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ICT Use For Teaching Media Literacy: A Closer Look At The Relationships Between Teaching With And Teaching About Media

ABSTRACT

Information and communication technologies (ICTs) are often considered crucial for teaching media and information literacy (MIL). However, there is a wide variety in educational media, and there are different competence areas in MIL. Thus, the idea that using any ICT can facilitate the fostering of different MIL areas equally seems oversimplified. This study investigates associations between three types of ICT use and four MIL competence areas. It analyzes data of 315 secondary teachers in Germany employing exploratory structural equation modeling. After controlling for teacher and school traits, the findings show that teachers who use the computer lab in their schools and basic computer applications tend to foster their students' critical, safety, information, and operational competencies more often. Conversely, using ICTs that mainly serve presentation and visualization purposes has a negative or no association with fostering the four MIL areas. Finally, using mobile devices and online resources is positively associated with fostering students' information competence. The analysis contributes to a more specific understanding of teachers' practices with digital media. Possible implications are discussed for teachers' practice and training as well as for research and policy.

KEY WORDS

Competence areas. Educational media. ICT use. Media and information literacy. Media education. Secondary schools. Teaching practice.

1. Introduction

Investments in information and communication technologies (ICTs) tend to be the primary actions of policies for media education. In a comparative study of the media education policies adopted in 28 European countries, Frau-Meigs et al. found out that most of the funding in media education is destined for equipment rather than human resources.[1] In Germany, a recent federal policy called School Digital Pact [*Digitalpakt Schule*] designated funds for schools to invest in digital infrastructure. Through a higher integration of technology, the policy aims to enable schools to prepare youth adequately with the necessary competencies for a skillful, responsible, and critical use of media in a world whose systems and environments become increasingly digital.[2]

Studies have shown positive associations between ICT use for instruction and the fostering of media and digital competencies.[3] However, most studies refer to ICT in general. Thus, the peculiarities of the different technologies and their employment in class are not taken into account. It must be considered that both practices – teaching with and teaching about media – happen in a variety of formats. The range of ICT that can be adopted in education is vast, from computers connected to data projectors to individual tablets and offline and online software, which permit different levels of teacher and student involvement with the technologies. Similarly, the set of competencies that should be taught in the realm of media and information literacy (MIL) is also broad. Nevertheless, so far, little has been discussed about teachers' use of what types of technology are linked to fostering particular competencies.

This study aims to contribute to the discussion about teachers' practice involving media by addressing differences in ICT use in class and the variety of MIL competence areas. Therefore, it analyzes survey data collected from 315 teachers in the federal state of Thuringia, Germany, to investigate the associations between the use of different media for instruction and the fostering of different areas of MIL.

2. Digital Media in Teaching Practice

Anderson elucidates that, in principle, ICT includes all technologies for information process and communication. In the educational context, ICT can also be referred to as technology, new media, or digital media, corresponding to *"computer technology, multimedia, and networking, especially the internet."*[4] Thus, the range of media that can be employed for teaching is vast.

From a medium theory perspective, the particular characteristics of a medium may generate specific impacts when that medium is selected over another. However, the impacts due to the particular characteristics "are susceptible to human intervention".[5] Based on this, it is possible

1 FRAU-MEIGS, D., VELEZ, I., MICHEL, J. F.: *Public Policies in Media and Information Literacy in Europe: Cross-Country Comparisons*. London : Routledge, 2017, p. 47.

2 *Verwaltungsvereinbarung DigitalPakt Schule 2019 bis 2024*. [online]. [2021-07-13]. Available at: <https://www.digitalpaktschule.de/files/VV_DigitalPaktSchule_Web.pdf>.

3 See e.g.: HATLEVIK, I. K. R., HATLEVIK, O. E.: Students' Evaluation of Digital Information: The Role Teachers Play and Factors That Influence Variability in Teacher Behaviour. In *Computers in Human Behavior*, 2018, Vol. 83, p. 56-63. [online]. [2021-07-14]. Available at: <https://oda.oslomet.no/oda-xmlui/handle/10642/7132>; LORENZ, R., ENDBERG, M., BOS, W.: Predictors of Fostering Students' Computer and Information Literacy – Analysis on a Representative Sample of Secondary School Teachers in Germany. In *Education and Information Technologies*, 2019, Vol. 24, No. 1, p. 911-928. [online]. [2021-07-14]. Available at: <https://rdcu.be/bKOJH>; SIDDIQ, F., SCHERER, R., TONDEUR, J.: Teachers' Emphasis on Developing Students' Digital Information and Communication Skills (TEDDICS): A New Construct in 21st Century Education. In *Computers & Education*, 2016, Vol. 92-93, (Supplement C), p. 1-14.

4 ANDERSON, R. E.: Implications of the Information and Knowledge Society for Education. In VOOGT, J., KNEZEK, G. (eds.): *International Handbook of Information Technology in Primary and Secondary Education.* Berlin, Heidelberg : Springer Science & Business Media, 2008, p. 8.

5 MEYROWITZ, J.: Medium Theory. In HOBBS, R., MIHAILIDIS, P. (eds.): *The International Encyclopedia of Media Literacy*. Hoboken : Wiley Blackwell, 2019, p. 1117.

to differentiate educational technologies in at least two main aspects: on the one hand, the characteristics of the ICT and the functions it offers, and on the other hand, the purposes for which the ICT is employed in teaching practice, usually determined by the teacher's intervention. For example, interactive or digital whiteboards are tools that offer multimedia and interactive features. Therefore, they differ in their characteristics and functions from normal blackboards and data projectors. However, studies reported that teachers use interactive whiteboards in various ways, including for mere visualization of contents as data projectors.[6]

Considering the first aspect, the characteristics of educational ICT, Wimmer identifies two broad classes of digital media for education in his literature review: educational hardware and concrete services or applications.[7] Karaseva et al. classify the use of hardware in educational settings as input and output technologies. Examples of the former are tablets and desktop computers, and of the latter, projectors and interactive whiteboards.[8] Similarly, Livingstone observes that some technologies can be used exclusively by the teacher to project and transmit content, which she calls one-to-many technologies.[9] In contrast, other resources can facilitate the active use of ICT by students, which Livingstone names peer-to-peer and networked technologies. Concerning software, Papanastasiou and Angeli identify two modalities of computer applications used in teaching practice. The first is denominated common-use software applications and corresponds to spreadsheets, word processing, the internet, e-mail, and presentation software. The second is called specialized software and refers to modelling, concept mapping, authoring, and database software.[10]

Regarding the second aspect, the purposes of using ICT in class, Tondeur et al. differentiate between the development of ICT-related competencies, when computers are the subject of the instruction, and the assimilation of contents of traditional school subjects, when computers are used as an educational tool.[11] Similar dimensions are proposed by Comi et al., who point out the following purposes of teachers' practice with ICT: aiding the presentation of contents in class for knowledge transmission, involving students for them to reach a goal under the supervision of the teacher, and media education for fostering students' media-related skills.[12]

Therefore, the first observation that can be raised is that fostering students' MIL can be one of the several purposes for which teachers employ ICT in class. That is, integrating technology in teaching (i.e., teaching with media) and fostering media-related competence (i.e., teaching about media) might be connected. Nevertheless, the association between these two practices cannot be over-simplified and taken for granted.

