 2008; Adebowale et al, 2009). However, some authors point at higher levels of enjoyment in boys than in girls (Fraillon et

al, 2014). On the other hand, Kubiatko et al (2011) found that enjoyment in the use of computers among girls was higher than among boys but that mean values of enjoyment decreased with age in girls and increased in boys.

Self- confidence is defined as the personal perception of controlling ICT tools, feeling comfortable when using them and feeling able to overcome difficulties by one's own means (Shashaani, 1993). Boys tend to perceive themselves as "experts" in ICT, even when their objective knowledge is low, while girls seem to perceive themselves as less skilful and with less knowledge even if their objective knowledge shows no difference from boys' (Volman and Van Eck, 2001). All authors report levels of self-confidence lower in girls (Volman and Van Eck, 2001; Ogan et al, 2005; Christoph et al, 2015) and seems to be associated with girls' tendency to undervalue themselves, boosted by a lower informal self-learning comparing with boys'.

Self-efficacy is the conviction of one's own ability to successfully carry out a given task (Busch, 1995). Self-efficacy is lower among girls (Miura, 1987; Durndell and Haag, 2002). Downes and Looker (2011) and Beyer (2014) findings suggested that students with a high level of self-perceived computer ability were more likely to consider pursuing an ICT career. Another factors such as frequent use of computers, parental support and teachers' roles may increase self-efficacy (Downes and Looker, 2011; Papastergiou, 2008; UNESCO, 2017; Vekiri, 2010).

It has been hypothesised that the systematic use of computers in schools (e.g. 'one-to-one initiatives') could reduce gender differences in attitudes and self-efficacy (Garland and Noyes, 2004; Friend, 2015; Teo, 2008).

3. ONE-TO-ONE PROJECTS

One-to-one initiatives consist on intensive computer use facilitated by the fact that each pupil has his/her own computer as a fundamental learning tool.

According to Zheng et al (2016), one-to-one laptop programs were first introduced in Australia and the United States in the 1990s and they have spread widely to other countries (Balanskat et al, 2013; Islam & Grönlund, 2016; Severin & Capota, 2011).

Devices use in these initiatives include laptops, netbooks, tablets or smartphones and can be purchase by parents or by schools (Islam & Grönlund, 2016) and they are used to write, develop Internet searches, and personalize instruction and assessment using educational software or online tools (Zheng et al, 2016).

3.1. EFFECTS OF ONE-TO-ONE INITIATIVES

Acording to Valiente (2010), the main objectives of these initiatives should be:

- Provide students with ICT skills and the necessary skills to develop as a citizen of society and the knowledge economy.
- Reduce the digital divide between individuals and social groups and generalize their access to ICT so that they are available not only in schools but also in homes.
- Improve the quality of education by making it strongly oriented towards the student to improve academic results and reduce the distance between formal and informal learning.

Simply introducing computers in classrooms has a very low impact on improving student outcomes and achieving digital competence and its associated skills. Educational change requires a rethinking of learning objectives, curricula, teaching strategies, didactics and evaluation so that the

use of computers has the greatest possible effect (Balanskat and Garoia, 2010; Bebell and O'Dwyer, 2010; Kengwee et al, 2012; Valiente, 2010).

The effects of the one-to-one initiatives have been analyzed in studies focused on specific experiences, limited to few schools and observed in a single intervention, mostly in the US (Bebell and O'Dywell, 2010; Dunleavy et al, 2007; Holcomb, 2009; Keengwee et al, 2012; Zucker and Light, 2009). These studies report on students' academic achievement, implementation of the initiatives, and effects on teaching and learning processes.

However, there are four systematic literature reviews on the effects of one-to-one initiatives (Penuel, 2006; Fleischer, 2012; Harper and Milman, 2016; Islam and Grönlund, 2016) and a metanalysis (Zheng at al, 2016), which report more specific information.

Harper and Milland (2016) report effects on students' achievement, changes on the classroom environment and uses, and effects on students' engangement, focusing in US schools. Islam and Grönlund (2016) describe in their international literature review effects on student's engagement and motivation, self-directed and independent learning, and achievement of computational skills. Zheng et al (2016) results show more specific effects: students' academic achievement increased in science, writing, maths and English; impact on teaching and learning processes, perceptions and outcomes with more student-centered, individualized and project-based strategies, and students' enhanced engagement.

Attending to gender differences, none of these reviews report on them or on outcomes related to attitudes towards ICT. In fact, Cussó-Calabuig, Carrera and Bosch-Capblanch (2018) carried out a systematic review on effects of intensive use of computers on gender differences and the authors did not report any one-to-one program initiative.

Of all the studies consulted, only one case has been found that relates the one-to-one programs with gender, carried out by Schaumburg (2001), whose objective was to analyze if the differences in digital competences between boys and girls can be reduced by the participation in this type of programs. The participants were 113 students of a German secondary school with classes involved and not involved in the program, used as a control group. The results of the study show an improvement of the girls in the ICT knowledge with respect to the control group and no statistically representative difference on the improvement of the self-efficacy of the girls in the group participating in the program.

Finally, as mentioned by Valiente (2010) and Islam and Grönlund (2016), there are not studies that take into account the initial state of the students before the intervention in order to establish a comparison with their final state after the implementation.

4. RESEARCH CONTEXT

As indicated in the Effects of one-to-one initiatives section, authors report as essential effects of these initiatives (Harper and Milman, 2016; Islam and Grönlund, 2016; Zheng at al, 2016): an increase in engagement and motivation, the possibility of generating individualized learning strategies, the application of student-centered methodologies, an increase in the digital competences of students, and an improvement in mathematics and science results. These conclusions suggest that one-to-one initiatives can have an effect on improving girls' attitudes and self-efficacy in relation to the use of ICT, also taking into account that this intensive use of computers in all subjects implies the use of specific applications with direct uses that are the interests of the girls with regard to ICT as concluded in OECD, 2015a.

4.1. RESEARCH QUESTIONS

This study aims to establish the effects of one-to-one programs on gender differences in attitudes and self-efficacy in the use of ICT, with the following research questions:

- What is the impact of one-to-one programs on gender differences in attitudes and self-efficacy regarding the use of computers?
- What is the impact of one-to-one programs on the attitudes and self-efficacy of girls with respect to the use of computers?
- What is the absolut change in the outcomes for boys and girls?

4.2. ONE-TO-ONE INITIATIVES IN CATALAN SCHOOLS

This study was carried out in public secondary schools in Catalonia. Catalonia, as an autonomous community within Spain, has full competencies in the field of Education. The Department of Education is the body that designs and legalizes the initiatives and curriculum that Catalan schools must follow, based on their own policies in a minimum legislative framework, common to the rest of the autonomous regions, which can ensure the student mobility within Spanish territory.

Attending to the use of ICT in schools, the Ministry of Education, Culture and Sports of Spain designed in 2009 an initiative called School 2.0 in application of EU policies addressed to the achievement of the students' digital competence.

The Department of Education of Catalonia also implemented this initiative under the name of eduCAT 1x1 in the academic year 2009-2010 and eduCAT 2.0 from the academic year 2010-2011. This program included the use of personal computers in one-to-one laptop initiative and schools joined it voluntarily.

5. METHODS

In order to solve the research questions, secondary students, from randomized schools, from their entrance to the educational level to the last compulsory egalitarian curriculum (three school years) has been tracked. These students belong to centers that follow one-to-one programs (intervention groups) and centers that do not implement this initiative (control groups). Since they are the centers that choose to implement this program or not, it is not an experimental study but an observational one.

The data correspond to the answers of a questionnaire applied online from which the quantitative study was carried out (see Appendix 1).

There were several rounds of data collection, two per course, except for the last year in which only one collection was done (a total of five data collections). The first round gives us information about the starting point of the students that is the same both for the intervention groups and those of control, since the questionnaire was carried out during the first days of the beginning of the secondary school. The last round gives us information about the final state of the two groups and allows us, therefore, to establish the effects of the intervention. Intermediate collections have the objective of establishing the absolut changes in outcomes by gender in booth groups.

5.1. SAMPLE

The public Catalan education system consists of 537 secondary schools, 362 of them implement one-to-one programs according to the data provided by the Department of Education of Catalonia. In order to capture a balanced mix of schools we decided to include all the schools where one-to-one programs are not implemented (175) and the same number from the rest of schools, which

were selected using a list of random numbers produced in MS Excel. No school was excluded on the grounds of geographical location, size or any other reason. Schools were considered as clusters and all eligible students were selected in each school or cluster.

All selected schools were approached by an email addressed to the school headmaster. One reminder was sent to non-respondents two weeks after the first one. The questionnaire was on-line and self-administered under teachers' supervision in classes' hours, minimising the potential impact of ICT educational inputs from the school.

5.2. QUESTIONNAIRE

The questionnaire was structured into four sections: socio-demographic context, frequency of use, attitudes in front of the use of computers and self-efficacy. Except for the first section, the other sections were drawn from validated questionnaires, as described below and used a four-categories Likert scale (further described below). Where possible, responses were codified and shown through a drop-down box to minimise entry errors (see Appendix 1).

5.2.1. SOCIO-DEMOGRAPHIC SECTION

This section describes personal and contextual features of students, following similar approaches reported elsewhere (Chen, 1986; Shashaani, 1993; Busch, 1995; Durndell and Haag, 2002; Ogan et al, 2005). They include: (a) gender, (b) age, (c) school, (d) starting age in the use of computers, (e) place where use of computers began, (f) reference place for computers use learning, (g) computer skills of father and (h) mother, and (i) reference person to address computer problems.

5.2.2. FREQUENCY OF USE OF COMPUTERS SECTION

This section includes a series of routine tasks carried out with computers outside schools. Tasks were drawn from the PISA 2012 and 2015 questionnaires and they include: (a) on-line gaming, (b) social networks participation, (c) homework, (d) email use, (e) participation in chats, (f) Internet browsing, (g) downloads of media and (h) management of personal web sites.

The question statement in the questionnaire was: "Tell us how often you carry out the next tasks using a computer". Responses (4 levels Likert scale) ranged from "Never or hardly ever" (1 point), "Once or twice per month" (2 points), "Once or twice per week" (3 points) and "Almost daily" (4 points). We included "Once or twice a month" to allow responses for some specific actions that could be unusual (e.g. "Management of personal web sites").

5.2.3. ATTITUDES SECTION

Attitudes in relation to computer use are classified into three domains: anxiety, self-confidence and enjoyment, following the CAS scale (Computer Attitude Scale) defined by Loyd and Gressard (1984), used in the design of our questionnaire. The CAS scale has 30 items groups in three sub-scales corresponding to the three domains, although statements are mixed and not structured around domains.

The CAS scale is one of the most used in similar studies (Francis, 1994; Selwyn, 1997; Powell, 2013) and it has been widely validated (Gardner, Discenza, and Dukes, 1993; Nash and Moroz, 1997; Garland and Noyes, 2008; Powell, 2013). Yet, we revised questions statements to ensure smoothly adaptation to the context of this study, especially for those terms, which are out of use. Finally, the scale was translated into Catalan language, which is the vehicular language in the schools of Catalonia.

Definition for the three attitudes domains can be found at Gender differences: factors section.

The introductory explanation to the questions was formulated as “Indicate the extent to which you agree or disagree with the ideas expressed”. Five questions in each domain are formulated in a negative sense to minimize automatic answering and to stimulate a careful reading of the questions. Responses (4 Likert levels) ranged from “Strongly disagree” (1 point), “Disagree” (2 points), “Agree” (3 points) and “Strongly agree” (4 points). Although the former CAS scale ranges from 1 to 5, we have adopted ranges from 1 to 4 after more recent studies have found these scores to be more appropriate to force students to choose negative or positive responses by avoiding neutral central position (Farkas and Murthy, 2005; Varank, 2007).

5.2.4. SELF-EFFICACY SECTION

Self-efficacy section of the questionnaire were drawn from the PISA 2012 and 2015 questionnaires. Tasks are classified into basic and advanced. The former include: (a) digital edition of pictures, (b) production of a presentation, in general, (c) creation of a text document, (d) working with collaborative documents, (e) reading and responding to emails; and the latter: (f) database creation, (g) use of spread sheets, (g) production of a presentation with images and sound, (h) designing a web site and (i) creating a blog.

