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**Media literacy as intergenerational project: skills, norms, and mediation**

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## Who needs teachers?

### Factors associated with learning ICT skills from teachers in a multilevel analysis of the ICILS data

Priscila Berger

#### Abstract

*While great responsibility is placed upon schoolteachers for educating children and adolescents in media and technology, the increasing access to technology offers opportunities for youngsters to develop information and computer technology (ICT) skills informally. Thus, they do not depend solely on the school to develop computer and information literacy (CIL). Conversely, studies confirm that in some countries students report that they have learned specific ICT skills mainly from their teachers. However, little is known about the conditions under which students rely on teachers to develop CIL skills. This study explores the characteristics of students, schools, and countries that are associated with the incidence of learning CIL from teachers. Based on previous studies, a model was developed and tested employing a three-level analysis with data from 14 participant countries of the International Computer and Information Literacy Study (ICILS). The model reveals significant associations with students' socioeconomic conditions, students' self-efficacy in advanced ICT tasks, students' gender and countries' ICT Development Index score. The schools' characteristics do not contribute significantly to the model. Furthermore, implications for the involvement of both students and teachers regarding media education in schools are discussed.*

#### Wer braucht Lehrkräfte? Einflussfaktoren auf die Vermittlung von ICT-Kompetenzen durch Lehrkräfte am Beispiel der ICILS-Daten

#### Zusammenfassung

*Bei der Vermittlung eines kompetenten Umgangs mit Medien und Technologien tragen Lehrkräfte eine grosse Verantwortung. Jedoch bietet die wachsende Verfügbarkeit unterschiedlicher Technologien Jugendlichen die Möglichkeit, Fähigkeiten im Umgang mit Informations- und Computertechnologien (ICT) auch ausserhalb der Schule zu erlernen. Folglich ist die Schule nicht alleine verantwortlich für die Vermittlung von Computer- und Informationskompetenzen (CIL). Dennoch zeigen Forschungsergebnisse, dass Schülerinnen und Schüler in einigen Ländern angeben, dass sie ihre Fähigkeiten im digitalen*

*Bereich hauptsächlich von ihren Lehrkräften vermittelt bekommen haben. Unbekannt ist jedoch, welche Faktoren (z.B. Eigenschaften der Schülerinnen und Schüler, der Schulen und Bedingungen in den einzelnen Ländern) dafür verantwortlich sind, dass die Lernenden sich verstärkt auf die Lehrkräfte verlassen. Das Ziel der vorliegenden Studie ist es, diese Faktoren systematisch zu untersuchen. Ausgehend von vorhandenen Studien wird ein Model entwickelt und mittels Mehrebenenanalyse anhand von Daten aus 14 Ländern (alle Teilnehmer der letzten International Computer and Information Literacy Study) getestet. Die Ergebnisse zeigen den signifikanten Einfluss der sozioökonomischen Rahmenbedingungen, der Selbstwirksamkeitserwartung und des Geschlechts der Schülerinnen und Schüler sowie des ICT Development Index. Eigenschaften der Schulen hingegen beeinflussen die Vermittlung der Kompetenzen nicht signifikant. Abschließend werden die vorliegenden Ergebnisse im Hinblick auf das Zusammenwirken von Lehrkräften sowie Schülerinnen und Schülern bei der schulischen Medienerziehung diskutiert.*

## **Introduction**

Initiatives in several countries have led to the inclusion of media education in their formal school curricula. Although there are a variety of media education proposals that emphasize specific competencies, most of them agree that pupils must learn how to access and analyse information and how to create and use various forms of media (Buckingham 2010; Baacke 1996; LKM 2015).

In many countries, the availability of information and communication technologies (ICT) in households is widespread. For instance, in Germany, 98% of the youngsters between 12-19 years old that participated in the «JIM Studie» [Youth, Information, Media Study] in 2018 report having a smartphone, a computer/laptop and an internet connection available at home (Feierabend, Rathgeb, and Reuther 2018). This easy access to ICTs offers new possibilities for youngsters to develop some media-related skills autonomously and in their exchanges with family and peers (Claro et al. 2012). However, this informal learning is unlikely to cover all areas of media literacy required to prepare youngsters sufficiently for the challenges of the digitalized world. In consequence, a significant part of the responsibility for this is attributed to schools (Buckingham 2007; Vanderlinde, van Braak, and Hermans 2009; Wilson et al. 2011), and especially to teachers (Brüggemann 2013; Dias-Fonseca and Potter 2016; UNESCO 2008).