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6 See: SLAY, H., SIEBÖRGER, I., HODGKINSON-WILLIAMS, C.: Interactive Whiteboards: Real Beauty or Just "Lipstick"? In *Computers & Education*, 2008, Vol. 5, No. 3, p. 1321-1341.; NORTHCOTE, M. et al.: Interactive Whiteboards: Interactive Or Just Whiteboards? In *Australasian Journal of Educational Technology*, 2010, Vol. 26, No. 4, p. 494-510.

7 See: WIMMER, J.: Potentiale digitaler Bildungsmedien: Ein Überblick über Forschung, Lernformen und Trends. In *TelevIZIon*, 2017, Vol. 30, No. 1, p. 9-15.

8 KARASEVA, A., SIIBAK, A., PRUULMANN-VENGERFELDT, P.: Relationships Between Teachers' Pedagogical Beliefs, Subject Cultures, and Mediation Practices of Students' Use of Digital Technology. In *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 2015, Vol. 9, No. 1. No pagination. [online]. [2021-07-14]. Available at: <https://cyberpsychology.eu/article/view/4331/3394>.

9 See: LIVINGSTONE, S.: Critical Reflections on the Benefits of ICT in Education. In *Oxford Review of Education*, 2012, Vol. 38, No. 1, p. 9-24. [online]. [2021-07-14]. Available at: <https://www.researchgate.net/publication/232939736_Critical_Reflections_on_the_Benefits_of_ICT_in_Education>.

10 See: PAPANASTASIOU, E. C., ANGELI, C.: Evaluating the Use of ICT in Education: Psychometric Properties of the Survey of Factors Affecting Teachers Teaching with Technology (SFA-T3). In *Journal of Educational Technology & Society*, 2008, Vol. 11, No. 1, p. 69-86.

11 See: TONDEUR, J., VAN BRAAK, J., VALCKE, M.: Towards a Typology of Computer Use in Primary Education. In *Journal of Computer Assisted Learning*, 2007, Vol. 23, No. 3, p. 197-206. [online]. [2021-07-14]. Available at: <https://www.researchgate.net/publication/227733657_Towards_a_typology_of_computer_use_in_primary_education>.

12 See: COMI, S. L. et al.: Is It the Way They Use It? Teachers, ICT and Student Achievement. In *Economics of Education Review*, 2017, Vol. 56, p. 24-39.

Moreover, as much as there are several types of educational media, various competencies are classified in different areas of MIL that can be involved in school media education curricula. Frau-Meigs et al. observe that in Europe, most media-related policies have a composite definition, referring to information literacy, computer literacy, and digital literacy.[13] These different concepts of media-related literacies tend to emphasize specific competencies. For instance, media literacy frequently accentuates critical thinking about media content; information literacy prioritizes searching and processing information, while digital, ICT, and computer literacies tend to focus on the operation of technologies.[14]

With the access and distribution of information and media content occurring currently via various digital tools, it becomes increasingly more challenging to separate the domains of media, ICT, and information. Therefore, UNESCO pleads for a comprehensive understanding of media and related literacies under the concept of MIL.[15] The "Paris Declaration on MIL in the Digital Era" highlights three broad MIL competence areas: critical thinking and reflecting media and information systems, using information, media and digital technology for individual and societal purposes, and handling of media, the latter referring to operational and production skills.[16] Buckingham highlights similar competence areas that can be identified in most media-related literacies frameworks.[17] He defines critical competencies as evaluating the contents, underlying formats, interests, and effects of media products, and operational competencies as performing particular tasks with technologies. However, different from the Paris Declaration, instead of referring to usage competencies, Buckingham is more specific and points out the competence areas of safety and information. The first refers to capabilities of protecting oneself against content and practices that can be harmful, and the second corresponds to abilities in searching for information, identifying relevant content, and assessing its attributes.

Hence, the second observation about teaching practices with media is that there is diversity in the ICT used for instruction and in the media-related competencies that can be fostered. Livingstone points out the problem that much literature about technology in teaching practice summarizes its diversity simply under "ICT," which makes it *"difficult to distinguish which aspects of technologically-mediated learning, if any, are effective in any particular situation."*[18] Consequently, it is rarely discussed what technologies are meaningful for specific MIL competencies. Anderson makes a few suggestions in this direction, stating that search engines can promote skills in accessing, assembling and reorganizing information, groupware can develop collaboration and teamwork skills, and presentation programs can be employed for fostering communication and presentation skills.[19] Nonetheless, Pötzsch argues that ICT does not necessarily need to be used in class for conducting activities with students that aim

[13] FRAU-MEIGS, D., VELEZ, I., MICHEL, J. F.: *Public Policies in Media and Information Literacy in Europe: Cross-country Comparisons*. London : Routledge, 2017, p. 30.

[14] HOBBS, R.: *Digital and Media Literacy: A Plan of Action*. [online]. [2021-07-14]. Available at: <http://mediaeducationlab.com/digital-and-media-literacy-plan-action>; *Global Media and Information Literacy Assessment Framework: Country Readiness and Competencies*. Paris : UNESCO, 2013. [online]. [2021-07-14]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000224655_eng>.

[15] *Global Media and Information Literacy Assessment Framework: Country Readiness and Competencies*. Paris : UNESCO, 2013. [online]. [2021-07-14]. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000224655_eng>.

[16] *Paris Declaration on Media and Information Literacy in the Digital Era*. [online]. [2021-07-14]. Available at: <www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/CI/CI/pdf/In_Focus/paris_mil_declaration_final.pdf>.

[17] See: BUCKINGHAM, D.: Defining Digital Literacy – What Do Young People Need to Know About Digital Media? In *Nordic Journal of Digital Literacy*, 2006, Vol. 1, No. 4, p. 263-277.

[18] LIVINGSTONE, S.: Critical Reflections on the Benefits of ICT in Education. In *Oxford Review of Education*, 2012, Vol. 38, No. 1, p. 6.

[19] See: ANDERSON, R. E.: Implications of the Information and Knowledge Society for Education. In VOOGT, J., KNEZEK, G. (eds.): *International Handbook of Information Technology in Primary and Secondary Education,* Berlin, Heidelberg: Springer Science & Business Media, 2008, p. 5-22.

to develop reflective and critical attitudes to media and technologies.[20] Pötzsch points out that traditional humanities subjects can well accommodate activities that encourage reflection and promote discussions about power, political use, data activism and surveillance, among other topics. Thus, looking at the use of specific ICT and differentiating between MIL competence areas can offer further insights on whether and how the characteristics of particular ICT can contribute to the fostering of specific skills.