The question statement was: “Tell us what do you think your level of expertise is in the following tasks”. The scale (4 levels Likert) ranged from “I don’t know what it means” (1 point), “I can’t do it” (2 points), “I can do it with help” (3 points) and “I can do it on my own” (4 points).

5.3. PROCEDURE

The questionnaire was piloted to ensure the coherence of the structure and the understanding of the specific terms of the CAS scale. It was administered to 50 first-year, secondary school students in one school, resulting in the rephrasing of two questions in the section of attitudes. We estimated the internal consistencies of the questionnaire (Cronbach’s α) for the three domains frequency of use of computers, attitude and self-efficacy. The results were 0.80, 0.85 and 0.8 respectively.

Other aspects, such as data consistency and completeness using the Google Form platform, were also verified and it was estimated that it would take around 20 minutes to fill the questionnaire. The questionnaire was accompanied by instructions for the teachers who will support its administration to the students.

The first data collection was undergone during the first term of the first academic year of secondary school. This first round gave us information about the baseline of all students, both from intervention groups and from control groups, due to the fact that is in this first year of secondary school when the introduction of ICT programmes is done, so we could expect no impact on attitudes and self-efficacy yet. The third data collection was undergone during the first term of the second academic year of secondary school. The second, the fourth and the fifth data collection were undergone during the last term of the first, second and third academic years of secondary schools respectively.

5.4. DATA ANALYSIS

All variables were analysed individually. Besides, certain variables were combined to build the indicators defined in the used questionnaires (PISA 2012, PISA 2015, CAS), as follows.

Variables related to frequency of use were grouped in four categories: leisure (i.e. on-line gaming, Internet browsing, downloading of media, management of personal Web sites), homework, communication (i.e. participation in social networks, use of email, participation in chats) and games. The latter was analysed individually despite being included in 'leisure' given the gender differences reported in several studies.

Negative statements in the attitudes domain were recoded to keep consistency with the rest of the statements. The overall attitude score was estimated adding the values of each question and sub-scale. All questions had the same weight.

Self-efficacy questions were grouped according to the categories basic (i.e. digital edition of pictures, production of a presentation, creation of a text document, working with collaborative documents and reading and responding to emails) and advanced (i.e. database creation, use of spread sheets, production of a presentation with images and sound, designing a web site and creating a blog). The overall score is also obtained by adding the values in each question for each category.

Descriptive statistics included proportions of categorised continuous variables and means. Effect estimates were calculated as mean differences with 95% confidence intervals. All analyses were carried out taking into account the clustering of the sample. Results are presented disaggregated by gender.

Data were analised taking into account three complementary approaches. First, the effect of the intervention was estimated as absolute differences of before and after differences between the intervention and control groups; second, we analised the effects of intervention on outcomes by gender subgroups; third, we examined the absolute changes on outcomes by gender.

All statistics was carried out using Stata 13.0 and R 3.4.3.

6. RESULTS

6.1. CHARACTERISTICS OF STUDY SUBJECTS

We received 1920 responses, 972 for boys and 948 for girls from 29 schools; 13 (44,83%) followed a one-to-one program (intervention groups) and 16 (55,17%) did not (control groups). Students were 11 to 14 years old (mean 12.2 years) at the first data collection.

Schools involved in the study are distributed throughout the territory, with a higher concentration in areas with a high-density population. Information about the characteristics of study subjects is shown in Table 1.

Table 1. Characteristics of study subjects

		Intervention group	Control group
Subjects		864 (45%)	1056 (55%)
Boys		442 (45.47%)	530 (54.53%)
Age		12.25 (12.16 to 12.34)	12.30 (12.19 to 12.40)
Age of initiation	Before 6	35.39% (27.87 to 42.71)	40.19% (34.66 to 45.71)
	From 6 to 8	42.30% (38.01 to 46.60)	42.26% (38.16 to 46.73)
	From 9 to 11	21.04% (14.25 to 27.83)	16.42% (13.27 to 19.56)
	After 11	1.36% (0.30 to 2.41)	1.13% (3.55 to 1.91)
Place of initiation	At home	70.82% (67.31 to 74.32)	71.13% (66.41 to 75.85)
	At school	19.23% (15.02 -23.44)	17.36% (12.40 to 22.32)
	At a relative's home	5.20% (2.46 to 7.95)	5.09% (3.37 – 6.82)
	At a friend's home	2.94% (0.97 to 4.90)	2.45% (0.86 to 4.05)
	Others	1.81% (0.80 – 2.82)	3.96% (1.66 to 6.26)
Place of learning	On my own at home	47.29% (40.69 to 53.88)	54.72% (48.45 to 60.99)
	At school	26.92% (21.80 to 32.04)	26.42% (19.72 to 33.11)
	At home with help	18.32% (13.31 to 23.34)	13.58% (10.73 to 16.44)
	With friends	7.47% (4.54 to 10.39)	5.28% (3.68 to 6.88)
Property of computer	Yes, mine	43.24% (22.80 to 81.98)	45.36% (28.34 to 72.61)
	Yes, shared	50.02% (28.37 to 88.22)	51.24% (32.87 to 79.88)
	No	3.59% (1.11 to 11.63)	3.12% (0.97 to 10.03)
Girls		422 (44.51%)	526 (55.49%)
Age		12.17 (12.08 to 12.27)	12.17 (12.09 to 12.24)
Age of initiation	Before 6	33.89% (28.21 to 39.56)	34.22% (28.65 to 39.79)
	From 6 to 8	45.97% (41.46 to 50.48)	47.91% (43.58 to 52.24)
	From 9 to 11	18.96% (14.42 to 23.49)	17.11% (12.34 to 21.88)
	After 11	1.18% (-0.41 to 2.78)	0.76% (-0.24 to 1.76)
Place of initiation	At home	71.09% (65.74 to 76.44)	69.77% (65.51 to 74.03)
	At school	20.38% (14.84 to 25.92)	19.77% (15.38 to 24.16)
	At a relative's home	4.74% (2.75 to 6.72)	4.18% (2.08 to 6.29)
	At a friend's home	1.66% (0.62 to 2.69)	1.90% (0.61 to 3.19)
	Others	2.13% (1.06 to 3.20)	4.37% (2.00 to 6.74)
Place of learning	On my own at home	49.29% (42.71 to 55.87)	55.32% (50.18 to 60.47)
	At school	23.93% (18.35 to 29.52)	25.28%(18.82 to 31.75)
	At home with help	19.90% (14.72 to 25.09)	14.64% (11.78 to 17.50)
	With friends	6.87% (4.23 to 9.51)	4.75% (2.77 to 6.74)
Property of computer	Yes, mine	50.31% (30.84 to 82.05)	49.92% (30.08 to 82.83)
	Yes, shared	46.98% (28.43 to 77.65)	47.48% (29.73 to 75.82)
	No	2.61% (0.89 to 7.59)	2.17% (0.57 to 8.30)
Schools		13 (44.83%)	16 (55.17%)
Schools context (Median population)		17743 IQR: 9748 to 43964	27915 IQR: 6164 to 567523

6.2. EFFECT OF THE INTERVENTION ON GENDER DIFFERENCES (PRIMARY OUTCOMES)

Effects were estimated as before and after differences of gender differentials in each outcome of interest, between intervention and control groups (Table 2).

All the outcomes corresponding to the frequency of use show an increase on gender differences in the intervention group compared to the control group, but they are not statistically significant, with confidence interval including zero (no difference), except for outcomes related to frequency of game and leisure frequency.

Regarding to outcomes corresponding to attitudes, that is, anxiety, self-confidence and enjoyment, there is a slight positive effect of the intervention, especially with regard to self-confidence, but, again, it is not statistically significant (mean = -0.082; SE = 0.147).

Finally, the outcomes related to self-efficacy also indicate results of a slight improvement in the reduction of gender differences due to the effect of the intervention, without statistical significance (mean = -0.035; SE = 0.121). The basic level operations are those that show a higher decrease in gender differences (mean = -0.061; SE = 0.097).

Table 2. Effects of the intervention on gender differences by outcomes

		Intervention group						Control group						Effect	
		N	R1	SE	N	R5	SE	N	R1	SE	N	R5	SE	ddR	SE
Commun. frequency	Boys	442	2.909	0.059	395	2.942	0.049	530	2.969	0.060	500	2.810	0.069	0.045	0.236
	Girls	422	3.062	0.047	386	3.018	0.086	526	3.119	0.051	466	2.927	0.077		
Homework frequency	Boys	442	3.391	0.109	395	3.253	0.109	530	2.996	0.102	500	2.792	0.112	-0.069	0.263
	Girls	422	3.486	0.096	386	3.346	0.119	526	3.114	0.104	466	2.839	0.092		
Game frequency	Boys	442	2.554	0.073	395	2.840	0.090	530	2.521	0.065	500	2.248	0.077	0.558	0.177
	Girls	422	1.872	0.091	386	1.415	0.097	526	1.930	0.036	466	1.472	0.073		
Leisure frequency	Boys	442	2.557	0.049	395	2.771	0.091	530	2.613	0.033	500	2.515	0.088	0.231	0.206
	Girls	422	2.310	0.049	386	2.251	0.083	526	2.417	0.038	466	2.277	0.046		
Frequency index	Boys	442	2.793	0.040	395	2.896	0.043	530	2.794	0.034	500	2.660	0.068	0.124	0.180
	Girls	422	2.739	0.032	386	2.676	0.074	526	2.767	0.030	466	2.591	0.042		
Anxiety	Boys	442	3.371	0.031	395	3.261	0.085	530	3.393	0.032	500	3.280	0.062	-0.014	0.154
	Girls	422	3.304	0.024	386	3.153	0.057	526	3.392	0.020	466	3.223	0.034		
Self-confidence	Boys	442	3.217	0.032	395	3.083	0.090	530	3.230	0.033	500	3.146	0.047	-0.082	0.147
	Girls	422	3.065	0.036	386	2.952	0.049	526	3.120	0.036	466	2.975	0.036		
Enjoyment	Boys	442	3.010	0.029	395	2.928	0.075	530	3.041	0.032	500	2.957	0.046	-0.020	0.119
	Girls	422	2.855	0.0365	386	2.661	0.057	526	2.932	0.025	466	2.715	0.031		
Attitude index	Boys	442	3.199	0.029	395	3.091	0.082	530	3.221	0.029	500	3.127	0.051	-0.039	0.1333
	Girls	422	3.075	0.029	386	2.922	0.047	526	3.148	0.024	466	2.971	0.030		
Basic operations	Boys	442	3.670	0.028	395	3.709	0.044	530	3.651	0.031	500	3.765	0.031	-0.061	0.097
	Girls	422	3.697	0.021	386	3.759	0.050	526	3.707	0.021	466	3.782	0.025		
Advanced operations	Boys	442	3.210	0.034	395	3.406	0.077	530	3.243	0.027	500	3.478	0.024	-0.010	0.162
	Girls	422	3.198	0.026	386	3.361	0.049	526	3.220	0.034	466	3.412	0.033		
Self-efficacy index	Boys	442	3.440	0.024	395	3.558	0.056	530	3.447	0.025	500	3.622	0.026	-0.035	0.121
	Girls	422	3.447	0.019	386	3.560	0.046	526	3.464	0.022	466	3.597	0.026		

6.3. EFFECTS OF THE INTERVENTION ON OUTCOMES BY GENDER SUBGROUPS

This comparison allows us to refine the results presented in the previous section 6.2. since, in addition to showing whether there is or not a decrease in gender differences due to the effect of the intervention, they also indicate whether this effect is the same in both genders and if, in some cases, this effect can be of different sign in boys or girls.