Shin and Lwin (2017) argue that due to the expectations placed upon teachers, their roles in youngsters' development of media and technology skills deserve empirical and conceptual investigation. Previous research has indicated that secondary school students recognize teachers as relevant agents in their development of skills in safe internet use (Livingstone et al. 2011; Shin and Lwin 2017), suggesting that the fostering of students' digital protection skills is an area that deserves attention in the

school curriculum. However, it is unclear how the school is perceived as a source of youngsters' ICT skills in other areas. For instance, the area of computer and information literacy (CIL) consists of skills in knowing about and understanding computer use as well as accessing, evaluating, managing, transforming, and creating information (Fraillon et al. 2014). The International Computer and Information Literacy Study (ICILS) pointed out factors associated with students' CIL level, for instance, their socioeconomic status, gender, parental education level, and parental occupation level. However, the mediation of CIL has not yet been discussed, and therefore little is known about which characteristics and circumstances make youngsters count more on the school rather than on other agents or their own autonomous learning, when it comes to developing CIL.

Moreover, the previous results of the ICILS data reinforce that some children have an advantage in developing skills demanded in digital environments because of their greater access to ICTs and through having parents who are experienced with computers and technology (Buckingham 2007). In this sense, media education at school should be an opportunity to alleviate the digital divide among students created by external factors. Knowing under which circumstances youngsters rely more on teachers for the development of diverse media-related skills is useful for schools to adjust their priorities in media education, improve their chances of bridging gaps and meet the students' demands.

While learning ICT from teachers may depend partly on the learner, i.e., on the characteristics of the individual level, it is also to some extent a result of the media education practiced in schools, i.e., the components of the institutional level. Besides, media-related initiatives in education happen in a specific national context, and so the characteristics of a country may shape their implementation and outcomes. Based on this, the present analysis aims to explore the aspects of students, schools, and countries that are associated with the incidence of learning ICT skills from teachers. Therefore, the study applies a secondary analysis of data from 14 countries, which took part in the first ICILS. The study, thus, aims to improve understanding about the circumstances in which teachers' mediation plays a relevant role in youngsters' CIL, and discusses possible implications for the practice of media education in schools.

### **Influence of different levels on media education and its outcomes**

According to Kozma (2003), the process of introducing technology-related innovations in education passes through three different spheres, namely (1) the macro level, which refers to the economic, political, educational, and media context of a region, (2) the meso level, which consists of the processes that happen in the organizational sphere, e.g. schools and institutions involved in media education, and (3) the

micro level, which corresponds to individual agents involved in the media education process, namely teachers, parents, peers, and students. Research has investigated the influence of different aspects in these levels on the implementation of technology for instruction and media education in schools as well as on its outcomes, such as students' ICT competence, self-efficacy, and reported learning.

### *Micro level*

On the micro level, a few studies have presented associations between student characteristics and the role of teachers in media and technology education. Livingstone and colleagues (2011) pointed out that older teenagers as well as those with lower socioeconomic status (SES) tend to receive advice on safe internet use primarily from teachers. Independently from the role of teachers, parental SES was also found to have a positive correlation with students' CIL (Fraillon et al. 2014; Hatlevik et al. 2018). A possible explanation for this finding is that parents with lower educational and occupational levels are less likely to be digitally literate themselves and, therefore, less able to instruct their children in ICT-related matters (Hatlevik et al. 2018). Moreover, youngsters with lower SES tend to have less access to ICT at home, and access to computers and the internet is a relevant factor considered to contribute to youngsters' CIL (Fraillon et al. 2014).

Research also points towards gender as an important aspect associated with the role of teachers in youngsters' ICT self-efficacy. Vekiri (2010) identified that students' perception of receiving support from teachers to learn ICT was more strongly associated with girls' ICT self-efficacy, whereas boys' self-efficacy had a stronger association with parental support. Previous research has also revealed that boys tend to receive more stimuli to develop ICT skills from parents than girls (Vekiri and Chronaki 2008). Thus, girls might rely more on teachers as a source for their CIL development (Vekiri 2010).

In addition to gender, autonomous ICT learning has been found to have a positive influence on students' ICT efficacy (Hatlevik et al. 2018). However, studies have also considered the possibility that students might overestimate their own computer and information skills (Hatlevik et al. 2018; Rohatgi, Scherer, and Hatlevik 2016), perceiving their teachers to have low computer-related competences (Herrero Martínez 2014; Siqueira and Rothberg 2014). Even though associations between students' ICT self-efficacy and receiving ICT instruction from teachers have not been directly tested in previous literature, it is likely that students with high ICT self-efficacy might be critical about their teachers' ICT skills, and, thus, not rely so much on teachers as the primary source of their CIL development.

The associations between ICT use at school and learning CIL from teachers have, to the best of our knowledge, not been investigated yet. It is reasonable to expect that higher learning of ICT from teachers might coincide with more intense use of ICT at school. Nevertheless, studies point to a negative association of ICT use at school with students' overall ICT skills (Claro et al. 2012) or show inconclusive results (Hatlevik et al. 2018). This might be explained by the measure of use: Instead of frequency, some studies suggest adopting the quality of use (Hatlevik et al. 2018; Rohatgi et al. 2016).