3. Associations Between Teaching with and Teaching about Media

Frequently, the association between teaching with and about media appears in arguments that teaching with ICT is necessary for promoting students' media and technology-related skills for life and work in the 21st-century.[21] However, in research, this relationship has not been widely investigated. The International Computer and Information Literacy Study (ICILS) is probably the most comprehensive study that collects international data about school ICT use and types of media-related literacy, namely computer and information literacy (CIL). Gerick et al. analyzed ICILS 2013 data from Australia, the Czech Republic, Germany, and Norway. They found that only for Germany did a small positive association between ICT use for teaching and students' CIL level exist. For the other three countries, no associations were found.[22] The ICILS 2018 reports positive associations between student use of ICT during class and CIL levels in five out of 10 countries.[23]

Focusing on teachers' practices, the ICILS 2018 estimated a regression model to predict teacher emphasis on developing students' CIL, finding out teachers' experience with using ICT in class, perception of positive outcomes of using ICT in class, ICT self-efficacy, and collaboration between teachers as significant positive predictors in all participant countries.[24] In addition, a few studies worked with more complex models that tested the relationships between ICT use and teaching MIL and included predictors of both practices. Examples of such studies are the analyses of ICILS 2013 data of Norwegian teachers conducted by Hatlevik and Hatlevik[25] and Siddiq et al.[26] and a representative study with secondary teachers in Germany by Lorenz

[20] See: PÖTZSCH, H.: Critical Digital Literacy: Technology in Education beyond Issues of User Competence and Labour-market Qualifications. In *TripleC Journal for a Global Sustainable Information Society*, 2019, Vol. 17, No. 2, p. 221-240. [online]. [2021-07-14]. Available at: <https://www.triple-c.at/index.php/tripleC/article/view/1093/1296>.

[21] See: CHARALAMBIDIS, D.: ICT in the Future Classrooms and Teaching: Preparing the Knowledge Workers of the 21st Century. In ILIADIS, L. et al. (eds.): *Artificial Intelligence Applications and Innovations.* Berlin, Heidelberg : Springer, 2014, p. 56-62.; LEWIN, C., MCNICOL, S.: Supporting the Development of 21st Century Skills through ICT. In BRINDA, T. et al. (eds.): *KEYCIT 2014 – Key Competencies in Informatics and ICT.* Potsdam : Universitätsverlag Potsdam, 2015, p. 181-198. [online]. [2021-07-14]. Available at: <https://publishup.uni-potsdam.de/opus4-ubp/frontdoor/deliver/index/docId/8267/file/cid07_S181-198.pdf>.

[22] GERICK, J., EICKELMANN, B., BOS, W.: School-level Predictors for the Use of ICT in Schools and Students' CIL in International Comparison. In *Large-Scale Assessments in Education*, 2017, Vol. 5, No. 1, Article 5. [online]. [2021-07-14]. Available at: <https://largescaleassessmentsineducation.springeropen.com/articles/10.1186/s40536-017-0037-7>.

[23] See: FRAILLON, J. et al.: *Preparing for Life in a Digital World: IEA International Computer and Information Literacy Study 2018 International Report.* Berlin, Heidelberg: Springer, 2020, 297 p. [online]. [2021-07-14]. Available at: <https://link.springer.com/book/10.1007%2F978-3-030-38781-5>.

[24] Ibidem.

[25] See: HATLEVIK, I. K. R., HATLEVIK, O. E.: Students' Evaluation of Digital Information: The Role Teachers Play and Factors that Influence Variability in Teacher Behaviour. In *Computers in Human Behavior*, 2018, Vol. 83, p. 56-63. [online]. [2021-07-14]. Available at: <https://oda.oslomet.no/oda-xmlui/handle/10642/7132>.

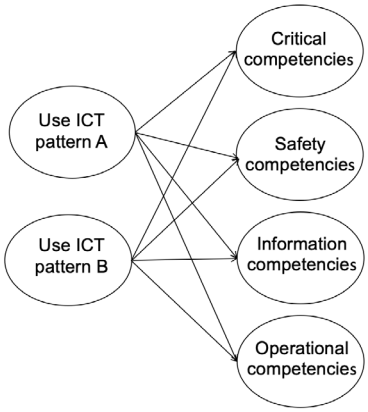
[26] See: SIDDIQ, F., SCHERER, R., TONDEUR, J.: Teachers' Emphasis on Developing Students' Digital Information and Communication Skills (TEDDICS): A New Construct in 21st Century Education. In *Computers & Education*, 2016, Vol. 92-93, (Supplement C), p. 1-14.

et al.[27] The three studies found a positive association between teachers' use of technology in class and their efforts to develop students' digital skills. In addition, feeling prepared to use ICT,[28] satisfaction with school ICT equipment, and ICT-related collaboration among teachers[29] were found to positively predict both using ICT for instruction and fostering students' digital information competencies.

As the studies refer to ICT use in general and focus on single areas of competence, identifying different ICTs and competence areas can expand the understanding of the relationships between teachers' practices with media even though it makes the model more complex. The goal is to explore to what extent the use of particular technologies is associated with fostering different competence areas. Thus, the study considers the plurality of ICT that teachers use in their practice and different competence areas covered in MIL frameworks. The first research question is specified as:

RQ1: To what extent does the use of particular types of ICT for instruction associate with the practice of fostering different areas of media-related competencies?

Therefore, this study verifies the different patterns of ICT use in the sample and tests their associations with the teachers' engagement in fostering four MIL competence areas: critical competencies, safety competencies, information competencies, and operational competencies.



PICTURE 1: *Research mode question 1*

Source: Author's model, own processing, 2021

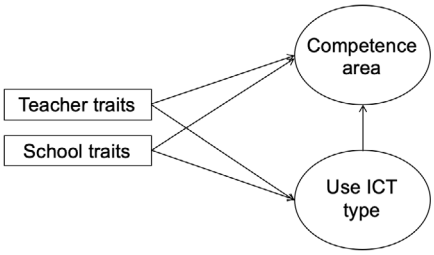
Besides considering the relationships between different types of ICT use and different media competence areas, the model accounts for school and teacher traits that might influence both practices. Thus, the second research question is:

[27] See: LORENZ, R., ENDBERG, M., BOS, W.: Predictors of Fostering Students' Computer and Information Literacy – Analysis Based on a Representative Sample of Secondary School Teachers in Germany. In *Education and Information Technologies*, 2019, Vol. 24, No. 1, p. 911-928. [online]. [2021-07-14]. Available at: <https://rdcu.be/bKOJH>.