The variables corresponding to the frequency of use of computers show an increase due to the intervention for both boys and girls. Even so, these effects are only statistically significant for boys and only in game frequency outcomes (95% confidence intervals do not include the zero no effect value), frequency of leisure and overall frequency index. (Figure 1)

As shown in the previous section, gender differences in game frequency are significantly increased due to the intervention. Figure 1 shows that this increase is due to the group referring to the boys, since there is no increase in this outcome in the group of girls. That is to say, the increase produced by effect of the intervention game frequency only affects the boys.

Although the results are not statistically significant, the other outcomes referring to the frequency of use suggest that the intervention may affect boys more than girls, with the exception of the frequency variable of homework where the situation is at reverse.

Attitude-related variables (i.e. anxiety, self-confident and enjoyment) do not show significant results and the differences between the intervention group and the control group are very small both in boys and girls, with a very slight increase in the intervention group. It's worth noting that the outcome of self-confidence is the only one where there are differences between

boys and girls. While in the group of boys the results show that the intervention produces a decrease in the level of this outcome, the girls are the opposite, that is, the girls in the intervention group increase the level of self-confidence with respect of those of the control group. As discussed in the previous section 6.2., gender differences with respect to self-confidence outcome decrease with intervention. The results shown in Figure 1 indicate that this decrease is due to the positive effect of the intervention on girls that counteracts the negative effect on boys.

Regarding the results related to self-efficacy (i.e. basic level operations and advanced level operations), the results show that the intervention produces a negative effect on both genders, although they overalp with the non-effect value. The results seem slightly worse in boys, both with regard to the overall index of self-efficacy and the two related outcomes, especially in the basic level operations. Although the intervention had a negative effect on both genders, this effect has been lower in girls than in boys, which explains the decrease in gender differences between the intervention and control groups.

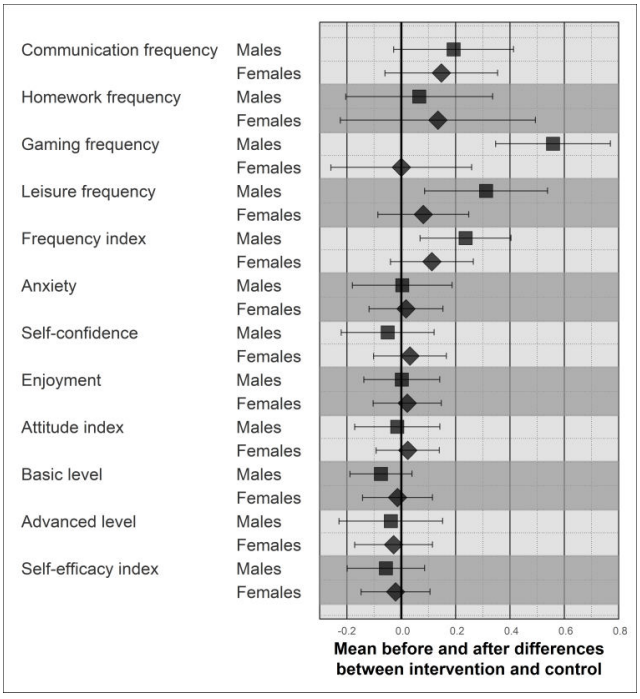


Figure 1. Effects of the intervention on outcomes by gender subgroups (Results <0 indicates a negative effect of the intervention)

6.4. ABSOLUTE CHANGES OF OUTCOMES BY GENDER

Finally, we examined in more detail whether, despite that lack of statistical significance in some estimates, the observed effects were unveiling a time trend in each outcomes, by gender subgroup.

The results are presented separately by gender and only specifically those related to the variables related to attitudes (ie, anxiety, self-confidence and enjoyment) and self-efficacy (i.e. basic level operations and advanced level operations), as well as the global index of frequency

Regarding the girls, all outcomes referring to attitudes indicate a progressive descent throughout the rounds, both in the intervention group and in the control group, as shown in Figure 2; i.e. the values of the outcomes decrease their value with age.

The decrease in the values of outcomes referring to attitudes of girls in the intervention group is slightly lower than in the control group, which may explain the small positive effect of the intervention on the girls mentioned in the previous section 6.3.

The global frequency index in the intervention group shows similar values throughout the five rounds of data collection, while in the control group the trend seems to decrease, consistently with the positive effects of the intervention discussed in the previous section 6.3.

Regarding the outcomes related to self-efficacy, they all show a slight increase, both in the intervention group and in the control group. Unlike the attitude variables, in this case the increase is slightly higher in the girls in the control group, especially in the advanced level operations. This explains the negative results of the intervention on the girls commented in the previous section 6.3.

In boys, attitude outcomes suggest a decrease in the intervention and control groups, although this decrease is smaller than in girls. All the values remain above the mean value of 3.

It is worth noting that the value of self-confidence is the one with the greatest decrease in the boys in the intervention group. This fact is consistent with the before and after differences which suggests a negative effect of the intervention and also with the fact that self-confidence is the attitudes outcome where the effects of the intervention on gender differences is greater.

Regarding the global frequency index, boys in the intervention group show an increase in results while the boys in the control group have a decline throughout the rounds supporting the overall before and after difference

Attending to self-efficacy outcomes, the tendency to increase the results along the data collection rounds is observed both in the intervention group and in the control group, although in this last group the increase is slightly higher, which may explain the negative effects of the intervention in boys.

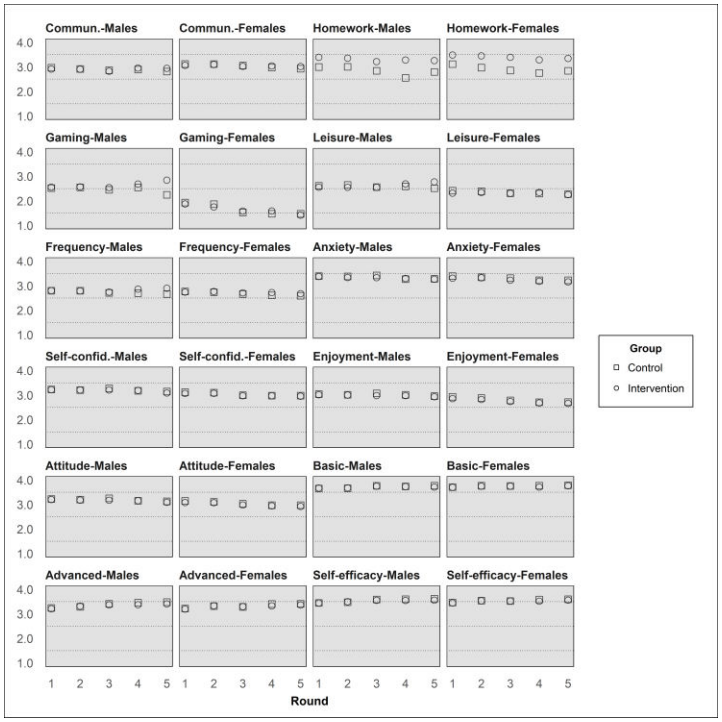


Figure 2. Absolute changes of outcomes by gender

7. DISCUSSION

We have carried out a controlled before and after study to assess the effects of one-to-one initiatives on gender differences in selected outcomes, among 1920 secondary schools students in 29 school in Catalonia. To our knowledge, this is the only comparative study addressing this critical issue.

One-to-one initiatives in secondary schools do not seem to reduce gender differences in the outcomes of interest. Despite the relative large number of subjects included in both groups, the clustered design of the sample, which has been taken into account in the estimation of effects, and baseline differences, may have limited the capacity of the study to detect real effects. Some outcomes seemed to suggest some positive effect but, as mentioned, we cannot rule out the role of chance.

However, the lack of effects in gender differences may mask actual effects in both gender subgroups, which are not translated into gender differentials. For example, we reported positive effects of the intervention on the global frequency index, frequency of game and leisure frequency on boys, which are consistent with the findings in ICILS (Fraillon et al., 2014) and the OECD (2015a, 2015b), showing that girls use computers for leisure less than boys. This is also the case of the use of computers for online gaming, being more prevalent in boys than in girls as shown in the OECD (2015a) report on gender and education. However, the ICILS and the OECD reports were observational studies that show the values of these outcomes in relation to gender, regardless of the use of computers in schools. Unlike these reports, the results of our study refer to the effects of an intervention, therefore, the increase of gender differences in the outcomes of global frequency index, frequency of game and leisure frequency seems to be related to the implementation of one-to-one programs.

Taking into account the effects of the intervention in the subgroup of girls, our findings suggest that the global frequency index values in girls in the intervention group do not change along the five data collection rounds while it slightly decrease in the control group. It is difficult to conclude whether these results are due to the specific effect of the intervention or that girls participating in one-to-one initiatives have a computer of their property and, therefore, easier access to its use.

It is interesting to note that the intervention did not seem to have an impact on the results of the frequency of homework, despite that one-to-one programs are characterized by an intensive use of digital resources that lead to an increased use of computers at home to carry out school tasks. This may be explained by the fact that classroom methodologies, essential to get advantage of digital technologies (Balanskat and Garoia, 2010; Bebell and O'Dwyer, 2010; Kengwee et al, 2012; Valiente, 2011), remain the same despite that students have personal computers.

The intervention do not show any remarkable effect, on the global attitude index, despite that these seemed to slightly decrease in the intervention group. Other studies (Garland and Noyes, 2004; Teo, 2008) suggest that the systematic use of computers can reduce gender differences with regard to the attitude in their use. These studies are observational in nature, and are based on samples of students participating in specific ICT courses without evaluating their effect.

Attending to the outcomes related to attitudes, there were no effects either regarding anxiety and enjoyment, but there was a slight improvement in self-confidence.

We have found two studies addressing the effects of intensive use of computers in attitudes, differentiated by gender (not in terms of gender difference) that include students of different ages. The study of Kubiatko et al. (2011) collected answers from secondary students of each level (first to fourth), focusing on anxiety and enjoyment, while the Schaumburg (2001) study includes students of the same level, divided into two groups, one on which the intervention was carried out for two years and another as a control group, focusing on self-confidence.

Kubiatko et al. (2011) conclude as well that girls show an increase in anxiety and a decrease in enjoyment over time. However, our results show a slight decrease in anxiety and enjoyment in girls. This is not consistent with the results of Kubiatko et al. (2011) and it may be explained due to the differences of the studies design. While our research is based in a before and after methodology tracking the students over time, the authors evaluate the effect of an intervention on different students.

With regard to self-confidence, the results of our study indicate a mild effect. In fact, self-confidence decreses in girls in the second round of data collection in both groups, to remain constant till the last round. These results are not consistent with the conclusions of Schaumburg (2001), which indicates that girls have a lower value than boys in this outcome despite the intervention. Again, our study is different from design from that of Schaumburg (2001), because the author does not follow the students throughout the intervention but rather the results refer to a single moment of data collection.

We could not find effects of the intervention on self-efficacy. Attending to self-efficay outcomes (i.e. basic level operations and advanced level operations) by gender subgroups, both boys and girls show increasing level over time. However, these results are better in the control group than in the intervention group, showing a slight negative effect of the intervention. Our finding are not consistent with the literature because the consulted studies indicate that self-efficacy improves with the intensive use of computers (Downes and Looker, 2011; Papastergiou, 2008; UNESCO, 2017; Vekiri, 2010). These studies are based in a single moment of data collection, so they do no track students on time as our study does.

Our study has some limitations. First of all, the fact that a school does not follow a one-to-one program does not mean that computers are not used in classrooms and, therefore, their students may also be exposed to the effects of this use. Schools where not randomly allocated to the intervention and control groups, which may introduce bias in our findings. This fact may explain as well the baseline differences that we also took into account in our analyses.

8. CONCLUSIONS

The results of the study do not show a significant effect of the intervention on gender differences existing in the first round of collection. Only slight differences can be observed when analysing the results by gender, but none of them are significant, except for the frequency of game and leisure.

Both the intervention group and the control group similar trends to all outcomes, which implies that the intervention has no effect. This fact is especially relevant in the case of outcomes basic level operations and advanced level operations, as they should show some change between the intervention group and that of control in either of the two genders.

In the same sense, the lack of difference between the intervention group and the control group in the homework frequency outcome is also relevant, since it shows that, in fact, few tasks are carried out that imply the use of the computers to be solved in the intervention group.