### ***Meso level***

In addition to the possible influences on the micro level, students' perceived learning of ICT skills from teachers should also be a result of school teaching practices. On the meso level, research has found that the specific characteristics of the school environment, culture and infrastructure influence the extent to which teachers promote education with and about media in their lessons. For instance, positive associations were found with the time available for teachers to prepare classes that integrate media in a meaningful way, support from school principals and colleagues, and teachers' positive attitudes toward media and technology in education (Lorenz, Endberg, and Eickelmann 2016; Wolling and Berger 2018). While some results also point to positive associations with school ICT resources (Petko 2012), other studies did not find significant relationships (Lorenz et al. 2016; Wolling and Berger 2018).

### ***Macro level***

When it comes to the macro level, the context in which media education happens shapes its processes. For instance, a country's development level can be expected to affect the conditions for schools to develop media education. Buckingham and colleagues (2006, 9) draw attention to how the relationship between media and education differs depending on a country's context, so that teachers' media education training must take into consideration «cultural and societal differences as teachers in the different countries are not a homogeneous body. Their level of awareness of the importance of media education varies from country to country. Their relations and their use of media in the educational context may differ dramatically». Hence, factors such as the level of a country's technology penetration indicate the access to media technology both on the individual and the institutional levels, which might affect the priority given to the topic and the conditions of media education in schools. In general, a country's socioeconomic conditions will probably affect aspects such as school equipment, teachers' training, and curriculum priorities, which may influence the emphasis given to media in formal education. For instance, the ICILS reports a significant positive correlation between students' mean score in the CIL test and countries'

ICT Development Index score, and a significant negative correlation with countries' computer-student ratio (Frailon et al. 2014). On the other hand, Areepattamannil and Khine (2017) did not find significant results when testing countries' Gross Domestic Product and Gini coefficient of inequality as predictors of students' ICT use for social communication, referring to the data of 20 participant countries in the ICILS 2013 study.

### **Research question and hypotheses**

Based on previous research findings, this study addresses the lack of investigations into learning ICT from teachers by exploring associations with characteristics of students, schools, and countries, as outlined in the following research question:

*RQ. To what extent is the incidence of learning CIL from teachers influenced by student, school, and country characteristics?*

Based on the reviewed literature, on the micro level four hypotheses are presented below regarding the characteristics of students. Although Livingstone and colleagues (2011) also found associations with age, the ICILS targeted adolescents in the 8th grade or equivalent, therefore the variance in age of the sample is minimal, and consequently not adequate to be part of the model tested in the present study.

- H1. Female students report a higher incidence of learning CIL from teachers than male students.
- H2. Students with higher socioeconomic status report a lower incidence of learning CIL from teachers than students with lower socioeconomic status.
- H3. Students with higher ICT self-efficacy report a lower incidence of learning CIL from teachers than students with lower ICT self-efficacy.
- H4. Students who use ICT at school more intensively report a higher incidence of learning CIL from teachers than students who use ICT at school less intensively.

Regarding the meso level, two hypotheses are presented involving the characteristics of schools.

- H5. Students who attend schools that place a stronger emphasis on teaching ICT report a higher incidence of learning CIL from teachers than students in schools whose emphasis on teaching ICT is lower.
- H6. Students who attend schools that give stronger support to teaching with and about ICT report a higher incidence of learning CIL from teachers than students in schools that do not support teaching with and about ICT.

Finally, one hypothesis refers to aspects of the macro level, i.e., the country level.

- H7. Students who live in countries with better socioeconomic conditions report a lower incidence of learning CIL from teachers than students in countries with inferior socioeconomic conditions.

Figure 1 presents the student, school, and country level aspects that are included in the research model, addressing the aforementioned research question and hypotheses.