[28] See: HATLEVIK, I. K. R., HATLEVIK, O. E.: Students' Evaluation of Digital Information: The Role Teachers Play and Factors that Influence Variability in Teacher Behaviour. *Computers in Human Behavior*, 2018, Vol. 83, p. 56-63. [online]. [2021-07-14]. Available at: <https://oda.oslomet.no/oda-xmlui/handle/10642/7132>; SIDDIQ, F., SCHERER, R., TONDEUR, J.: Teachers' Emphasis on Developing Students' Digital Information and Communication Skills (TEDDICS): A New Construct in 21st Century Education. In *Computers & Education*, 2016, Vol. 92–93, (Supplement C), p. 1-14.

[29] See: LORENZ, R., ENDBERG, M., BOS, W.: Predictors of Fostering Students' Computer and Information Literacy – Analysis Based on a Representative Sample of Secondary School Teachers in Germany. In *Education and Information Technologies*, 2019, Vol. 24, No. 1, p. 911-928. [online]. [2021-07-14]. Available at: <https://rdcu.be/bKOJH>.

RQ2: How conditioned are the associations between teacher use of ICTs for instruction and their efforts in teaching MIL to school and teacher traits?



PICTURE 2: *Research mode question 2*
Source: Author's model, own processing, 2021

4. Methods

The proposed model is tested with data collected in a survey with secondary school teachers conducted in Thuringia, Germany, in the summer of 2017. Of 448 secondary schools, 88 (corresponding to circa 2,700 teachers) were randomly selected to participate in the study. The school principals of the selected schools were contacted and asked to distribute the questionnaire among the teachers. Teachers could answer the survey either online or on paper, as printed copies of the questionnaire were sent to the schools together with a pre-stamped return envelope. The final sample consists of 315 teachers who completed the survey (60% on paper), corresponding to a response rate of 12%. The majority of participants are female (72%). The age groups between 45 and 54 years and 55 years or older are the most represented in the sample (37% each). These characteristics were similar to the teacher population in Thuringia for the school year 2017/2018.[30]

4.1 Measures

ICT use was measured with a question about how often teachers use a set of 12 ICTs for instruction in their classes on a scale from 1 = never to 5 = several times a week. From the 12 ICTs, four correspond to hardware (computer lab, students' mobile devices, data projector, and interactive whiteboard). The remaining eight consist of software and applications. The items are displayed in Table 1.

Fostering students' MIL was measured by asking survey participants how often they conducted activities in class that aimed to foster several competencies listed in the media literacy plan for secondary schools of Thuringia.[31] The answer options were displayed on a 5-point scale ranging from 1 = never to 5 = very often. Table 2 displays the items that correspond to each of the four competence areas: critical, safety, information, and operational.

As for teacher traits, participants were asked whether they received in- or pre-service training regarding using ICT for instruction, teaching students to use ICT, and teaching students to reflect critically about media use. The value 1 indicates that the teacher received formal training in at least one of the topics, and 0 that the teacher has not received formal training in any of the

[30] *Statistisches Informationssystem Bildung: Personal nach Alter und Durschnittsalter.* [online]. [2021-07-14]. Available at: <http://www.schulstatistik-thueringen.de/?link=Allgemeines~Neue%20Berichte%20und%20Daten>.

[31] *Durchführung des Kurses Medienkunde an den Thüringer allgemeinbildenden weiterführenden und berufsbildenden Schulen*. [online]. [2021-07-14]. Available at: <https://www.schulportal-thueringen.de/tip/resources/medien/9213?dateiname=+Medienkunde2010_komplett.pdf>.

issues (53% received formal training). Moreover, teachers were asked whether they learned through collaboration with other teachers about using ICT for instruction, teaching students to use ICT, and teaching students to reflect critically about media use. Response options were 1 = yes or 0 = no, where 1 indicates that the teacher collaborated with colleagues in relation to at least one of the topics and 0 that the teacher has not engaged in collaboration in any of the issues (55% engaged in collaboration). Finally, a binary variable differentiates the participants who teach Natural Sciences, Physics, Mathematics, Chemistry, Informatics, or Biology (value = 1) from the teachers who do not teach any of these subjects (47% teach STEM subjects).

Item	Description/ Examples	Mean (SD)
Data projector	The technology is usually paired with a desktop computer, laptop, or tablet used by the teacher to present content.	3.56 (1.38)
Computer laboratory	A room in the school that is equipped with stationary computers for students' use. Depending on the number of students, computers might be used either by one or several students at a time.	2.96 (1.28)
Mobile devices	Laptops, tablets, or smartphones for individual student use.	2.71 (1.41)
Interactive whiteboard	The technology is usually paired with a desktop computer, laptop, or tablet used by the teacher.	2.55 (1.57)
Search engines	e.g., Google, Ecosia, Bing	3.44 (1.23)
Presentation program	e.g., Microsoft PowerPoint, Prezi	3.07 (1.21)
Websites	Diverse webpages accessed for class activities	2.96 (1.25)
Text editing program	e.g., Microsoft Word, Google Docs	2.94 (1.30)
Online videos	e.g., YouTube, Vimeo	2.77 (1.10)
Learning program	e.g., Programs or applications that aid the teaching and learning of specific school subjects	2.41 (1.13)
Spreadsheet program	e.g., Microsoft Excel, Google Sheets	2.19 (1.28)
Online communication applications	e.g., E-mail service, WhatsApp, Facebook	2.12 (1.33)

TABLE 1: *Measure items of ICT use*

Source: own processing, 2021[32]

Regarding the school's traits, respondents were asked how they evaluated the ICT equipment available in their schools, on a scale from 1 = not available to 6 = very good. The items evaluated were the quantity of hardware available, quality of hardware available, quality of software available, access to the internet in the dependencies of school, speed, and quality of the connection. The items were averaged to build a composite scale of satisfaction with ICT equipment available in the school ($\alpha = 0.88$, $M = 2.81$, $SD = 0.89$). Additionally, the type of school is identified in a binary variable indicating 1 = teachers who work in a Gymnasium and 0 = teachers who work in other kinds of schools (36% work in a Gymnasium).

[32] *Note*: Besides the twelve items above, teachers could inform about whether they use other media regularly in their classes. From the entries of this open question, 22 teachers reported using offline media (CDs, DVDs, books, newspapers, magazines). In addition, a few teachers reported using other digital tools, for example online learning platforms such as Google Classroom (four teachers) and specialized applications for programming and simulations (two teachers). This very low frequency of use of advanced digital tools (e.g., simulations software, online collaboration tools, learning management systems) is consistent with findings of the ICILS 2018 for German teachers.; See: DROSSEL, K.: Nutzung digitaler Medien und Prädiktoren aus der Perspektive der Lehrerinnen und Lehrer im internationalen Vergleich. In EICKELMANN, B. et al. (eds.): *ICILS 2018 #Deutschland – Computer- und informationsbezogene Kompetenzen von Schülerinnen und Schülern im zweiten internationalen Vergleich und Kompetenzen im Bereich Computational Thinking.* Münster : Waxmann, 2019, p. 205-240.; FRAILLON, J. et al.: *Preparing for Life in a Digital World: IEA International Computer and Information Literacy Study 2018 International Report*. Berlin, Heidelberg: Springer, 2020, 297 p. [online]. [2021-07-14]. Available at: <https://link.springer.com/book/10.1007%2F978-3-030-38781-5>.