This lack of differences seems to indicate that schools that follow one-to-one programs do not apply methodologies that are different from those of traditional centers, that is, they are able to make intensive use of computers but this fact is not reflected in a real pedagogical change. Future research must take into account the relationship between the intensive use of computers and the real classroom methodologies to be able to determine what the real effects are and what are the methodologies that favor them.

Another future line of research is to establish correlations between the effects of the intervention and the student's baseline in reference to prior experience in the use of computers, access to the use of computers in homes and referents relatives of students regarding ICT. These correlations would make it possible to more specifically define interventions to increase their effects.

On the other hand, given the high cost of implementing one-to-one programs, not only at the level of infrastructure and hardware, but also teacher training and ad-hoc resource creation, it is essential to carry out a evaluation of the effectiveness of these programs from different points of view, including the vision of the effect on gender differences.

Finally, it is important to emphasize the lack of controlled studies before and after. In order to evaluate the real effects of one-to-one programs, research must be based on studies that track the students involved.

9. REFERENCES

Adebowale, O., Adediwura, A., & Bada, T. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research*, *3*(2), 20-30.

Balanskat, A., & Garoia, V. (2010). Netbooks on the rise and netbook initiatives in schools. European Schoolnet (EUN Partnership AISBL)

Balanskat, A., Bannister, D., Hertz, B., Sigillò, E., & Vuorikari, R. (2013). *Overview and Analysis of 1:1 Learning Initiatives in Europe* (p. 166). https://doi.org/10.2791/20333

Baloğlu, M., & Çevik, V. (2008). Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students. *Computers in Human Behavior*, *24*(6), 2639-2648. http://dx.doi.org/10.1016/j.chb.2008.03.003

Bebell, D., & O'Dwyer, L. M. (2010). Educational outcomes and research from 1:1 computing settings. *Journal of Technology, Learning and Assessment, 9*(1), 4–15.

Beyer , S.(2014) Why are women underrepresented in Computer Science? Gender differences in stereotypes, self-efficacy, values, and interests and predictors of future CS course-taking and grades. C*omputer Science Education*, *24*(2-3), 153-192. https://doi.org/10.1080/08993408.2014.963363

Busch, T. (1995). Gender Differences in Self-Efficacy and Attitudes Toward Computers. *Journal of Educational Computing Research*, *12*(2), 147-158. http://dx.doi.org/10.2190/H7E1-XMM7-GU9B-3HWR

Carrington, B., Tymms, P., & Merrell, C. (2008). Role models, school improvement and the "gender gap" – Do men bring out the best in boys and women the best in girls? *British Educational Research Journal*, *34*(3), 315-327. http://dx.doi.org/10.1080/01411920701532202

Castaño, C., & Webster, J. (2011). Understanding Women's Presence in ICT: the Life Course Perspective. *International Journal of Gender, Science and Technology*, *3*(2), 364 - 386. Retrieved from http://genderandset.open.ac.uk/index.php/genderandset/article/view/168

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, *2*, 265-282. http://dx.doi.org/10.2190/WDRY-9K0F-VCP6-JCCD

Cheryan, S., Plaut, V.C., Handron, C., & Hudson, L. (2013). The stereotypical computer scientist: Gendered media representations as a barrier to inclusion for women. *Sex Roles, 69,* 58-71. http://dx.doi.org/10.1007/s11199-013-0296-x

Christoph, G., Goldhammer, F., Zylka, J., & Hartig, J. (2015). Adolescents' computer performance: The role of self-concept and motivational aspects. *Computers and Education*, *81*, 1-12. http://dx.doi.org/10.1016/j.compedu.2014.09.004

Clayton, K. L. (2007). The influence of metropolitan Brisbane middle-school ICT experiences on girls' ICT study and career choices. PhD dissertation, Griffith University, December 2007.

Clayton, K. L., Hellens, L. A. von, & Nielsen, S. H. (2009). Gender Stereotypes Prevail in ICT: A Research Review. *Public Understanding of Science*, *23*(2), 153–158. http://dx.doi.org/10.1145/1542130.1542160

Clegg, S. (2001). Theorising the Machine: Gender, education and computing. *Gender and Education*, *13*(3), 307-324. http://dx.doi.org/10.1080/09540250120063580

Colley, A., & Comber, C. (2003). Age and gender differences in computer use and attitudes among secondary school students: what has changed?. *Educational Research*, *45*(2), 155-165. http://dx.doi.org/10.1080/0013188032000103235

Cussó-Calabuig, R., Farran, X.C. & Bosch-Capblanch, X. (2018). *Education and Information Technologies.* https://doi.org/10.1007/s10639-018-9706-6

Downes, T., & Looker, D. (2011). Factors that influence students' plans to take computing and information technology subjects in senior secondary school. *Computer Science Education*, *21*(2), 175-199. http://dx.doi.org/10.1080/08993408.2011.579811

Dunleavy, M. , Dexter, S. and Heinecke, W. (2007), What added value does a 1:1 student to laptop ratio bring to technology-supported teaching and learning?. *Journal of Computer Assisted Learning, 23*, 440-452. doi:10.1111/j.1365-2729.2007.00227.x

Durndell, A., & Haag, Z. (2002). Computer self efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior*, *18*(5), 521-535. http://dx.doi.org/10.1016/S0747-5632(02)00006-7

European Union Statistical Office (Eurostat). (n.d.). *Survey on Digital Economy and Society.* Retrieved from http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database

Fančovičová, J., & Prokop, P. (2008). Students' attitudes toward computer use in Slovakia. *Eurasia Journal of Mathematics Science & Technology Education*, *4*(3), 255-262.

Farkas, D., & Murthy, M. (2005). Attitudes Toward Computers , the Introductory Course and Recruiting New Majors : Preliminary Results. *Proceeding of Programming Interest Group 17*, 268-277

Fleischer, H. (2012). What is our current understanding of one-to-one computer projects: a systematic narrative research review. *Educational Research Review*, *7*(2), 107-122. http://dx.doi.org/10.1016/j.edurev.2011.11.004

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Students' Use of and Engagement with ICT at Home and School. *Preparing for Life in a Digital Age: The IEA International Computer and Information Literacy Study International Report* (pp. 125-166). Retrieved from http://dx.doi.org/10.1007/978-3-319-14222-7_6

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers & Education*, *22*(4), 283–289. http://doi.org/10.1016/0360-1315(94)90050-7

Friend, M. (2015) Middle school girls' envisioned future in computing. *Computer Science Education, 25(*2), 152-173. https://doi.org/10.1080/08993408.2015.1033128

Gardner, D. G., Discenza, R., & Dukes, R. L. (1993). The Measurement of Computer Attitudes: an Empirical Comparison of Available Scales. *Journal of Educational Computing Research*, *9*, 487-507. https://doi.org/10.1016/j.chb.2003.11.010

Garland, K. J., & Noyes, J. M. (2004). Computer experience: a poor predictor of computer attitudes. *Computers in Human Behavior, 20*, 823–840.

Garland, K. J., & Noyes, J. M. (2008). Computer attitude scales: How relevant today? *Computers in Human Behavior*, *24*(2), 563-575. http://dx.doi.org/10.1016/j.chb.2007.02.005

Harper, B., & Milman, N. (2016). One-to-One Technology in K-12 Classrooms: A Review of the Literature from 2004 through 2014. *Journal of Research on Technology in Education, 48*(2), 129-142. http://doi.org/10.1080/15391523.2016.1146564

Holcomb, B. (2009). Results & Lessons Learned from 1:1 Laptop Initiatives: A Collective Review. *Technology Trends, 53*(6), 49-56.

Islam, M., & Grönlund, A. (2016). An international literature review of 1:1 computing in schools. *Journal of Educational Change, 17*(2), 191-222. http://doi.org/10.1007/s10833-016-9271-y

Kaino, L. M. (2008). Technology in learning: Narrowing the gender gap? *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 263-268.

Keengwe, J., Schnellert, G., & Mills, C. (2012). Laptop initiative: Impact on instructional technology integration and student learning. *Education and Information Technologies*, *17*(2), 137–146. https://doi.org/10.1007/s10639-010-9150-8

Kubiatko, M., Haláková, Z., Nagyová, S., & Nagy, T. (2011). Slovak high school students' attitudes toward computers. *Interactive Learning Environments*. http://dx.doi.org/10.1080/10494821003612232

Kubiatko, M. (2013). The comparison of different age groups on the attitudes toward and the use of ICT. *Educational Sciences: Theory and Practice*, *13*(2), 1263-1272. Retrieved from http://files.eric.ed.gov/fulltext/EJ1017271.pdf

Loyd, B. H., & Gressard, C. (1984). Reliability and Factorial Validity of Computer Attitude Scales. *Educational and Psychological Measurement*, *44*, 501-505. http://dx.doi.org/10.1177/0013164484442033

Miura, I. T. (1987). The relationship of self-efficacy expectations to computer interest and course enrollment in college. *Sex-roles, 16*, 303-311. http://dx.doi.org/10.1007/BF00289956

Nash, J., & Moroz, P. (1997). An examination of the factor structures of the computer attitude scale. *Journal of Educational Computing Research*, 21.

OECD (2015a), *The ABC of Gender Equality in Education: Aptitude, Behaviour, Confidence*, PISA, OECD Publishing. Retrieved November 2016. http://dx.doi.org/10.1787/9789264229945-en

OECD (2015b), *Students, Computers and Learning: Making the Connection*, OECD Publishing, Paris. Retrieved November 2016. http://dx.doi.org/10.1787/9789264239555-en

Ogan, C., Herring, S. C., & Robinson, J. C. (2005). International Communications Association Conference. The More Things Change , the More They Stay the Same : Gender

Differences in Attitudes and Experiences Related to Computing Among Students in Computer Science and Applied Information Technology Programs.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers and Education*, *51*(2), 594-608. http://dx.doi.org/10.1016/j.compedu.2007.06.009

Penuel, W. (2006). Implementation and Effects of One-to-One Computing Initiatives. *Journal of Research on Technology in Education, 38*(3), 329-348. http://dx.doi.org/10.1080/15391523.2006.10782463

Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior*. http://dx.doi.org/10.1016/j.chb.2013.05.012

Sáinz, M., & López-Sánchez, M. (2010). Gender differences in computer attitudes and the choice of technology-related occupations in a sample of secondary students in Spain. *Computers & Education*, *54*(2), 578-587. http://dx.doi.org/10.1016/j.compedu.2009.09.007

Sáinz, M., Pálmen, R. & García-Cuesta, S. (2012). Parental and Secondary School Teachers' Perceptions of ICT Professionals, Gender Differences and their Role in the Choice of Studies. *Sex Roles, 66*(3-4), 235-249. http://dx.doi.org/ 10.1007/s11199-011-0055-9

Schaumburg, H. (2001). Fostering Girls' Computer Literacy through Laptop Learning: Can Mobile Computers Help to Level Out the Gender Differences?. National Educational Computing Conference. 1-8.

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers & Education*. http://doi.org/10.1016/S0360-1315(96)00035-8

Severin, E., & Capota, C. (2011) Modelos Uno a Uno en América Latina y el Caribe. Panorama y perspectivas. Banco Interamericano de Desarrollo.

Shashaani, L. (1993). Gender-Based Differences in Attitudes. *Computers & Education, 20*(2), 169-181.