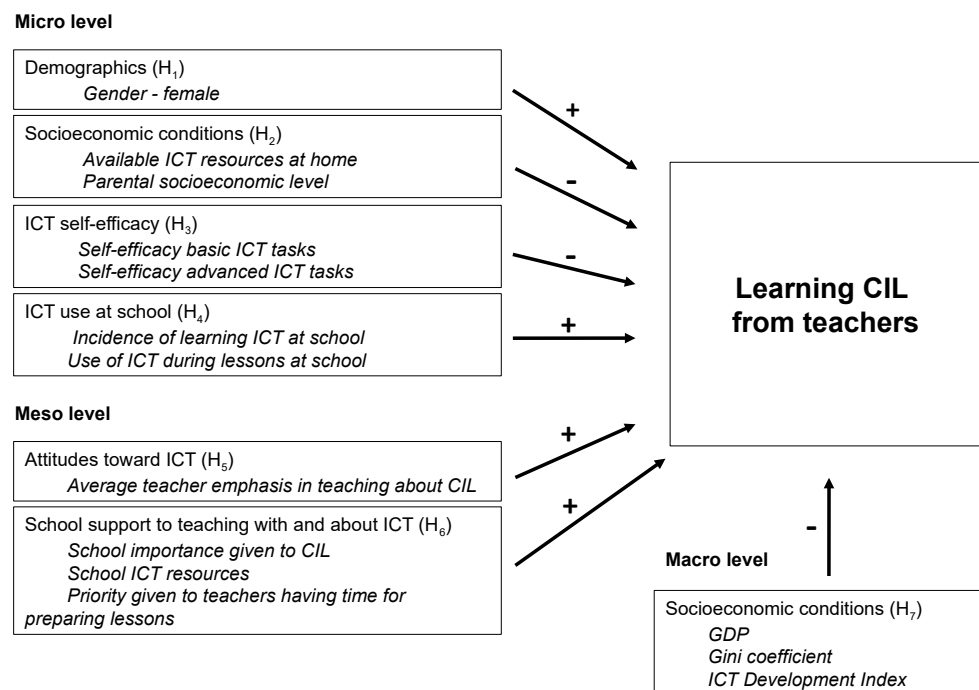


Fig. 1.: Research model.

### Method

To investigate the influence of the different levels on youngsters' perceptions of teachers as media educators, large-scale studies are necessary to collect data that cover the different levels involved. The International Computer and Information Literacy Study (ICILS) follows a multilevel approach and includes the three levels we have outlined. The study conducted in 20 countries in 2013 targeted grade 8 or equivalent students to measure their abilities to use computers for gathering, managing, and communicating information. A main advantage of a secondary analysis of data from large-scale studies such as ICILS is the access to an extensive amount of data and its high quality. Data in such studies are usually professionally collected, frequently using quality sampling and weighting methods, and providing clean and well-structured datasets (Cheng and Phillips 2014; Sautter 2014). Thus, high quality existing data can be explored to answer new, upcoming research questions. Even though the ICILS data covers different levels, most previous studies analyzing it have focused on single-level and single-country analyses (e.g., Rohatgi et al. 2016; Scherer, Rohatgi,

and Hatlevik 2017; Scherer and Siddiq 2015; Siddiq, Scherer, and Tondeur 2016). To the best of our knowledge, the incidence of learning ICT from teachers has not yet been investigated either with single or multilevel analyses of ICILS data. The present study employs the latest available ICILS data (2013) to explore this issue. ICILS data (IEA 2018), as well as rich documentation of data collection processes, data operationalization, quality procedures, and instructions for further analyses are all publicly available (Fraillon et al. 2014; Fraillon et al. 2015; Jung and Carstens 2015).

### **Sample**

The ICILS drew representative samples of both teachers and students via systematic random sampling in all countries (Jung and Carstens 2015). School principals and ICT coordinators were additionally surveyed in the participant schools. The ICILS makes available the data of students, teachers, and schools by country. For the present study, student data were combined with school and country data. Given the nature of the data collected in the ICILS, «student and teacher data must not (and cannot) be merged at the level of individuals» (Jung and Carstens 2015, 19). Consequently, aggregated teacher data were included at the school level. The total ICILS student sample consists of over 60,000 pupils from about 3,300 schools. From the total of 20 countries that participated in the ICILS 2013, five were excluded from the present study for not meeting sampling requirements on the student level, besides Canada<sup>1</sup> (Jung and Carstens 2015). Consequently, the sample of this analysis was reduced to 44,143 students (age  $M = 14.44$ ,  $SD = .70$ ; 49.30% females), from 2497 schools in 14 countries (Australia, Chile, Czech Republic, Germany, Croatia, South Korea, Lithuania, Norway, Poland, Russia, Slovakia, Slovenia, Thailand, and Turkey).

### **Measures**

The measures included in the present analysis are described below. Some measures were operationalized especially for this study, while most measures were adopted from the ICILS datasets. The scales operationalized in the ICILS were developed using confirmatory factor analysis, Cronbach's alpha ( $\alpha$ ) coefficient by country, and item response modeling, and were standardized with a mean of 50 and a standard deviation of 10 (Fraillon et al. 2015). In all measures, higher values indicate a higher incidence of the measured phenomenon, unless specified otherwise.

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1 Canada did not have a national sample. Instead, only two provinces participated. Therefore, it was excluded from the analysis.



*Micro level*

*Learning CIL from teachers.* In the student questionnaire, respondents were asked «Who mainly taught you the following things?» regarding the items (1) communicating over the internet, (2) creating documents for school work, (3) changing computer settings, (4) finding information on the internet, and (5) working in a computer network. Students could choose only one answer for each item. The response options were: «I mainly taught myself», «my teachers», «my family», «my friends», and «I have never learned this». For the present study, the number of «my teachers» was summed to create a composite scale of «student CIL learning from teachers», with values from 0 = student learned none of the five skills primarily from teachers, up to 5 = student learned all the five skills primarily from teachers ( $M = .98$ ,  $SD = 1.21$ ).

*Gender.* Participants indicated whether they were 0 = male or 1 = female (49.30% female).