Area	Competency	Mean (SD)
Critical	Understanding the influence of media on society.	3.41 (0.91)
Critical	Understanding why different media actors present facts in different ways.	3.07 (1.03)
Critical	Differentiating between advertising and journalistic content.	3.06 (0.97)
Safety	Surfing safely on the internet.	3.36 (1.11)
Safety	Protecting own data and private sphere effectively.	3.30 (1.11)
Safety	Understanding how personal data is gathered and used further when using online media.	3.01 (1.12)
Information	Searching for information effectively.	3.72 (0.94)
Information	Filtering and interpreting information from different sources.	3.42 (0.93)
Information	Judging the credibility of different information sources.	3.24 (0.88)
Operational	Using technical terms correctly.	2.88 (1.11)
Operational	Differentiating between different data formats and using them with the right programs.	2.43 (1.08)
Operational	Presenting data in graphics and tables.	2.35 (1.24)

TABLE 2: *Measure items of fostering MIL in four competence areas*

Source: own processing, 2021

4.2 Analysis

Structural equation modelling (SEM) allows the test of models that hypothesize complex relationships among variables, which is the case of this study. The dependent variables ICT use and fostering MIL are latent variables, and the predictor variables referring to school and teacher traits are manifest variables. First, the latent variables were modelled. The latent variables corresponding to the fostering of students' competence in four areas result from a confirmatory factor analysis (CFA) with the competence items presented in Table 2. The item loadings are presented as findings in Table 3.

Unlike the competence items, the types of ICT use were not pre-established since there is no strong hypothesis concerning which ICT factors can be found in the data. Therefore, exploratory factor analysis was conducted with the measures of teacher's use of different ICTs (Table 1) to generate the latent variables of ICT use. Items loadings are displayed in the findings (Table 4).

In a second step, the latent variables of fostering MIL were also regressed on the variables corresponding to teacher and school traits, controlling their associations with ICT use. As the analysis includes exploratory factor analysis and SEM features, it consists of exploratory structural equation modelling (ESEM). In ESEM, some parts of the measurement model are unrestricted, i.e., indicators are allowed to load on every factor, different from CFA, in which it is restricted.[33]

Preliminary analyses of skewness, kurtosis, and distribution of residuals did not raise any issues. However, the data show a few missing values, i.e., less than 3.5% in single variables. These missing values are considered missing at random since they cannot be attributed to the research design. Therefore, Full Information Maximum Likelihood was adopted to handle the missing cases. The ESEM was conducted with Robust Maximum Likelihood as the estimation method in *MPlus* Version 8.4.

[33] KLINE, R. B.: *Principles and Practice of Structural Equation Modeling*. New York : Guilford Publications, 2011, p. 121.

5 Results

Table 3 displays the item loadings of the CFA that generated the latent variables corresponding to the fostering of four media-related competence areas: critical competence, safety competence, information competence and operational competence. Most fit indices indicate a good model fit (Chi2 = 118.05(48), p < .001; RMSEA = .07 [.05, .08]; CFI = .96; TLI = .95; SRMR = .04).

	Critical	Safety	Information	Operational
Understanding the influence of media on society.	.74			
Understanding why different media actors present facts in different ways.	.78			
Differentiating between advertising and journalistic content.	.82			
Surfing safely on the internet.		.80		
Protecting own data and private sphere effectively.		.90		
Understanding how personal data is gathered and used further when using online media.		.88		
Searching for information effectively.			.82	
Filtering and interpreting information from different sources.			.77	
Judging the credibility of different information sources.			.78	
Using technical terms correctly.				.85
Differentiating between different data formats and using them with the right programs.				.65
Presenting data in graphics and tables.				.92

TABLE 3: *Loadings of the competence items in CFA*

Source: own processing, 2021[34]

Exploratory analysis was conducted to generate the latent variables that correspond to ICT use. Parallel analysis with scree plotting suggested extracting three factors from the twelve indicators of ICT use. Based on how the items loaded in each of the three factors (Table 4), it was possible to interpret that the first factor is strongly characterized by the use of stationary computers for students' active use, which correspond to input technologies in the classification by Karaseva et al.[35] and to networked technologies by Livingstone.[36] In terms of software, the first factor includes the use of common-use software applications,[37] mainly word processor and spreadsheets, and to a lesser extent, online tools. Therefore, the latent variable originated by this factor is labelled desktop-basics. The second factor has highly significant loadings for data projector and interactive board as hardware, denominated output technologies by Karaseva

[34] *Note*: All loadings are significant at the. 001 level.

[35] KARASEVA, A., SIIBAK, A., PRUULMANN-VENGERFELDT, P.: Relationships between Teachers' Pedagogical Beliefs, Subject Cultures, and Mediation Practices of Students' Use of Digital Technology. In *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 2015, Vol. 9, No. 1. No pagination. [online]. [2021-07-14]. Available at: <https://cyberpsychology.eu/article/view/4331/3394>.

[36] See: LIVINGSTONE, S.: Critical Reflections on the Benefits of ICT in Education. In *Oxford Review of Education*, 2012, Vol. 38, No. 1, p. 9-24. [online]. [2021-07-14]. Available at: <https://www.researchgate.net/publication/232939736_Critical_Reflections_on_the_Benefits_of_ICT_in_Education>.

[37] See: PAPANASTASIOU, E. C, ANGELI, C.: Evaluating the Use of ICT in Education: Psychometric Properties of the Survey of Factors Affecting Teachers Teaching with Technology (SFA-T3). In *Journal of Educational Technology & Society*, 2008, Vol. 11, No. 1, p. 69-86.

et al.[38] and one-to-many technologies by Livingstone.[39] The tools presentation programs and videos also load strongly in this factor, suggesting that it corresponds predominantly to the use of presentation and visualization ICTs. Finally, in the third factor, the significant loadings also correspond to input or networked technologies. However, it differs from the first factor: instead of stationary computers, mobile devices are the hardware for students' active use. Moreover, a range of online tools characterizes this factor. Therefore, it is named mobile-online.