Stockdale, R., & Keane. T. (2016). Influencing the influencers: The role of mothers in IT career choices. *Journal of Information Technology Education: Innovations in Practice, 15*, 181-194. https://doi.org/10.28945/3624

Teo, T. (2008). Assessing the computer attitudes of students: An Asian perspective. *Computers in Human Behavior*, *24*(4), 1634-1642. http://dx.doi.org/10.1016/j.chb.2007.06.004

UNESCO (2017). Cracking the code. United Nations Educational, Scientific and Cultural Organization Publishing. Retrieved from http://unesdoc.unesco.org/images/0025/002534/253479e.pdf

Valiente, O. (2010). 1-1 in Education Current Practice, International Comparative Research Evidence and Policy Implications. *OECD Education Working Papers, 44*. OECD Publishing. http://dx.doi.org/10.1787/5kmjzwfl9vr2-en

Varank, I. (2007). Effectiveness of Quantitative Skills, Qualitative Skills, and Gender in Determining Computer Skills and Attitudes: A Causal Analysis. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 81*(2), 71-80

Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter?. *Computers and Education, 55*(1), 16-23. https://doi.org/10.1016/j.compedu.2009.11.013

Volman, M., & Eck, E. van. (2001). Gender Equity and Information Technology in Education: The Second Decade. *Review of Educational Research*, *71*(4), 613-634. http://dx.doi.org/10.3102/00346543071004613

Volman, M., van Eck, E., Heemskerk, I., & Kuiper, E. (2005). New technologies, new differences. Gender and ethnic differences in pupils' use of ICT in primary and secondary education. *Computers and Education*, *45*(1), 35-55. http://dx.doi.org/10.1016/j.compedu.2004.03.001

Zheng, B., Warschauer, M., Lin, C., & Chang, C. (2016). Learning in One-to-One Laptop Environments: A Meta-Analysis and Research Synthesis. *Review of Educational Research, 86*(4), 1052–1084. http://dx.doi.org/10.3102/0034654316628645

Zucker, A., and Light, D. (2009). Laptop Programs for Students. *Science, 323*(5910), 82-85. http://dx.doi.org/10.1126/science.1167705

Generalitat de Catalunya
Departament d'Educació
XTEC

ROSER CUSSO CALABUIG <rcusso@xtec.cat>

TKNL-D-19-00002 - Submission Confirmation
1 missatge

Technology, Knowledge and learning (TKNL) <em@editorialmanager.com> 6 de gener de 2019 a les 12:31
Respon: "Technology, Knowledge and learning (TKNL)" <sharmila.prathaban@springernature.com>
Per a: Roser Cussó-Calabuig <rcusso@xtec.cat>

Dear Mrs. Cussó-Calabuig,

Thank you for submitting your manuscript, Disentangling the factors that contribute to gender differences in the use of computers among teens and implications for career development, to Technology, Knowledge and Learning.

The submission id is: TKNL-D-19-00002

Please refer to this number in any future correspondence.

During the review process, you can keep track of the status of your manuscript by accessing the journal website.

Your username is: rcusso
If you forgot your password, you can click the 'Send Login Details' link on the EM Login page at https://tknl.editorialmanager.com/

Should you require any further assistance please feel free to e-mail the Editorial Office by clicking on "Contact Us" in the menu bar at the top of the screen.

Thank you very much.

With kind regards,
Springer Journals Editorial Office
Technology, Knowledge and Learning

Now that your article will undergo the editorial and peer review process, it is the right time to think about publishing your article as open access. With open access your article will become freely available to anyone worldwide and you will easily comply with open access mandates. Springer's open access offering for this journal is called Open Choice (find more information on www.springer.com/openchoice). Once your article is accepted, you will be offered the option to publish through open access. So you might want to talk to your institution and funder now to see how payment could be organized; for an overview of available open access funding please go to www.springer.com/oafunding.
Although for now you don't have to do anything, we would like to let you know about your upcoming options.

Annex 4: Disentangling the factors that contribute to gender differences in the use of computers among teens and implications for career development.

Abstract

Gender differences in the use of computers and attitudes and self-efficacy perceptions on their use are the main determinants associated to ICT vocations. In the context of a large 1-to-1 evaluation study, we aimed at estimating and better qualifying these associations, in secondary schools of Catalonia, along three academic courses. We carried out logistic regression models controlling by three variables, expression associations as odds ratios. Results show consistent associations between gender and enjoyment in the use of computers as well as in the type of activities carried out with computers; between the frequency of computer use and attitudes; and between the age of beginning in the use of computers and attitudes and the perception of self-efficacy. Self-efficacy, particularly relevant for post-school professional choices, showed stronger association among girls than boys. Our findings would support an earlier introduction of ICT in schools. The exact point in time for ICT introduction, the implementation strategy, as well as the accompanying learning ICT activities, should be piloted and carefully evaluated prior to national scale up.

Keywords: gender, attitudes towards computers, self-efficacy, ICT careers, secondary school

1. Introduction

Despite the commonly high frequency use of computers by boys and girls, this does not seem to translate into a great interest in pursuing Information and Communication Technologies (ICT) related careers, particularly among girls (Schreiner and Sjøberg 2010; OECD 2015)
The possible causes that explain this low interest are related to the attitudes that boys and girls have towards the use of computers and the level of self-efficacy they experiment in the resolution of digital tasks. Lo
No hi ha cap origen al document actual.
No hi ha cap origen al document actual.w levels of enjoyment, self-confidence and self-efficacy and high levels of anxiety seem to lead to lack of consideration of ICT as a promising domain to get a job in the future (Tondeur et al. 2010; Downes and Looker 2011).
Several studies have described the distributions of attitude towards computers and self-efficacy variables in boys and girls (Durndell and Haag 2002; Kubiatko et al. 2011; Christoph et al. 2015).
Taking the advantage of a large sample of secondary school boys and girls, interviewed over a period of three years, our aim is to establish associations between attitudinal (i.e. anxiety, enjoyment and self-confidence) and self-efficacy variables and gender, frequency of use of computers and age of initiation in the use of computers variables in order to (i) verify or challenge current knowledge on these types of

associations; (ii) inform pedagogical approaches and (iii) inform future research relevant to ICT educational policies.

2. Literature Review

According to the statistical office of the European Union (Eurostat), only 5% of students of tertiary education (International Standard Classification of Education ISCED 2013 levels 5-8) are following studies in the field of ICT (Eurostat, n.d., year searched 2016). In the specific case of Spain (average 4.7%), 4.1% students are men and 0.6% are women.
The low number of students enrolled in these studies is a tendency that has remained unchanged in recent years and it seems that it will continue so taking into account the results of the most recent PISA questionnaire (OECD 2016). Students were asked about their intentions to choose higher education. The answers gathered showed that only 4.8% of the boys and 0.4% of the girls consider ICT studies in the future, which is consistent with the data from tertiary education students, shown above.
Taking into account that the use of ICT among adolescents is very extensive as well as intensive, it is mandatory to address the issue of the possible causes that could explain this low motivation towards ICT studies, especially in regard to girls.

2.1. Attitudes towards computers

Attitudes towards computers include different dimensions: anxiety, enjoyment and self-confidence.
Anxiety is defined as fear to interact with ICT and showing overall negative attitudes towards ICT, which leads to a deterioration of tasks and their accomplishment (Shashaani 1993).
Enjoyment is defined as an interest in the use of ICT in the academic context but also during leisure time (Shashaani 1993).
Self- confidence is defined as the personal perception of controlling ICT tools, feeling comfortable when using them and feeling able to overcome difficulties by one's own means (Shashaani 1993).
According to Tondeur et al. (2010), attitudes toward ICT influence the actual and future use of computers. This means that a low level of anxiety and high levels of enjoyment and self-confidence cause an increase in the use of computers and, as a consequence, a greater chance to value future studies in the field of ICT.
In terms of gender, authors report higher anxiety in girls as compared with boys (Baloğlu and Çevik 2008; Kaino 2008; Adebowale, Adediwura and Bada 2009; Kubiatko et al. 2011). Self-confidence levels are lower in girls (Volman and Van Eck 2001; Ogan, Herring and Robinson 2005; Christoph et al 2015), which seems to be associated with girls' tendency to undervalue themselves, boosted by lower informal self-learning, as comparing with boys'.
Despite that girls and boys show similar levels of enjoyment (Ogan et al. 2005; Fančovičová and Prokop 2008; Kaino 2008; Teo 2008; Adebowale et al. 2009). Kubiatko et al (2011) found that enjoyment in the use of computers among girls was

higher than among boys but that mean values of enjoyment decreased with age in girls and increased in boys.

2.2. Frequency of use

Boys and girls are frequent users of ICT. According to the European Union Statistical Office (Eurostat, n.d., year searched 2016), 80% of the youth between 16 and 24 years old use the computer on a daily basis.
Some authors have related the levels of self-efficacy and attitudes towards computers with the frequency of computer use. Papastergiou (2008), Vekiri (2010), Downes and Looker (2011) i Rohatgi, Scherer and Hatlevik (2016) suggested that self-efficacy improves with the increase in the use of computers. Other studies (Garland and Noyes 2004; Teo 2008) show that the systematic use of computers can improve attitudes towards computers.
The locations where this use of computers takes place are mainly students' homes much more frequently than in schools (Murphy and Beggs 2003; Kent and Facer 2004; Selwyn, Potter, and Cranmer, 2009; Tømte and Hatlevik 2011; Scherer et al. 2017). This finding suggests that learning how to use computers occurs in nonformal surroundings that favor activities of leisure over academic ones. Furthermore, using computers at home more often than at school implies that the starting age of use is greatly varies across children and that not everyone will have the same background of expertise.
Attending to gender, there are evident differences in the use of ICT as shown in reports from the International Computer and Information Literacy Study (ICILS) (Fraillon, Ainley, Schulz, Friedman and Gebhardt 2014) and the Organisation for Economic Co-operation and Development (OECD 2015) based on the Programme for International Student Assessment (PISA) tests. Data suggest that girls have a more intensive use of ICT for communication, including social networks, than boys. Boys more often use ICT for leisure and gaming.

2.3. Computer self-efficacy

Self-efficacy is the conviction of one's own ability to successfully carry out a given task (Busch 1995). Psychological studies relate self-efficacy to the likelihood of selecting or being interested in a task, the level of effort and the persistence in completing tasks (Bandura 1978; Bandura and Schunk 1981). Bandura (1978) suggests several factors affecting self-efficacy perceptions; e.g. the experience of being successful in carrying out a task increases the self-efficacy related to that task; observing someone else's success or failure influences self-efficacy; verbal persuasion may have an impact on the possibilities of success; and the issue of one's emotional status. According to the theory of self-efficacy of Bandura, there is a relationship between career choice behaviour and the values of self-efficacy referred to the field of choice (Betz and Hackett 1986; Miura 1987). Downes and Looker (2011) established a correlation between self-efficacy and the intention of students to enrol in ICT studies in the future. Findings suggested that students with a high level of self-perceived computer ability were more likely to consider pursuing an ICT career.

Some evidence suggests other factors such as frequent use of computers, that may increase self-efficacy (Downes and Looker 2011; Papastergiou 2008; Vekiri 2010). Tømte and Hatlevik (2011) pointed out that students who frequently use ICT gain experience in working on ICT-related tasks, which in turn helps them to strengthen the beliefs in their self-efficacy (Usher and Pajares,2008).
In terms of gender differences, self-efficacy seems to be lower among girls than boys (Miura,1987; Durndell and Haag 2002).

3. Research context

This study was carried out in public secondary schools in Catalonia. Catalonia, as an autonomous community within Spain, has almost full competencies in the field of Education. The Department of Education is the body that designs and proposes legislation on the initiatives and curriculum that Catalan schools must follow. All initiatives have to relate to the Spanish educational legislative framework, common to the rest of the autonomous regions, which ensures a certain degree of harmonisation and students mobility within the Spanish territory.
ICT contents are included in Technology, a compulsory subject that has been taught in secondary schools in Catalonia since 1996. In primary education, there is not a formal Technology or ICT subject and computers are used or not by students depending on the pedagogical trends of each particular school.
In the year 2009, the Ministry of Education, Culture and Sports of Spain designed an initiative called School 2.0, in application of EU policies, aiming at the achievement of the students' digital competence.
The Department of Education of Catalonia also implemented this initiative under the name of eduCAT 1x1 in the academic year 2009-2010 and eduCAT 2.0 from the academic year 2010-2011 onwards. This program included the use of personal computers in one-to-one laptop initiative and schools joined it voluntarily.
The data for this study were collected through a questionnaire administered to secondary students of Catalan public schools. The overall aim of the study was to evaluate the eduCAT initiative taking into account the following domains: socio-demographical data, frequency of use of computers, attitudes towards the use of computers (i.e., anxiety, enjoyment and self-confidence), and self-efficacy.