*Parental socioeconomic level.* Two variables were summed to represent the parental socioeconomic level: First, parental highest occupational status was measured, which corresponds to the higher score of either parent or of the only available parent according to the International Socioeconomic Index of Occupational Status (ISEI). Second, parental educational status was indicated, which corresponds to the higher educational level of either parent according to the International Standard Classification of Education (ISCED). The variables are positively and significantly correlated ( $r = .55$ ,  $p < .001$ ). For this study, these variables were standardized with a mean of 0 and a standard deviation of 1, and were summed to build a composite scale of the parental socioeconomic level ( $M = .02$ ,  $SD = 1.75$ ).

*Student home ICT resources.* For the present study, two items have been summed to build one single variable that measures the number of computers, either desktop or portable, that students have at home. The values have been recoded into a binary scale of 0 = no computers at home, and 1 = at least one computer at home. Further, a variable regarding students' type of internet connection at home was used distinguishing between 0 = students without internet access at home, and 1 = students with any type of internet connection at home. Finally, the variables of computers and internet connection have been summed, resulting in a composite scale ( $M = 1.87$ ,  $SD = .43$ ) indicating 0 = students without computers or internet at home, 1 = <sup>2</sup>students with either computers or internet connection at home, and 2 = students with both computers and internet connection at home.

*Student ICT self-efficacy.* Two separate scales operationalized by Fraillon and colleagues (2015) were used, one corresponding to self-efficacy in advanced ICT tasks ( $\alpha$  by country between .64 and .84;  $M = 49.79$ ;  $SD = 10.10$ ) and the other in basic ICT

2 Students were asked about the availability only of computers, not other ICTs at home. Therefore, it is possible that by indicating value «1» in the scale, students have internet access but not necessarily a computer available at home. In this case, it is implied that the access to the internet would occur via other devices such as smartphones or tablets.

tasks ( $\alpha$  between .75 and .84;  $M = 48.10$ ;  $SD = 11.01$ ). These measures derived from the question «How well can you do each of these tasks on a computer?», with response options 1 = I know how to do this, 2 = I could work out how to do this, and 3 = I do not think I could do this. The advanced tasks correspond to (1) use software to find and get rid of viruses, (2) create a database, (3) build or edit a webpage, (4) change the settings on your computer to improve the way it operates or to fix problems, (5) use a spreadsheet to do calculations, store data, or plot a graph, (6) create a computer program or macro, and (7) set up a computer network. The basic tasks refer to (1) search for and find a file on your computer, (2) edit digital photographs or other graphic images, (3) create or edit documents, (4) search for and find necessary information on the internet, (5) create a multimedia presentation, and (6) upload text, images, or video to an online profile.

*Student use of ICT at school.* Two separate scales operationalized by Fraillon and colleagues (2015) were adopted, namely the reported incidence of learning ICT at school ( $\alpha$  between .70 and .91,  $M = 49.74$ ,  $SD = 9.96$ ), and reported use of ICT during school lessons ( $\alpha$  between .71 and .92,  $M = 50.60$ ,  $SD = 10.64$ ). The former derives from the question «At school, have you learned how to do the following tasks?», with response categories 1 = yes or 2 = no for the following items: (1) providing references to internet sources, (2) accessing information with a computer, (3) presenting information for a given audience or purpose with a computer, (4) working out whether to trust information from the internet, (5) deciding what information is relevant to include in school work, (6) organizing information obtained from internet sources, (7) deciding where to look for information about an unfamiliar topic, and (8) looking for different types of digital information on a topic. The latter scale corresponds to the question «At school, how often do you use computers during lessons in the following subjects or subject areas?», with the items (1) mother language, (2) foreign languages, (3) mathematics, (4) sciences, and (5) humanities. For these items, the response options were 1 = never, 2 = in some lessons, 3 = in most lessons, 4 = in every or almost every lesson, and 5 = I don't study this subject.

#### *Meso level*

*School average emphasis on teaching ICT.* The scale operationalized by Fraillon and colleagues (2015) is based on the following question within the teachers' questionnaire: «In your teaching of the reference class in this school year how much emphasis have you given to developing the following ICT-based capabilities in your students», with response categories 1 = strong emphasis, 2 = some emphasis, 3 = little emphasis, and 4 = no emphasis. The items that compose the scale ( $\alpha$  between .94 and .99,  $M = 49.16$ ,  $SD = 10.25$ ) are: (1) accessing information efficiently, (2) evaluating the relevance of digital information, (3) displaying information for a given audience/purpose, (4) evaluating the credibility of digital information, (5) validating the accuracy

of digital information, (6) sharing digital information with others, (7) using computer software to construct digital work products, (8) evaluating their approach to information searches, (9) providing digital feedback on the work of others, (10) exploring a range of digital resources when searching for information, (11) providing references for digital information sources, and (12) understanding the consequences of making information publically available online. To aggregate teachers' data to the school level, averages of this scale were calculated per school and incorporated as a characteristic of the school in which students are enrolled (2<sup>nd</sup> level). The number of participant teachers per school varied between 1 and 32 ( $M = 12.68$ ;  $SD = 3.54$ ).