ESEM ICT use	Desktop-basics	Presentation-visualization	Mobile-online
Computer lab	**.92**	-.18^{ns}	.01^{ns}
Mobile devices	.03^{ns}	**.**39^{b}	**.30**
Interactive board	.08^{ns}	**.49**	-.01^{ns}
Data projectors	.01^{ns}	**.72**	-.02^{ns}
Presentation programs	.34^{b}	**.57**	.01^{ns}
Word processor	**.85**	.12^{ns}	-.04^{ns}
Spreadsheets	**.81**	.01^{ns}	-.10^{ns}
Websites	**.52**	-.01^{ns}	**.52**
Communication tools	.08^{ns}	.38^{b}	**.41**
Search engines	**.59**	.00^{ns}	**.50**
Videos	-.03^{ns}	**.52**	**.51**
Learning platforms	**.44**	.05^{ns}	.29

TABLE 4: *Loadings of exploratory structure equation modeling for ICT use items*

Source: own processing, 2021[40]

Once the latent variables were modelled, the first model investigated the associations of the three types of ICT use with the fostering of the four competence areas. Evaluating the model fit, some indices indicate a good fit: Root Mean Square Error of Approximation (RMSEA) [90% confidence interval] = .05 [.05, .06], Comparative Fit Index (CFI) = .95, and Standardized Root Mean Square Residual (SRMR) = .04. Besides, the Tucker-Lewis Index (TLI) is .93, for which values higher than .90 tend to be considered acceptable or at least defendable.[41] However, the chi-square is very large (416.41 for 213 degrees of freedom) and significant. Schermelleh-Engel et al. recommend not emphasizing the chi-square statistic alone and considering the ratio between the chi-square value and the degrees of freedom.[42] This ratio should be as small as possible, with a value of 2 indicating a good model fit. The ratio of the model below is 1.95, meeting this criterion.

[38] KARASEVA, A., SIIBAK, A., PRUULMANN-VENGERFELDT, P.: Relationships between Teachers' Pedagogical Beliefs, Subject Cultures, and Mediation Practices of Students' Use of Digital Technology. In *Cyberpsychology: Journal of Psychosocial Research on Cyberspace*, 2015, Vol. 9, No. 1. No pagination. [online]. [2021-07-14]. Available at: <https://cyberpsychology.eu/article/view/4331/3394>.

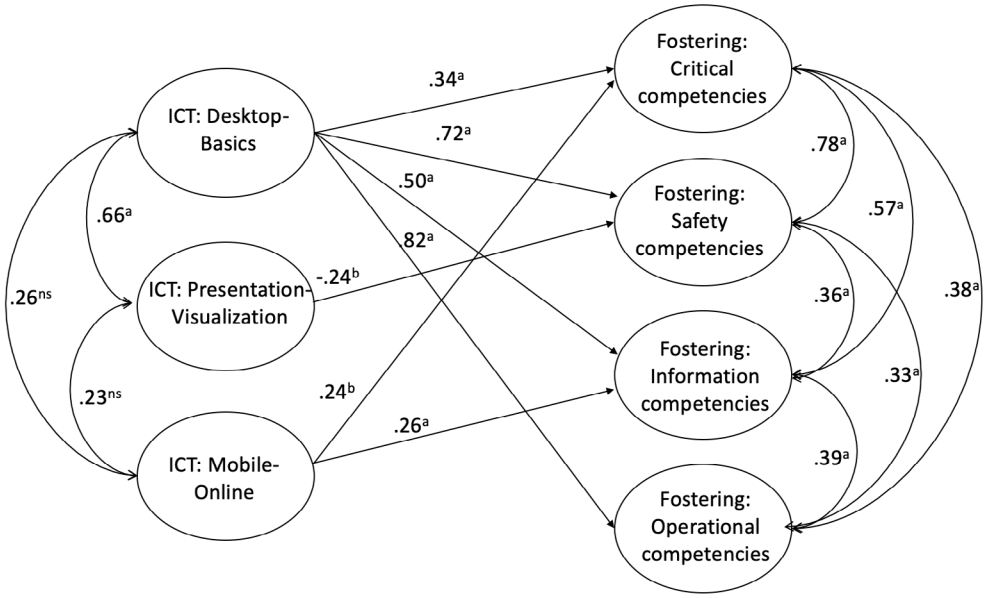
[39] See: LIVINGSTONE, S.: Critical Reflections on the Benefits of ICT in Education. In *Oxford Review of Education*, 2012, Vol. 38, No. 1, p. 9-24. [online]. [2021-07-14]. Available at: <https://www.researchgate.net/publication/232939736_Critical_Reflections_on_the_Benefits_of_ICT_in_Education>.

[40] *Note*: Bold = $p < .001$; b = $p < .01$; ns = nonsignificant. $Chi^2 = 87.45(33)$, $p < .001$; RMSEA = .07 [.05, .09]; CFI = .97; TLI = .93; SRMR = .03.

[41] See: HOX, J. J., BECHGER, T. M.: An Introduction to Structural Equation Modeling. In *Family Science Review*, 1998, Vol. 11, No. 4, p. 354-373.

[42] See: SCHERMELLEH-ENGEL, K., MOOSBRUGGER, H., MÜLLER, H.: Evaluating the Fit of Structural Equation Models: Tests of Significance and Descriptive Goodness-of-Fit Measures. In *Methods of Psychological Research*, 2003, Vol. 8, No. 2, p. 23-74.

Picture 3 presents the correlations between the factors resulting from both the exploratory and the confirmatory factor analysis (curved arrows) and the paths representing the associations between ICT use and fostering MIL (straight arrows). The correlations between the factors indicate discriminant validity; that is, the correlations between the factors are not excessively high (< .90[43]). As for the paths, the use of ICTs of desktop-basics kind associates positively and significantly with fostering all four competence areas, especially strongly with fostering operational competencies. The use of ICTs of mobile-online type is positively and significantly associated with fostering critical competencies and fostering information competencies. However, these coefficients are substantially weaker than in the associations with desktop-basics ICT use. The use of presentation-visualization ICTs is significantly associated only with fostering safety competence, and this association is negative. The model with the four types of ICT use as predictors accounts for 19% of explained variance of fostering critical competence, 37% of safety competence, 36% of information competence, and 57% of operational competence.



PICTURE 3: *Associations between three patterns of ICT use and fostering of four MIL areas*

Source: MPlus output, own processing, 2021[44]

In a subsequent step, school and teacher traits were included in the model. Although the model becomes more complex, the overall model fit is still acceptable (chi^2 = 548.88(298), p < .001, ratio chi^2/df = 1.84, RMSEA[CI 90%] = .05[.04; .06], CFI = .94, TLI = .92, SRMR = .04). The associations between the three types of ICT use and fostering the four competence areas remain pretty much the same as the first model, except for the association between mobile-online ICTs and fostering critical competence (Table 5). This association is reduced and becomes nonsignificant. In addition, the findings show that teachers who have received ICT-related training tend to conduct activities to foster students' information competence a little more often. However, it does not seem to influence the fostering of other competence areas. Training also correlates positively but weakly with the use of more conventional technologies (desktop-basis

[43] KLINE, R. B.: *Principles and Practice of Structural Equation Modeling*. New York : Guilford Publications, 2011, p. 116.