3.1. Research Questions

Existing evidence suggest that gender, the frequency of use of computers and the age at which computer use started may be related with the way teenagers face ICT in secondary school and beyond. However, the association (and the strength of the associations) between those variables has not been estimated. Our research questions are:
1. What is the association between gender and attitudes, frequency of use of computers and self-efficacy?
2. What is the influence of the frequency of computer use in attitudes and self-efficacy?

3. How does the age of initiation in the use of computers affect attitudes and self-efficacy?

4. Methods

In order to address the research questions, we have approached secondary school students, drawn from a random sample of public schools in Catalonia, from their entry year to the secondary level to the last year of common compulsory curriculum (three school years). Schools included a mix of schools applying or not the eduCAT 2.0 program.
Data were collected in two rounds per academic year, except for the last year in which only one round was implemented (total: five data collection rounds).

4.1. Sample

The sample of selected schools was drawn from all 537 public secondary schools in Catalonia, some of them enrolled in the eduCAT 2.0 program. Because we knew that there could be differences in individuals attending schools with and without intensive use of computers, we used a stratified sampling technique to include a balance sample of individuals from both types of schools. Anticipating a low response rate, we included all 175 schools not following the intensive use of computers programmes; and then the same number of 175 schools randomly selected from the 362 schools following the intensive use of computers programme. No school was excluded on the grounds of geographical location, size, or any other reason. Schools were considered as clusters and all eligible students were selected in each school or cluster.

Table 1. Number of participants by gender and collection round

	Boys	Girls	Total
Round 1	976	953	1929
Round 2	822	831	1653
Round 3	860	894	1754
Round 4	693	658	1351
Round 5	732	684	1416
Number of schools: 29			

4.2. Questionnaire

The questionnaire was structured into four sections: socio-demographic context, frequency of use, attitudes towards the use of computers and self-efficacy. Except for the first section containing socio-demographic data, the other sections were adapted from validated questionnaires (PISA 2012 and CAS scale after Loyd and Gressard 1984), as described below, with answers using a four-categories Likert scale. Where applicable, responses were codified and shown through a drop-down box to minimise entry errors (see Appendix 1).
The questionnaire was self-administered under teachers' supervision, using an on-line Google Form platform (https://goo.gl/forms/h5yeMezoyc45fUJw2, in Catalan).

4.2.1. Socio-demographic section

This section describes personal and contextual features of students, following similar approaches reported elsewhere (Chen 1986; Shashaani 1993; Busch 1995; Durndell and Haag 2002; Ogan et al. 2005). They include: (a) gender, (b) age, (c) school, (d) starting age in the use of computers, (e) place where use of computers began, (f) reference place for computers use learning, (g) computer skills of father and (h) mother, and (i) reference person to address computer problems.

4.2.2. Frequency of use section

This section includes a series of routine tasks carried out with computers outside schools. Tasks were drawn from PISA 2012 questionnaire and they include: (a) on-line gaming, (b) social networks participation, (c) homework, (d) email use, (e) participation in chats, (f) Internet browsing, (g) downloads of media and (h) management of personal web sites.
The question statement in the questionnaire was: "Tell us how often you carry out the next tasks using a computer". Responses (4 levels Likert scale) ranged from "Never or hardly ever" (1 point), "Once or twice per month" (2 points), "Once or twice per week" (3 points) and "Almost daily" (4 points). We included "Once or twice a month" to allow responses for some specific actions that could be unusual (e.g. "Management of personal web sites").

4.2.3. Attitudes towards computers section

Attitudes in relation to computer use are classified into three domains: anxiety, self-confidence and enjoyment (see 2. Literature Review section for definitions), following the CAS scale (Computer Attitude Scale) defined by Loyd and Gressard (1984). The CAS scale has 30 items groups in three sub-scales corresponding to the three domains, although statements are mixed and not structured around domains.
The CAS scale is one of the most used in similar studies (Francis 1994; Selwyn 1997; Powell 2013) and it has been widely validated (Gardner, Discenza, and Dukes 1993; Nash and Moroz 1997; Garland and Noyes 2008; Powell 2013). Yet, we revised questions statements to ensure adaptation to the context of this study, especially for

some terms, which are out of use. Finally, the scale was translated into Catalan language, which is the vehicular language in the schools of Catalonia.
Definition for the three attitudes domains can be found at Gender differences: factors section.
The introductory explanation to the questions was formulated as "Indicate the extent to which you agree or disagree with the ideas expressed". Five questions in each domain are formulated in a negative sense to minimize automatic answering and to stimulate a careful reading of the questions. Responses (4 Likert levels) ranged from "Strongly disagree" (1 point), "Disagree" (2 points), "Agree" (3 points) and "Strongly agree" (4 points). Although the former CAS scale ranges from 1 to 5, we have adopted ranges from 1 to 4 after more recent studies have found these scores to be more appropriate to force students to choose negative or positive responses by avoiding neutral, central responses (Farkas and Murthy 2005; Varank 2007).

4.2.4. Self-efficacy section

Self-efficacy section of the questionnaire was drawn from the PISA 2012 questionnaire. Tasks are classified into basic and advanced. The former include: (a) digital edition of pictures, (b) production of a presentation, (c) creation of a text document, (d) working with collaborative documents, (e) reading and responding to emails; and the latter: (f) database creation, (g) use of spread sheets, (g) production of a presentation with images and sound, (h) designing a web site and (i) creating a blog. The question statement was: "Tell us what do you think your level of expertise is in the following tasks". The scale (4 levels Likert) ranged from "I don't know what it means" (1 point), "I can't do it" (2 points), "I can do it with help" (3 points) and "I can do it on my own" (4 points).

4.3. Procedure

The questionnaire was piloted to ensure the coherence of the structure and the understanding of the specific terms of the CAS scale. It was administered to 50 first-year, secondary school students in one school, resulting in the rephrasing of two questions in the section of attitudes. We estimated the internal consistencies of the questionnaire (Cronbach's α) for the three domains frequency of use of computers, attitude and self-efficacy. The results were 0.80, 0.85 and 0.8 respectively.
Other aspects, such as data consistency and completeness using the Google Form platform, were also verified and it was estimated that it would take around 20 minutes to fill the questionnaire. The questionnaire was accompanied by instructions for the teachers who will support its administration to the students.
The first data collection was undergone during the first term of the first academic year of secondary school. The second, the fourth and the fifth data collection were undergone during the last term of the first, second and third academic years of secondary schools respectively. The third data collection was undergone during the first term of the second academic year of secondary school.
Further methodological details can be found elsewhere (Cussó-Calabuig, Carrera and Bosch-Capblanch 2017)

4.4. Data Analysis

All variables were analysed individually. Furthermore, certain variables were combined to build the indicators defined in the questionnaires (PISA 2012, CAS), as follows.

Variables related to frequency of use were grouped in four categories: leisure (i.e., on-line gaming, Internet browsing, downloading of media, management of personal Web sites), homework, communication (i.e., participation in social networks, use of email, participation in chats), and games. The latter was analysed individually despite being included in 'leisure' given the gender differences reported in several studies.

Negative statements in the attitudes domain were recoded to maintain consistency with the rest of the statements. The overall attitude score was estimated adding the values of each question and sub-scale. All questions had the same weight.

Self-efficacy questions were grouped according to the two categories: basic (i.e., digital edition of pictures, production of a presentation, creation of a text document, working with collaborative documents and reading and responding to emails) and advanced (i.e., database creation, use of spread sheets, production of a presentation with images and sound, designing a web site and creating a blog). The overall score was obtained averaging the scores across questions.

Descriptive statistics included percentages, means and their 95% confidence intervals, estimated by taking into account the clustering design of the sample.

In order to establish the associations between the variables, the variables of attitudes, frequency of use and age of initiation in the use of computers were dichotomized. Subsequently, multivariate logistic regression was carried out producing Odds Ratios and 95% confidence intervals, to estimate the following associations, related to the research questions: (i) gender and selected attitudes (i.e. anxiety, enjoyment, self-confidence and attitude index), frequency of use (i.e. leisure frequency, game frequency, communication frequency, homework frequency and frequency index) and self-efficacy variables (i.e. basic level, advanced level and self-efficacy index); (ii) frequency index and selected attitudes (i.e. anxiety, enjoyment, self-confidence and attitude index) and self-efficacy variables (i.e. basic level, advances level and self-efficacy index); and (iii) age of initiation in the use of computers and selected attitudes (i.e. anxiety, enjoyment, self-confidence and attitude index) and self-efficacy variables (i.e. basic level, advances level and self-efficacy index).

Controlling variables form the model (i) were following or not eduCAT program and collection round; and for the models (ii) and (iii) gender and following or not eduCAT program.

All statistics were carried out using Stata 13.0.

5. Results

Results are presented below, following the research questions described in section 3.1.

Table 2 shows the description of the variables included in the analyses: attitudes, frequency of use of computers and self-efficacy, differentiated by boys and girls, with means and SD (95% confidence interval).

Data suggests differences between boys and girls in their attitudes towards the use of computers, measured with the 'Attitude index'. We report separately the three dimensions of this feature: anxiety, enjoyment, and self-confidence. 95% confidence intervals for the overall index did not overlap, suggesting statistically significant differences in attitudes (means: boys = 3.21, SD = 0.019; girls = 3.11, SD = 0.019). Enjoyment (means: boys = 3.03, SD = 0.022; girls = 2.89, SD = 0.017) and self-confidence (means: boys = 3.22, SD = 0.022; girls = 2.89, SD = 0.023) in girls were lower than in boys'. 95% confidence intervals did not overlap in any of these two dimensions.

No differences were found between boys and girls in the computers' frequency use index, but differences were unveiled when looking at the specific habits in the use of computers.

There are three dimensions where boys and girls showed significant differences, with non-overlapping 95% confidence intervals: leisure, communication and game. In relation to leisure, there were minor gender differences: the frequency in the use of computers by girls was lower than in boys (means: boys = 2.59, SD = 0.028; girls = 2.34, SD = 0.033). Regarding the use of computers for communication, it was slightly higher in girls (mean= 3.09, SD = 0.034) than in boys (mean = 2.94, SD = 0.042). Finally, the largest differences were in the computers' frequency of use for gaming. Girls reported lower frequency of use below the half point in the scale (mean = 1.91, SD = 0.045); and boys a frequency slightly above the middle point (mean = 2.54, SD = 0.048). (see Table 2).

Table 2. Results of Frequency of use, Attitudes and Self-efficacy (*Statistically significant differences)

	Boys (N=4083)		Girls (N=4020)	
	Mean	SD	Mean	SD
ATTITUDES				
Anxiety	3.38	0.022	3.35	0.017
Enjoyment*	3.03	0.021	2.89	0.023
Self-confidence*	3.23	0.022	3.09	0.026
Attitude Index*	3.21	0.020	3.11	0.020
FREQUENCY OF USE				
Leisure frequency*	2.59	0.029	2.37	0.033
Game frequency*	2.54	0.048	1.91	0.045
Communication frequency*	2.94	0.042	3.09	0.034
Homework frequency	3.17	0.089	3.28	0.081
Frequency Index	2.79	0.025	2.75	0.022
SELF-EFFICACY				
Basic level	3.66	0.021	3.70	0.016
Advanced level	3.23	0.021	3.21	0.023
Self-efficacy index	3.44	0.017	3.45	0.016

Research question 1: What is the association between gender and attitudes, frequency of use of computers and self-efficacy?