*School importance given to CIL.* The scale ( $\alpha$  between .62 and .91,  $M = 52.35$ ,  $SD = 8.86$ ) operationalized by Fraillon and colleagues (2015) stems from this question in the principal's questionnaire: «In your opinion, how important is the use of ICT in this school for each of the following outcomes of education», with response categories 1 = very important, 2 = somewhat important and 3 = not important. The items that form the scale are: (1) using ICT for facilitating students' responsibility for their own learning, (2) using ICT to augment and improve students' learning, (3) developing students' understanding and skills relating to safe and appropriate use of ICT, and (4) developing students' proficiency in accessing and using information. In the present analysis, this variable is treated as a characteristic of the school in which students are enrolled (2<sup>nd</sup> level).

*School ICT resources.* The scale operationalized by Fraillon and colleagues (2015) is based on this request in the ICT coordinator's questionnaire: «For each of the following technology resources please indicate their availability for teaching and/or learning». Respondents were asked to indicate either 1 = available or 2 = not available for the following items, which formed the scale ( $\alpha$  between .49 and .72,  $M = 47.82$ ,  $SD = 10.62$ ): (1) interactive digital learning resources, (2) tutorial software, (3) digital learning games, (4) multimedia production tools, (5) data logging and monitoring tools, (6) simulations and modeling software, (7) graphing or drawing software, (8) space on a school network for students to store their work, and (9) a school intranet with applications and workspaces for students to use. In the present analysis, this variable is treated as a characteristic of the school in which students are enrolled (2<sup>nd</sup> level).

*School priority on time for teachers to prepare lessons.* Principals were asked «At your school, what priority is given to the following ways of facilitating the use of ICT in teaching and learning», with possible responses «high priority», «medium priority», «low priority» and «not a priority». This variable refers to the item «providing more time for teachers to prepare lessons in which ICT is used». For the present analysis, low priority and not a priority were assigned a value of 0, and medium and high priority were assigned a value of 1 ( $76.85\% = 1$ ). It is incorporated in the data as a characteristic of the school in which students are enrolled (2<sup>nd</sup> level).

### *Macro level*

*Country demographics.* On the country level, the following indicators were adopted as characteristics of the country where students live (3rd level): (1) Gross Domestic Product – GDP per capita, (2) Gini coefficient of inequality, for which a higher coefficient corresponds to a higher level of social inequality, and (3) ICT Development Index - IDI score, for which a higher score corresponds to a higher level of access to technology. In the present analysis, the values of these measures were standardized with a mean of 0 and a standard deviation of 1.

### *Analysis*

To answer the research question and test the previously stated hypotheses, a multilevel analysis was conducted. Initially, a model without predictor level was developed to verify the proportion of variance within the outcome due to between-student, between-school, and between-country differences. Subsequently, predictor variables were inserted hierarchically in the model, starting with the variables of the student level and finishing with the country level. In the process, only variables that showed a significant effect ( $p < .05$ ) were maintained in further steps of the model.

### **Findings**

Variation partition coefficients (VPC)<sup>3</sup> indicate that in terms of learning ICT from teachers, 10% of the variance in the sample can be attributed to differences between schools, 12% of the variance to differences between countries, and 78% of the variance to differences between students. Although VPC statistics show that there is a degree of clustering in the data, the majority of the variation in students' learning ICT from teachers lies at the student level.

Table 1 presents the results of the three-level hierarchical modeling. Findings show that on the student level, students with more ICT resources at home ( $B = -.27$ ,  $SE = .02$ ,  $p < .001$ ), and whose parents have a higher socioeconomic level ( $B = -.07$ ,  $SE = .003$ ,  $p < .001$ ) report a significantly lower incidence of learning CIL from teachers. In addition to this, self-efficacy in advanced ICT tasks ( $B = -.02$ ,  $SE = .001$ ,  $p < .001$ ) also predicted the incidence of learning CIL from teachers significantly and negatively. On the other hand, a positive and significant association has been found with incidence of learning ICT at school ( $B = .02$ ,  $SE = .001$ ,  $p < .001$ ). Furthermore, female students indicate more learning of CIL from teachers than male students with equivalent characteristics ( $B = .11$ ,  $SE = .01$ ,  $p < .001$ ). Although significant associations

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3 Calculation VPC (Leckie 2013): VPC schools = variance between schools (.14)/total variance (1.45); VPC countries = variance between countries (.17)/total variance (1.45); VPC individual = variance between student (1.14)/total variance (1.45).

were found with self-efficacy in basic tasks ( $B = -.007$ ,  $SE = .001$ ,  $p < .001$ ) and with use of ICT at school ( $B = .004$ ,  $SE = .001$ ,  $p < .001$ ), these predictors contributed very little to the explained variance (less than 0.03%), and for this reason, were dropped in the subsequent steps of the model.