[44] *Note*: Standardized coefficients. Straight arrows represent beta coefficients and curved arrows represent correlations; a = p < .001; b = p < .01; ns = not significant.

and presentation-visualization). Collaboration with colleagues in ICT-related issues associates significantly and positively only with the area of safety competence. The analysis also shows that MIL has less room in STEM subjects. In these subjects, teachers work less frequently with aspects of critical, safety, and information competence. Moreover, the use of mobile devices and online resources occurs less frequently in STEM classes. In contrast, the use of computer rooms and common-use applications occurs more frequently in these subjects.

Having satisfactory ICT equipment at school does not favour the fostering of MIL. The factor is negatively associated with fostering information competence and no significant associations are found with teaching the remaining three competence areas. However, evaluating the school's ICT equipment as satisfactory correlates positively with using desktop-basics and presentation-visualization ICTs. Regarding the type of school, no significant relationships are found with the fostering of MIL, but minor differences appear in ICT types. In Gymnasium schools, a type of secondary school in Germany that is more academically oriented, the use of output or one-to-many technologies is more frequent, and the use of technologies for students' active use occurs less frequently.

Paths				
	Critical competence	**Safety competence**	**Operational competence**	**Information competence**
Desktop-basics	**.50**[a]	**.83**[a]	**.92**[a]	**.64**[a]
Presentation-visualization	-.11	**-.27**[b]	-.20	-.10
Mobile-online	.14	-.02	.03	**.18**[c]
Equipment	.01	-.01	-.04	**-.11**[c]
Training	-.01	-.02	-.01	**.15**[b]
Collaboration	.11	**.13**[c]	.04	.09
STEM	**-.30**[a]	**-.18**[b]	-.01	**-.28**[a]
Gymnasium	.06	-.01	.08	.07
R^2	.28	.42	.58	.49
Correlations				
	Desktop-basics	**Presentation-Visualization**	**Mobile-Online**	
Equipment	**.24**[b]	**.18**[c]	.08	
Training	**.14**[a]	**.09**[b]	.05	
Collaboration	.00	-.02	.04	
STEM	**.14**[a]	.06	**-.10**[c]	
Gymnasium	**-.09**[b]	**.08**[c]	-.07[c]	

TABLE 5: *Paths coefficients and correlations of the model with predictors*

Source: own processing, 2021[45]

6. Discussion

This study followed the argument that in their practice with digital media, teachers can use various ICTs and foster different MIL areas. Thus, instead of treating the use of general ICT as a predictor of teaching MIL, this study sought to verify the associations between teaching with and teaching about media when different types of ICT and MIL areas are considered.

[45] *Note*: Standardized coefficients. Significant coefficients are in bold; a = $p < .001$; b = $p < .01$; c = $p < .05$.

In the first step, the analysis identified three different patterns of ICT use in the sample. The first is characterized by using stationary computers in a specific school room and basic computer applications and software ("desktop-basics"). The second type relates to using equipment and tools for presentation and visualization ("presentation-visualization"). Finally, the third corresponds to the use of mobile devices and online-based applications and resources ("mobile-online"). The ESEM analysis points out a strong association between the first type, "desktop-basics," and the fostering of all four areas of MIL. Thus, it seems that, at least by the time of the data collection, teaching MIL in schools in Thuringia was taking place mainly in computer labs.

By the time of the data collection, in many schools, taking students to the computer room was the only possibility for students to use ICTs actively. According to a study by Initiative D21 with 1.425 teachers and 1.116 students in Germany, in 2016, around 70% of students reported that they had access to desktop computers, while only 10% affirmed having access to tablets in their schools. From the available ICTs, teachers reported that 76% of the desktop computers and even 18% of the tablets were stationary, often centralized in a computer lab.[46] Also, the ICILS 2018 data for Germany depicts a similar situation: 98% of the German participant students attended schools where devices were available in computer laboratories. On the other hand, only 15% reported that students brought portable devices to class in their schools.[47] The findings of the present study suggest that teachers consider it necessary that students use ICTs actively for developing MIL in different areas. This is mainly manifested in the strong associations with the fostering of competencies to operate technologies.

Also, the competence areas of safety and information are strongly associated with the use of desktop-basics ICT type, suggesting that teachers prefer to approach safety and information-related issues with students actively using ICTs. On the other hand, the association with fostering critical competence is weaker than the associations with the other areas, which is reasonable since critical thinking about media and technologies does not necessarily demand interaction with ICTs.[48] Nevertheless, since the effect observed is still quite strong, it seems that teachers use the situations when students are working directly with the technologies in computer rooms to approach the critical aspects of MIL. However, it is not clear if teachers take students to the computer lab purposively to teach MIL or find more opportunities to approach MIL-related topics during activities in the computer lab.

However, it is pertinent to consider that the data used in this analysis were collected in 2017. As the study by Initiative D21 pointed out, fewer schools had the opportunity to implement mobile devices for students' active use.[49] Possibly, the prevalence of the use of computer rooms for teaching MIL may reduce as the use of mobile devices and online resources increases in schools. Moreover, the closure of schools during the corona pandemic highlighted the relevance

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[46] *Sonderstudie Schule Digital – Lehrwelt, Lernwelt, Lebenswelt: Digitale Bildung im Dreieck SchülerInnen-Eltern-Lehrkräfte*. [online]. [2021-07-14]. Available at: <https://initiatived21.de/publikationen/sonderstudie-schule-digital/>.

[47] FRAILLON, J. et al.: *Preparing for Life in a Digital World: IEA International Computer and Information Literacy Study 2018 International Report*. Berlin, Heidelberg : Springer, 2020, 297 p. [online]. [2021-07-14]. Available at: <https://link.springer.com/book/10.1007%2F978-3-030-38781-5>.

[48] See: PÖTZSCH, H.: Critical Digital Literacy: Technology in Education beyond Issues of User Competence and Labour-market Qualifications. In *TripleC Journal for a Global Sustainable Information Society*, 2019, Vol. 17, No. 2, p. 221-240. [online]. [2021-07-14]. Available at: <https://www.triple-c.at/index.php/tripleC/article/view/1093/1296>.

[49] *Sonderstudie Schule Digital – Lehrwelt, Lernwelt, Lebenswelt: Digitale Bildung im Dreieck SchülerInnen-Eltern-Lehrkräfte*. [online]. [2021-07-14]. Available at: <https://initiatived21.de/publikationen/sonderstudie-schule-digital/>.

of digital and online technologies for education.[50] Likely, the adaptations that many schools implemented due to the COVID-19 pandemic will reflect on media use in class afterward. Thus, the new tools and resources that teachers and students explored during the pandemic have the chance to become a regular part of the pedagogical processes.

In the analysis, the use of mobile devices and online resources associated significantly only with fostering of information competence when controlling for schools and teacher traits. These findings indicate that in schools where mobile devices are used, a stronger emphasis on dealing with information is put. When working with individual devices connected to the internet, students may be more frequently stimulated to search for and select information to conduct their independent work with these technologies. As mobile resources and online tools become more integrated into classes, they also may become more strongly associated with teaching other areas of MIL.