Table 3. Multivariate logistic regression describing the association of gender and selected attitudes, frequency of use and self-efficacy variables (Odds Ratios and 95% confidence intervals) (*Statistically significant)

	Odds Ratio	95% Confidence interval	Boys (N=4083)	Girls (N=4020)
ATTITUDES				
Low Anxiety	1.124	0.804 to 1.573	218	191
Low Enjoyment	0.582*	0.474 to 0.715	628	952
Low Self-confidence	0.726*	0.548 to 0.962	397	519
Low Attitude Index	0.708*	0.520 to 0.964	309	415
FREQUENCY OF USE				
Low Leisure frequency	0.489*	0.409 to 0.584	1547	2231
Low Game frequency	0.200*	0.166 to 0.241	1897	3255
Low Communication frequency	1.348*	1.119 to 1.626	1162	915
Low Homework frequency	1.289*	1.074 to 1.548	1205	978
Low Frequency Index	0.968	0.837 to 1.120	1135	1141
SELF-EFFICACY				
Low Basic level	1.642*	1.095 to 2.463	129	79
Low Advanced level	1.166	0.894 to 1.521	308	264
Low Self-efficacy Index	2.083*	1.444 to 3.005	124	60

The OR describing the relationship between gender and selected variables related to attitudes, frequency of computer use and self-efficacy, controlling for the effects of following or not eduCAT program and collection round, are shown in Table 3. ORs above 1 suggest a larger odd for boys than girls presenting low levels of the variables studied (and vice-versa for OR below 1). Significant OR could be found in all variables except for anxiety, frequency index of computer use and advanced level activities (see Table 3).

Boys show a greater likelihood than girls of positive attitudes towards the use of computers. This is shown in the OR of the attitude index (OR=0.708, comparing boys having low attitude index with girls having low attitude index, boys have 0.708 more probability to show low values) and also in all the related variables, being enjoyment the variable that shows a stronger association (OR=0.582).

Boys also show a greater association than girls using computers for leisure activities (OR=0.489) and, even more clearly, in their use for games (OR=0.200). By contrast, girls are more likely to use computers for communication (OR=1.348) and school homework (OR=1.289) than boys do.

With regard to self-efficacy and related variables, girls show a greater odd than boys having a positive self-perception both of their capabilities to carry out basic actions with computers (OR=1.642) and self- efficacy in global (OR=2.083).

Research question 2: What is the influence of the frequency of computer use in attitudes and self-efficacy?

Table 4. Multivariate logistic regression describing the association of frequency index and selected attitudes and self-efficacy variables (Odds Ratios and 95% confidence intervals) (*Statistically significant)

	Odds ratio	95% Confidence interval	Low Frequency Index (N=2276)	High Frequency Index (N=5827)
ATTITUDES				
Low Anxiety	2.249*	1.662 to 3.044	183	226
Low Enjoyment	2.660*	2.200 to 3.216	713	867
Low Self-confidence	2.444*	1.964 to 3.042	423	493
Low Attitude Index	2.984*	2.184 to 4.078	378	346
SELF-EFFICACY				
Low Basic level	1.292	0.814 to 2.049	86	122
Low Advanced level	1.733*	1.411 to 2.130	229	343
Low Self-efficacy Index	1.192	0.777 to 1.827	70	114

In these analyses, an OR above 1 suggests that higher frequency in the use of computers is associated with lower values of the selected variables controlling by following or not eduCAT program and gender.
Most of the OR describing the relationship between the frequency of use of computers and the variables referring to attitudes and self-efficacy are above 1, suggesting that more intense use of computers is associated to 'better' attitudes and advanced self-efficacy, and no association with the overall self-efficacy index and the basic resolution level activities (95% confidence intervals containing 1; see Table 4).
ORs show remarkably higher values for the attitudes variables than for the self-efficacy variables, suggesting a stronger association in the former.
Research question 3: How does the age of initiation in the use of computers affect attitudes and self-efficacy?

Table 5. Age of initiation in the use of computers for boys and girls

	Boys (N=4083)		Girls (N=4020)	
	Percentage	SD	Percentage	SD
AGE OF INITIATION				
Before 6	37.91%	2.24	34.00%	1.98
Between 6 and 8	42.42%	1.48	46.90%	1.57
Between 9 and 11	18.44%	1.76	17.94%	1.66
12 and more	1.23%	0.32	1.15%	0.50

In relation to the initiation in the use of computers, our analyses show that about 80% of the children use computers for the first time before the age of nine. Early use of computers is related to ages from six to eight and late use of computers to ages from 9. Boys have an earlier start in the use of computers than girls: 37.91% of boys report having used computers when they were younger than six years old, as compared with 34% of girls.

Table 6. Multivariate logistic regression describing the association of age of initiation in the use of computers and selected attitudes and self-efficacy variables (Odds Ratios and 95% confidence intervals) (All OR values statically significant)

	Odds ratio	95% Confidence interval	Early use of computers (N=6508)	Late use of computers (N=1595)
ATTITUDES				
Low Anxiety	0.593	0.503 to 0.701	252	157
Low Enjoyment	0.737	0.679 to 0.800	1168	412
Low Self-confidence	0.683	0.623 to 0.748	649	267
Low Attitude Index	0.629	0.569 to 0.696	492	232
SELF-EFFICACY				
Low Basic level	0.671	0.523 to 0.861	132	76
Low Advanced level	0.655	0.591 to 0.725	395	177
Low Self-efficacy Index	0.703	0.547 to 0.903	124	60

Looking at the association between the age of initiation in the use of computers and selected variables, controlling for following or not eduCAT program and gender, an OR below 1 suggests that later initiation age is associated with lower levels of the selected variables. All OR are below 1 and statically significant, with CI not including the value

of 1. This suggests a relatively strong association between the beginning in the use of computers at early ages and positive values of all the variables of attitudes and self-efficacy.

6. Discussion

The analysis of the associations between the variables of gender, attitudes towards computers, frequency of computer use, self-efficacy and age of initiation allows establishing interactions among them beyond the description of the values obtained in observational studies.

ORs values give us information about the probability that levels of a variable are related to certain levels of another variable. The results do not indicate causality but they do provide guidelines for the design of future research that may or may not verify this causality.

Research question 1: What is the association between gender and attitudes, frequency of use of computers and self-efficacy?

Regarding to attitudes, we have not found consistent associations of gender and anxiety dimension, despite the existing evidence suggesting that girls show greater anxiety than boys (Baloğlu and Çevik 2008; Kaino 2008; Adebowale et al. 2009; Kubiatko et al. 2011). In contrast, we have found associations between the other attitude variables and gender. Attending to the enjoyment variable, it was observed that boys have a greater chance of having a positive attitude than girls (OR=0.582; CI=0.474 to 0.715). This fact is not consistent with previous studies, reporting similar rates for boys and girls (Ogan et al. 2005; Fančovičová and Prokop 2008; Kaino 2008; Teo 2008; Adebowale et al. 2009).

The self-confidence variable showed an association with gender, with boys having higher odd values, although the results are lower than expected according to reviewed literature (Volman and Van Eck 2001; Ogan et al. 2005; Christoph et al. 2015).

The associations between the frequency variables of use and gender followed the expected patterns in relation to the literature consulted. Both the leisure variable and the game variable showed high values of OR, favouring the possibility of the boys making a high use of computers for these types of activities. The results also confirmed the positive association of girls with regard to the high use of computers to carry out communication tasks and resolution of homework (Fraillon et al., 2014; OECD, 2015).

Finally, the associations between self-efficacy variables and gender showed very different results from the consulted studies. While most authors indicate that girls have lower levels of self-efficacy than boys (Miura 1987; Durndell and Haag 2002) and that this may be one of the reasons why girls are not planning to pursue careers in the ICT field, the value of OR referring to the self-efficacy index indicated a greater likelihood that girls have positive values in this variable than boys (OR=2.083; CI=1.444 to 3.005). Given these results, it seems clear that self-efficacy is not one of main reasons that can explain the low number of women in the ICT field studies. However, it should be noted that the self-efficacy index reflects the values of the basic level activities and advanced level activities variables and that only the OR value of the

first indicated a greater probability of girls' positive attitudes while the second is not statistically significant. The performance of basic level activities with computers can be associated with the accomplishment of scholastic tasks, which would coincide with the value of OR of homework commented previously with reference to the girls.
On the other hand, the high association of positive attitudes of the boys with reference to the enjoyment in the use of the computers, the frequency of leisure and the frequency of game implies an informal and technical learning, related also with the necessity of resolution of complex tasks in an autonomous and non-guided way that can explain the OR value of self-confidence.
In summary, boys tend to use informal and autonomous learning in the use of computers and girls in a formal and guided use and learning.
Research question 2: What is the influence of the frequency of computer use in attitudes and self-efficacy?
The associations corresponding to the frequency of use of computers and the variables of attitudes and self-efficacy indicate that there is a positive correlation, that is, the higher the frequency of computer use, the greater the possibility of presenting positive trends to all variables, especially those that refer to attitudes. The results are consistent with the studies consulted that indicate that increased use of computers improves self-efficacy (Papastergiou 2008; Usher and Pajares 2008; Vekiri 2010; Downes and Looker 2011; Tømte and Hatlevik 2011; Rohatgi et al. 2016) and attitudes towards computers (Garland and Noyes 2004; Teo 2008).
Research question 3: How does the age of initiation in the use of computers affect attitudes and self-efficacy?
The association between the age of the beginning of the use of computers and the variables of attitudes and self-efficacy shows that there is a greater probability of presenting positive values of the variables when the use of the computer was started earlier. These results are consistent with those obtained in research question 2, since when the lower is the age of initiation, the higher the frequency with which the computer is used.
They are also consistent with studies that indicate that boys and girls mostly use computers in their homes, since the intensive use of ICT in schools begins at higher ages.

7. Conclusions

Our findings provide indirect evidence to inform educational managers and policy makers in several ways. First, these associations point at critical issues to take into account when planning and implement ICT initiatives in schools; namely: age of initiation in the use of computers at school, gender issues, students' attitude towards computers and perceived self-efficacy. Second, these associations help to understand the mechanisms that facilitate the equal achievement of the digital competence among boys and girls and that favour the vocations for studies in the field of ICT. To this end, we believe that the design of classroom activities and the methodologies of integration of ICT in the teaching-learning procedure are critical complementary issues.

The associations between gender and the rest of the variables showed that boys are more likely than girls to have a high level of enjoyment in the use of computers, greater self-confidence and higher use of computers for leisure and game. In other words: boys learn how to use computers independently, in non-formal settings and overcoming challenges by themselves. On the other hand, girls were more likely to make frequent use of computers to do homework and to communicate and to show a higher index of self-efficacy, specially related to solve basic level tasks, than boys. In other words, girls learn how to use computers in formal environments, especially through guided activities.

Hence, we need a better understanding about the aspects in which girls feel more or and less qualified in order to design learning activities using ICT that increase girls' self-efficacy and self-confidence. Promising strategies include the development of collaborative learning activities, because they need high levels of communication between students, a lot of creativity and are based on challenges, in order to integrate how boys and girls face the use of ICT.

The associations between frequency of use and the rest of the variables indicate that the frequent use increases the probability of having high values of all the variables, except those referring to basic level tasks and self-efficacy, which that do not show any meaningful association. The association with advanced level tasks, would call for a deeper analysis of a wide range of tasks to detect which ones lead to an increase in self-efficacy, including gender co-variates.

Our findings also suggest that introducing the use of computers at earlier ages may have favourable effects, which could be properly estimated using comparative study designs.

Policy makers and managers should take note of the wealth of research evidence that may inform promising policies that reduce the gender imbalances in the short run, but also in their vocational choices after school. Observational studies, like this one, can be used to generate hypothesis to inform further research.

8. References

Adebowale, O., Adediwura, A., and Bada, T. (2009). Correlates of computer attitude among secondary school students in Lagos State, Nigeria. *International Journal of Computing and ICT Research*, *3*(2), 20-30.