On the school level, only average emphasis on developing students' ICT skills delivered a significant association ( $B = .005$ ,  $SE = .002$ ,  $p < .05$ ). However, as its contribution to the explained variance was minor (less than 0.03%), it has been dropped in the final model. Finally, on the country level, a significant negative association has been found with the ICT Development Index score ( $B = -.18$ ,  $SE = .08$ ,  $p < .05$ ) – i.e., students in countries with a more developed ICT penetration report learning less CIL from teachers.

### **Discussion**

This study aimed to investigate what student, school and country characteristics are associated with the incidence of learning CIL from teachers, as reported by participants of 14 countries in the ICILS 2013. Based on the results of previous studies, hypotheses were stated concerning the influence of aspects on the micro, meso and macro levels of analysis.

On the micro level, i.e., the student level, the first hypothesis was confirmed, since findings indicate that female students reported a higher incidence of CIL learning from teachers than male students. As discussed previously, teacher support for learning ICT has a stronger effect on girls' ICT self-efficacy than on boys' (Vekiri 2010). Interestingly, the ICILS reports that girls on average scored better in the CIL test than boys but showed lower confidence in their advanced ICT skills in comparison to male students (Fraillon et al. 2014). A similar phenomenon is observed in the research about gender and STEM education, in which the most critical point of gender difference lies in the self-confidence in these fields (Rittmayer and Beier 2009) rather than in the performance (Hyde and Mertz 2009). Literature about the gender gap in STEM careers recommends teachers to invest in building students' confidence in the topics related to the field, and to be aware that this might be particularly critical for female students (Kosuch 2010). Such a recommendation can also be applied to the technical aspects involved in media education.

	Model 0	Model 1 B(SE)	Model 2 B(SE)	Model 3 B(SE)
Intercept	.95	1.31	1.10	1.34
Variance within schools	1.14	1.07	1.08	1.07
Variance between schools	.14	.10	.10	.10
Variance between countries	.17	.10	.10	.08
Explained variance#		12%	12%	14%
<i>Student level</i>				
Gender		.13** (.01)	.11** (.01)	.11** (.01)
Parental socioeconomic level		-.07** (.003)	-.07** (.004)	-.07** (.004)
Home ICT resources		-.26** (.02)	-.27** (.02)	-.27** (.02)
Self-efficacy advanced tasks		-.01** (.001)	-.02** (.001)	-.02** (.001)
Self-efficacy basic tasks		-.007** (.001)	-----	-----
Learning ICT at school		.02** (.001)	.02** (.001)	.02** (.001)
Use of ICT at school		.004** (.001)	-----	-----
<i>School level</i>				
Average emphasis on teaching CIL			.005* (.002)	-----
School importance of CIL			n.s.a	-----
School ICT resources			n.s.a	-----
Time for teachers to prepare lessons			n.s.a	-----
<i>Country level</i>				
GDP				n.s.a
Gini				n.s.a
IDI				-.18* (.08)

**Tab. 1.:** Linear hierarchical modeling analysis of learning CIL from a teacher.<sup>4</sup>

Second, a negative association between students' socioeconomic status and their learning of CIL from teachers was hypothesized and can be confirmed by the present analyses. This finding reinforces the view that school is probably the space with most potential to generate equality so that youngsters, independently of their socioeconomic background, can develop sufficient competencies to function adequately in the digitalized society.

<sup>4</sup> Notes: \* =  $p < .05$ ; \*\* =  $p < .001$ ; a = predictors were not significant when inserted individually in the stepwise process. The figures displayed correspond to model versions that exclude nonsignificant predictors. Excluded predictors are indicated with «-----». # Calculation explained variance (Leckie 2013): Total variance model 0 =  $1.14 + .14 + .17 = 1.45$ ; model 1 =  $1.07 + .10 + .10 = 1.27$ ; model 2 =  $1.08 + .10 + .10 = 1.28$ ; model 3 =  $1.07 + .10 + .08 = 1.25$ . Explained variance model 1 =  $(1.27 - 1.45)/1.45$ ; model 2 =  $(1.28 - 1.45)/1.45$ ; model 3 =  $(1.25 - 1.45)/1.45$ .