Using visualization and presentation tools has no relationship with fostering critical, operational, or information competence. In the case of safety competence, using this type of ICTs is associated with less frequent teaching about online safety. These findings consolidate that teachers favour ICTs that can be used actively by students for fostering students' MIL competence. Consequently, assuming that ICT use, in general, is associated with fostering MIL is deceiving.

Furthermore, the findings show that except for using the desktop-basics ICT type, which was a common predictor of the four MIL areas, the competence areas are predicted by different factors. That is, under certain conditions, teachers may favour the fostering of specific competencies over others. Therefore, when discussing teachers' role in fostering youngsters' MIL, it is pertinent to consider the diversity of competencies. As MIL frameworks are usually comprehensive, it is unrealistic to expect teachers to cover all competence areas when fostering students' MIL, especially when MIL is not a singular topic in school curricula. In schools, planning and distributing the responsibility to cover specific media-related topics among teachers might support the fostering of MIL in its comprehensiveness.

Considering the strong effects of the types of ICT use, school and teacher traits are weaker predictors in the models. How teachers evaluate the ICT equipment available at their schools is significantly associated only with fostering information competence. Interestingly, the association is negative, i.e., teachers who evaluate their school's equipment better tend to engage less frequently in activities that foster students' information competence, or vice-versa. It is possible that the teachers who emphasize the teaching of information competence are more demanding in their evaluation of their schools' available ICT and that they would like to have more advanced tools or conditions, such as better internet connection. Conversely, the model shows that teachers who use desktop-basics and presentation-visualization ICTs more frequently tend to evaluate the ICT available at school positively. However, the evaluation of ICT available at school is subjective. Consequently, its relations with ICT use do not solely concern what is available at school. It also depends on the teacher's ambitions regarding technologies.

[50] See: DREER, B., KRACKE, B.: *Befragung von Thüringer Lehrer*innen während der durch die Corona-Krise bedingten Schulschließungen 2020 – Bericht erster Ergebnisse*. [online]. [2021-07-14]. Available at: <https://www.uni-jena.de/unijenamedia/Thueringer_Studie_zum_Unterricht_in_der_Coronakrise.pdf>; FORSA POLITIK – UND SOZIALFORSCHUNG: *Das Deutsche Schulbarometer Spezial Corona-Krise: Ergebnisse einer Befragung von Lehrerinnen und Lehrern an allgemeinbildenden Schulen im Auftrag der Robert Bosch Stiftung in Kooperation mit der ZEIT*. [online]. [2021-07-14]. Available at: <https://deutsches-schulportal.de/unterricht/lehrer-umfrage-deutsches-schulbarometer-spezial-corona-krise-folgebefragung/>; HUBER, S. G., HELM, C.: COVID-19 and Schooling: Evaluation, Assessment and Accountability in Times of Crises – Reacting Quickly to Explore Key Issues for Policy, Practice and Research with the School Barometer. In *Educational Assessment, Evaluation and Accountability*, 2020, Vol. 32, No. 2, p. 237-270. [online]. [2021-07-14]. Available at: <https://link.springer.com/article/10.1007%2Fs11092-020-09322-y>.

Teachers' media-related professional development is often considered an influential factor in their practices of teaching with and about media.[51] While teachers can develop their competence in different ways, formal training and exchanges with colleagues are known ways to equip teachers with skills related to media and technology. In the analysis, media-related training and collaboration with colleagues are associated only with a single competence area each. Therefore, it is worth examining what media and technology-related topics teacher pre-and in-service training emphasize.[52] It can be interpreted that teachers have received training in more conventional technologies and topics related to the area of information competence. Collaboration with colleagues might be a way of supplying a demand that perhaps formal training does not sufficiently provide. Also, the absence of associations with the other competence areas does not mean that teachers are not competent, as they might have earned the qualification by other means, including autonomously.

As this study found that the associations between uses of different types of ICT and fostering of different MIL competence areas vary, it is sensible to be precise when referring to teacher practices with digital media. Furthermore, to the extent that technologies become more diverse in schools, with the integration of wearables, virtual reality, and artificial intelligence systems, to name a few, it is opportune to look at what types of competence they can potentially help foster.

7. Limitations

The data measured the fostering of different competence areas, which rarely happens in research. By doing so, fostering different MIL areas could be analyzed concerning the use of different ICT, resulting in a complex model that would rigorously demand a larger data set. Therefore, the results were handled and reported with caution. No claims were made that using certain ICTs leads to specific types of competence. Instead, the present study contributed to understanding teachers' use of ICT to foster specific MIL competencies. Future studies with larger samples of teachers should consider different MIL areas and the diversity of ICT types. Also, in the measure of ICT use, there are many other tools not included in this study, such as specialized software.[53] As previously mentioned, the data of this study are from 2017. Teachers' use of ICT has likely suffered transformations due to investments in digital technologies in schools and the COVID pandemic experience, which might also affect the fostering of students' MIL. Since teachers' practices with digital media are susceptible to suffering transformation, studies on teaching with and teaching about media should happen continuously.

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[51] GERICK, J., EICKELMANN, B., BOS, W.: School-level Predictors for the Use of ICT in Schools and Students' CIL in International Comparison. In *Large-Scale Assessments in Education*, 2017, Vol. 5, No. 1, Article 5. [online]. [2021-07-14]. Available at: <https://largescaleassessmentsineducation.springeropen.com/articles/10.1186/s40536-017-0037-7>; GIL-FLORES, J., RODRÍGUEZ-SANTERO, J., TORRES-GORDILLO, J. J.: Factors that Explain the Use of ICT in Secondary-education Classrooms: The Role of Teacher Characteristics and School Infrastructure. In *Computers in Human Behavior*, 2017, Vol. 68, p. 441-449. [online]. [2021-07-14]. Available at: <https://idus.us.es/bitstream/handle/11441/87990/1-s2.0-S0747563216308068-main.pdf?sequence=1&isAllowed=y>; TONDEUR, J. et al.: Teacher educators as gatekeepers: Preparing the next generation of teachers for technology integration in education. In *British Journal of Educational Technology*, 2019, Vol. 50, No. 3, p. 1189-1209.

[52] For example: TIEDE, J., GRAFE, S.: Media Pedagogy in German and U.S. Teacher Education. In *Comunicar*, 2016, Vol. 24, No. 49, p. 19-28. [online]. [2021-07-14]. Available at: <https://www.revistacomunicar.com/index.php?contenido=detalles&numero=49&articulo=49-2016-02>.

[53] See: PAPANASTASIOU, E. C., ANGELI, C.: Evaluating the Use of ICT in Education: Psychometric Properties of the Survey of Factors Affecting Teachers Teaching with Technology (SFA-T3). In *Journal of Educational Technology & Society*, 2008, Vol. 11, No. 1, p. 69-86.

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