Baloğlu, M., & Çevik, V. (2008). Multivariate effects of gender, ownership, and the frequency of use on computer anxiety among high school students. *Computers in Human Behavior*, *24*(6), 2639-2648. http://dx.doi.org/10.1016/j.chb.2008.03.003

Bandura, A. (1978). Self-efficacy: Toward a unifying theory of behavioral change. *Advances in Behavior Research and Therapy*, *1*(4), 139-161. http://dx.doi.org/10.1016/0146-6402(78)90002-4

Bandura, A., & Schunk, D. H. (1981). Cultivate competence, self- efficacy and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology, 41(*3), 586-598. http://dx.doi.org/10.1037/0022-3514.41.3.586

Betz, N., and Hackett, G. (1986). Applications of Self-Efficacy Theory to Understanding Career Choice Behavior. *Journal of Social and Clinical Psychology*, *4,* Special Issue: Self-Efficacy Theory in Contemporary Psychology, 279-289. https://doi.org/10.1521/jscp.1986.4.3.279

Busch, T. (1995). Gender differences in self-efficacy and attitudes toward computers. *Journal of Educational Computing Research*, *12*(2), 147-158. http://dx.doi.org/10.2190/H7E1-XMM7-GU9B-3HWR

Chen, M. (1986). Gender and computers: The beneficial effects of experience on attitudes. *Journal of Educational Computing Research*, *2*, 265-282. http://dx.doi.org/10.2190/WDRY-9K0F-VCP6-JCCD

Christoph, G., Goldhammer, F., Zylka, J., & Hartig, J. (2015). Adolescents' computer performance: The role of self-concept and motivational aspects. *Computers and Education*, *81*, 1-12. http://dx.doi.org/10.1016/j.compedu.2014.09.004

Cussó-Calabuig, R., Carrera, X., & Bosch-Capblanch, X. (2017). Are Boys and Girls still Digitally Differentiated? The Case of Catalonian Teenagers. *Journal of Information Technology Education: Research, 16*, 411-435. https://doi.org/10.28945/3879

Downes, T., & Looker, D. (2011). Factors that influence students' plans to take computing and information technology subjects in senior secondary school. *Computer Science Education*, *21*(2), 175-199. http://dx.doi.org/10.1080/08993408.2011.579811

Durndell, A., & Haag, Z. (2002). Computer self-efficacy, computer anxiety, attitudes towards the Internet and reported experience with the Internet, by gender, in an East European sample. *Computers in Human Behavior*, *18*(5), 521-535. http://dx.doi.org/10.1016/S0747-5632(02)00006-7

European Union Statistical Office (Eurostat). (n.d.). *Survey on Digital Economy and Society.* Retrieved from https://ec.europa.eu/eurostat/web/education-and-training/data/main-tables and http://ec.europa.eu/eurostat/web/digital-economy-and-society/data/database

Fančovičová, J., & Prokop, P. (2008). Students' attitudes toward computer use in Slovakia. *Eurasia Journal of Mathematics Science & Technology Education*, *4*(3), 255-262.

Farkas, D., & Murthy, M. (2005). Attitudes toward computers, the introductory course and recruiting new majors: Preliminary results. *Proceeding of Programming Interest Group 17*, 268-277.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). Students' use of and engagement with ICT at home and school. *Preparing for Life in a Digital Age: The IEA International Computer and Information Literacy Study International Report*, 125-166. Retrieved May 2017. http://dx.doi.org/10.1007/978-3-319-14222-7_6

Francis, L. J. (1994). The relationship between computer related attitudes and gender stereotyping of computer use. *Computers and Education*, *22*(4), 283-289. http://dx.doi.org/10.1016/0360-1315(94)90050-7

Gardner, D. G., Discenza, R., & Dukes, R. L. (1993). The measurement of computer attitudes: an empirical comparison of available scales. *Journal of Educational Computing Research*, *9*, 487-507.

Garland, K. J., & Noyes, J. M. (2008). Computer attitude scales: How relevant today?. *Computers in Human Behavior*, *24*(2), 563-575. http://dx.doi.org/10.1016/j.chb.2007.02.005

Kaino, L. M. (2008). Technology in learning: Narrowing the gender gap? *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 263-268.

Kent, N., & Facer, A: (2004): Different worlds? A comparison of young people's home and school ICT use. *Journal of Computer Assisted Learning, 20*, 440-455. https://doi.org/10.1111/j.1365-2729.2004.00102.x

Kubiatko, M., Haláková, Z., Nagyová, S., & Nagy, T. (2011). Slovak high school students' attitudes toward computers. *Interactive Learning Environments*.
http://dx.doi.org/10.1080/10494821003612232

Loyd, B. H., & Gressard, C. (1984). Reliability and factorial validity of computer attitude scales. *Educational and Psychological Measurement*, *44*, 501-505. http://dx.doi.org/10.1177/0013164484442033

Murphy, C., & Beggs, J. (2003). Primary pupils' and teachers' use of computers ay home and school. *British Journal of Educational Technology, 34*(1), 79-83. https://doi.org/10.1111/1467-8535.d01-9

Nash, J., & Moroz, P. (1997). An examination of the factor structures of the computer attitude scale. *Journal of Educational Computing Research*, *17*(4), 341-356.

OECD. (2014). PISA 2012 Technical Report, PISA, OECD Publishing. Retrieved October 2018.
https://www.oecd.org/pisa/pisaproducts/PISA-2012-technical-report-final.pdf

OECD. (2015). *Students, Computers and Learning: Making the Connection*, OECD Publishing, Paris.
http://dx.doi.org/10.1787/9789264239555-en

OECD (2016), PISA 2015 Results (Volume I): Excellence and Equity in Education, PISA, OECD Publishing, Paris, http://dx.doi.org/10.1787/9789264266490-en.

OECD. (2017). PISA 2015 Technical Report, PISA, OECD Publishing. Retrieved October 2018.
https://www.oecd.org/pisa/sitedocument/PISA-2015-technical-report-final.pdf

Ogan, C., Herring, S. C., and Robinson, J. C. (2005). International Communications Association Conference. *The More Things Change , the More They Stay the Same : Gender Differences in Attitudes and Experiences Related to Computing Among Students in Computer Science and Applied Information Technology Programs*.

Papastergiou, M. (2008). Are computer science and information technology still masculine fields? High school students' perceptions and career choices. *Computers and Education*, *51*(2), 594-608.
http://dx.doi.org/10.1016/j.compedu.2007.06.009

Powell, A. L. (2013). Computer anxiety: Comparison of research from the 1990s and 2000s. *Computers in Human Behavior*, *29*(6), 2337-2381. http://dx.doi.org/10.1016/j.chb.2013.05.012

Selwyn, N. (1997). Students' attitudes toward computers: Validation of a computer attitude scale for 16–19 education. *Computers and Education*, *28*(1), 35-41. http://dx.doi.org/10.1016/S0360-1315(96)00035-8

Selwyn, N., Potter, J., & Cranmer, S. (2009). Primary pupils' use of information and communication technologies at school and home. *British Journal of Educational Technology, 40*(5), 919-932. https://doi.org/10.1111/j.1467-8535.2008.00876.x

Scherer, R., Rohatgi, A., and Hatlevik, O. (2017). Students' profiles of ICT use: Identification, determinants, and relations to achievement in a computer and information literacy test. *Computers in Human Behavior, 70,* 486-499. https://doi.org/10.1016/j.chb.2017.01.034

Shashaani, L. (1993). Gender-based differences in attitudes. *Computers and Education*, *20*(2), 169-181.

Schreiner, C. & Sjøberg, S. (2010). The ROSE project: an overview and key findings. *Oslo: University of Oslo*, 1-31. http://www.uv.uio.no/ils/english/research/projects/rose/publications/the-rose-project.pdf

Teo, T. (2008). Assessing the computer attitudes of students: An Asian perspective. *Computers in Human Behavior*, *24*(4), 1634-1642. http://dx.doi.org/10.1016/j.chb.2007.06.004

Tømte, C., & Hatlevik, O.E. (2011). Gender-differences in Self-efficacy ICT related to various ICT-user profiles in Finland and Norway. How do self-efficacy, gender and ICT-user profiles relate to findings from PISA 2006. *Computers and Education, 57*(1), 1416-1424. https://doi.org/10.1016/j.compedu.2010.12.011

Tondeur, J., Sinnaeve, I., van Houtte, M. and van Braak, J. (2011). ICT as cultural capital: The relationship between socioeconomic status and the computer-use profile of young people. *New Media & Society, 13*(1), 151-168. https://doi.org/10.1177/1461444810369245

Usher, E:, & Pajares, F. (2008). Sources of Self-Efficacy in School: Critical Review of the Literature and Future Directions. *Review of Educational Research, 78*(4), 751-796. https://doi.org/10.3102/0034654308321456

Varank, I. (2007). Effectiveness of quantitative skills, qualitative skills, and gender in determining computer skills and attitudes: A causal analysis. *The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 81*(2), 71-80

Vekiri, I. (2010). Boys' and girls' ICT beliefs: Do teachers matter?. *Computers and Education, 55*(1), 16-23. https://doi.org/10.1016/j.compedu.2009.11.013

Volman, M., & van Eck, E. (2001). Gender equity and information technology in education: The second decade. *Review of Educational Research*, *71*(4), 613-634. http://dx.doi.org/10.3102/00346543071004613

Appendix 1: Questionnaire

Socio-Demographic Context

Questions	Answers
Gender	Boy / Girl
Age	11/12/13/14/15
Name of school	Open answer
Dou you have a computer at home?	Yes, mine/Yes, shared/No
When do you start using a computer?	Before 6/Between 6 and 8/Between 9 and 11/After 12
Where did you use a computer for the first time?	At home/At school/At a relative's home/At a friend's home
Which level of ICT skills do you think having your father?	Very high/High/Low/Very low/NA
Which level of ICT skills do you think having your mother?	Very high/High/Low/Very low/NA
Who do you ask for help when you have a computer problem?	Father/Mother/Brother-Sister/Friends
Where do you think you learn to use computers?	On my own at home/At school/At home with some help/With friends

FREQUENCY OF USE: Indicate how often you perform the following tasks with your computer
(Possible answers: Almost never/Once or twice a month/Once or twice a week/Almost everyday)

QUESTIONS
Gaming
Forums/Social networks
Schools homework
Email
Chats
Surfing the Internet
Downloading music, games, films
Maintaining a personal web or blog

Attitudes: Indicate the extent to which you agree or disagree with the ideas expressed

(Possible answers: Strongly disagree/Disagree/Agree/Strongly agree)

Questions	Related Variable
Computers do not scare me at all	Anxiety
I would like working with computers	Enjoyment
Working with a computer would make me very nervous (*)	Anxiety
I do not feel threatened when others talk about computers	Anxiety
It wouldn't bother me at all to take computer courses	Anxiety
I'm no good with computers (*)	Self-confidence
The challenge of solving problems with computers does not appeal to me (*)	Enjoyment
Computers make me feel uncomfortable (*)	Anxiety
Generally, I would feel OK about trying a new problem on the computer	Self-confidence
I would feel at ease in a computer class	Anxiety
I think working with computers would be enjoyable and stimulating	Enjoyment
I don't think I would do advanced computer work (*)	Self-confidence
Figuring out computer problems does not appeal to me (*)	Enjoyment
I get a sinking feeling when I think of trying to use a computer (*)	Anxiety
I am sure I could do work with computers	Self-confidence
I would feel comfortable working with a computer	Anxiety
When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer	Enjoyment
I'm not the type to do well with computers (*)	Self-confidence
I don't understand how some people can spend so much time working with computers and seem to enjoy it (*)	Enjoyment
I am sure I could learn a computer language	Self-confidence
Once I start to work with the computer, I would find it hard to stop	Enjoyment
I think using a computer would be very hard for me (*)	Self-confidence
I will do as little work with computers as possible (*)	Enjoyment
Computers make me feel uneasy and confused (*)	Anxiety
If a problem is left unsolved in a computer class, I would continue to think about it afterward	Enjoyment
I could get good grades in computer courses	Self-confidence
I do not enjoy talking with others about computers (*)	Enjoyment
I do not think I could handle a computer course (*)	Self-confidence
I have a lot of self-confidence when it comes to working with computers	Self-confidence
I feel aggressive and hostile toward computers (*)	Anxiety

Note: (*) Items for which score is reversed

Self-efficacy: Indicate what you think is your level with respect to the following tasks

(Possible answers: I don't know what it means/I can't do it/I can do it with help/I can do it on my own)

Questions
Edit digital images
Create a database
Use a spread sheet
Create a presentation
Create a multimedia presentation with images, sounds and videos
Create a text document
Work in collaborative documents
Create a web page
Create a blog
Read and answer email