The third hypothesis assumed a negative association between students' self-efficacy in ICT tasks with their incidence of learning CIL from teachers. The results confirm this assumption, as students with higher self-efficacy in advanced ICT tasks reported less CIL learning from teachers. The relationship was weaker for self-efficacy in basic tasks than for self-efficacy in advanced tasks, but still in line with the hypothesis. On the one hand, this finding may indicate that when students are very confident about their ICT skills, especially more complex ones, they might dismiss the teacher as a source of CIL development. From another perspective, students who had the opportunity to develop ICT skills by other means or with other agents do not recognize the teacher as the primary contributory agent to their CIL. However, the teacher might still be an agent that reinforces and further develops the skills that students already have. Furthermore, students highly skilled in ICT can allow the classroom to be turned into a space of exchange, where teachers and students develop their skills together through peer-peer and student-teacher projects (Jageer Singh, Raja Harun, and Fareed 2013). Thus, media and technology education can still be a part of the school, even when teachers do not feel completely capable of the topic (Ramírez-García and González-Fernández 2016; Roig-Vila, Mengual-Andrés, and Quinto-Medrano 2015; Siqueira and Rothberg 2014), in such a way that the knowledge and experiences of students are actively used and valued in class (Freire 2011).

The positive associations found with reported learning of CIL at schools and with the use of ICT at school are in line with the fourth hypothesis, although the fact that use of ICT at school delivered a minimal effect suggests that the sheer integration of technology in class may be a fundamental condition for teaching about ICT, but does not guarantee the learning of CIL. When ICT is employed in class to achieve the goals of other school subjects, students can develop ICT skills as a side effect, at best. Therefore, it might be necessary to plan opportunities in the school curricula in which ICT skills are learning goals rather than side effects.

On the school level (meso level), it was expected that the teachers' emphasis on fostering students' CIL would reflect positively on the incidence of CIL learning from teachers reported by students. Even though a positive association was found with average teachers' emphasis (in line with hypothesis 5), its contribution to the explained variance was minimal. This may be a consequence of the nature of ICILS data, which make it impossible to assign teachers' data directly to students since there is no guarantee that participant teachers taught participant students of the same school (Jung and Carstens 2015). Therefore, only school averages of teachers' emphasis on teaching CIL were taken, which hinders a more objective test of the influence of teachers' attitudes and practices.

The sixth hypothesis regarding the support that the school gives to teaching with and about ICT was rejected, since no significant results were found. Although the results of previous studies identified a positive influence of school support on

teachers' implementation of media use and media literacy initiatives, this is not necessarily reflected in the perception of students learning CIL from teachers. This learning seems to be a matter of students identifying an opportunity to fill a demand that they do not have the chance to fill elsewhere. Therefore, schools should offer quality media education but be aware that the demand among students may vary.

Finally, the last hypothesis presupposed that students in countries with better socioeconomic conditions would report a lower incidence of learning CIL from teachers. As it was only countries' ICT Development Index score that delivered a significant negative association, the hypothesis is partially confirmed. It is noticeable that greater access to ICT, both on the individual and on the country level, was negatively associated with the incidence of learning CIL from teachers. Thus, in regions where the access to ICT is limited, the relevance of the teacher and the school in fostering ICT skills becomes more critical.

In summary, students' backgrounds offer uneven opportunities to develop CIL, and so the level of opportunity they identify to learn ICT skills at school also varies. Consequently, teachers need to ensure they meet the demands of those students who rely on the school to learn CIL, and thus help to alleviate the digital divide, as well as involving the ones who do not perceive the school as a fundamental source of ICT learning. Regarding the latter group, it is pertinent to consider what Buckingham (2007) calls «the new digital divide» – when the media education offered at school is not compatible with students' media experience outside the school. To overcome the new digital divide, schools need to become better acquainted with their students' media habits and develop approaches that relate to their media experiences and gratifications, while giving them the opportunity to employ skills they already have. National representative studies into youngsters' media behavior, such as the JIM (Feierabend, Rathgeb, and Reuther 2018) in Germany and the MIKE (Genner et al. 2017) in Switzerland, might be a good starting point for schools to evaluate their students' media profiles and demands.

### **Limitations and future studies**

This analysis could not identify aspects on the school level that predict students' learning of CIL from teachers significantly. Nevertheless, instead of denying the role that school characteristics may play, further analyses should be conducted to explore it in more depth. For instance, future studies should collect data from teachers and students in a way that enables them to be merged at the individual level. Path analyses may then help to identify possible indirect effects of school aspects on students' perceptions of learning ICT skills from teachers.



As a secondary data analysis, the research model of this study was limited to the measures available in the datasets. Future studies should extend the measure of the incidence of learning media literacy from teachers by including further skills, for example, safe internet use, and critical evaluation of media content. The ownership of and access to ICT should be measured in greater detail, i.e., to also include smartphones and tablets, among other devices. Moreover, when this study was conducted, the latest available data were collected in 2013. Therefore, a future replication of the study with the data from the ICILS 2018 could offer further contributions. Notably, access to ICT at home might have increased considerably in recent years in the countries included in the study. In addition, a future analysis could investigate the associations between students' CIL levels and learning CIL from different agents.

The final model in the analysis was able to explain only 14% of the variance, which shows that the contribution of teachers to youngsters' media and digital literacy is a complex phenomenon to investigate. To gain more understanding of factors that might be associated more specifically with the learning of media competency at school, qualitative studies with students at different school levels might offer constructive contributions.

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