Digital Competence of Educators (DigCompEdu): Development and Evaluation of a Self-Assessment Instrument for Teachers' Digital Competence

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Abstract: Based on the European Framework for the Digital Competence of Educators (DigCompEdu), a self-assessment tool was developed to measure teachers' digital competence. This paper describes the DigCompEdu reference framework, the development and the evaluation of the instrument, and analyses the results of the study with 335 participants in Germany in view of the reliability and validity of the tool. To determine internal consistency, Cronbach's alpha is considered for the entire instrument as well as separately for the six competence areas. To investigate the validity, hypotheses based on groups with known attributes are tested using the Mann-Whitney-U test and the Spearman rank correlation. As predicted, there is a significant, albeit small, difference between STEM and non-STEM teachers, and computer science and non-computer science teachers. Furthermore, there is also a significant difference between teachers with negative attitudes to the benefits of technologies compared to those with neutral or positive attitudes. Teachers who are experienced in using technologies in class have significantly higher scores, which further confirms the validity of the instrument. In sum, the results of the analysis suggest that the survey is a reliable and valid instrument to measure teachers' digital competence.

1 INTRODUCTION

The Internet and digital technologies have become an integral part of everyday life in the 21st century. It is therefore imperative that all citizens develop digital competence as a key competence of lifelong learning, facilitating personal fulfilment and development, employability, social inclusion and active citizenship (Council of the European Union, 2018). The European Digital Competence Framework (DigComp) published in 2013 and revised in 2016 and 2017 describes the digital competence of citizens (Ferrari, 2013; Carretero et al., 2017). European member states have used the DigComp framework as a reference framework, e.g. in Germany the Kultusministerkonferenz (KMK) refined it for their own framework for students' digital competence (KMK, 2016). The need to equip citizens with the corresponding critical and creative skills places new demands on educators at all levels of education, who must not only be digitally competent themselves, but must also promote students' digital competence and seize the potential of digital technologies for enhancing and innovating teaching.

The European Framework for the Digital Competence of Educators (DigCompEdu) published in 2017 describes the digital competences specific to the teaching profession (Redecker, 2017). This framework is based on extensive expert consultations and aims to structure existing insights and evidence into one comprehensive model, applicable to all educational contexts. To allow educators to get a better understanding of this framework and to provide them with a first assessment on their individual strengths and learning needs, an online self-assessment instrument has been developed, freely accessible in a number of languages.

The aim of this study is to validate the German version of this instrument for teachers in primary, secondary and vocational education. Once validated, the self-assessment tool will help teachers to reflect on their digital competences and identify their need for further training and professional development.

2 THEORETICAL FRAMEWORK

According to Redecker (2017) the European Framework for the Digital Competence of Educators (DigCompEdu) details 22 educator-specific digital competences organised in six areas.

Applied to the context of school education Area 1 *Professional Engagement* describes teachers' efficient and appropriate use of technologies for communication and collaboration with colleagues, students, parents and external persons.

The core of the DigCompEdu framework is represented by the areas 2 to 5, in which technologies are integrated into teaching in a pedagogically meaningful way. Area 2 *Digital Resources* focuses on the selection, creation, modification and management of digital educational resources. This also includes the protection of personal data in accordance with data protection regulations and compliance with copyright laws when modifying and publishing digital resources. The third area (*Teaching and Learning*) deals with planning, designing and orchestrating the use of digital technologies in teaching practice. It focuses on the integration of digital resources and methods to promote collaborative and self-regulated learning processes and to guide these activities by transforming teaching from teacher-led to learner-centred processes and activities. Area 4 *Assessment* addresses the concrete use of digital technologies for assessing student performance and learning needs, to comprehensively analyse existing performance data and to provide targeted and timely feedback to learners. With Area 5 being centred on *Empowering Learners* the framework emphasises the importance of creating learning activities and experiences that address students' needs and allow them to actively develop their learning journey.

Area 6 (*Facilitating Learners' Digital Competence*) completes the framework by highlighting that a digitally competent teacher should be able to promote information and media literacy and integrate specific activities to enable digital problem solving, digital content creation and digital technology use for communication and cooperation.

Each individual competence of the DigCompEdu framework is described along six proficiency levels (A1, A2, B1, B2, C1, C2) with a cumulative progression, linked to the Common European Framework of Reference for Languages (CEFR). Teachers at the first two levels, A1 and A2, have started to use technology in some areas and are aware of the potential of digital technologies for enhancing pedagogical and professional practice. Teachers at level B1 or B2 already integrate digital technologies into practice in a variety of ways and contexts. At the highest levels C1 and C2, teachers share their expertise with peers, experiment with innovative technologies and develop new pedagogical approaches.

According to this approach, a teacher's general digital competences (as described in DigComp) is a prerequisite for developing the teacher-specific digital competences as described in DigCompEdu. Further prerequisites are the teacher's subject-specific, pedagogical and transversal competences.

Hence, DigCompEdu agrees with the TPACK framework published by Mishra and Koehler in 2006, which postulates that three knowledge areas - technological, pedagogical and content knowledge - need to be effectively integrated for teachers to use digital technologies with added value in their teaching. However, where TPACK falls short of explaining how this connection is established, DigCompEdu aims to identify pedagogical and professional focus areas for the integration of technology into teaching and professional practice. To be able to supply such detail and still be applicable across all subjects and in a continuously changing technological landscape, the focus of DigCompEdu is clearly on the pedagogical element. DigCompEdu describes how technological competence (as described in DigComp) and subject-specific teaching competence (as described by curricula) can be pedagogically integrated by teachers to provide more effective, inclusive, personalised and innovative learning experiences to students. DigCompEdu furthermore acknowledges that to transform education in such a way a wider approach, including the professional environment and the integration of learning into the overall social and societal context is needed. Areas 1 and 6 cover these aspects.

3 METHODOLOGY

Based on the DigCompEdu framework and its proficiency levels an online self-assessment tool was developed that allows teachers to assess their digital competence. The tool development was guided by three principles: (i) to condense and simplify the key ideas of the framework, (ii) to translate competence descriptors into concrete activities and practices, and (iii) to offer targeted feedback to teachers according to their individual level of competence for each of the 22 indicators. Following these principles, 22 items were developed, so that each competence is represented by one item. Each item consists of a statement describing the core of the competence in concrete, practical terms, and 5 possible answers, which are cumulatively structured and mapped onto the proficiency levels. The teacher is asked to select the answer that best reflects his or her practice.

Instrument Development

The instrument development followed an iterative process of expert consultations, pre-piloting and item revision. A first version of the self-assessment instrument using a frequency scale for answer options was made available via EUSurvey, an online survey tool, in March 2018. This English-language version was tested, by independent experts, with 160 English teachers in Morocco (Benali, Kaddouri and Azzimani, 2018). The data analysis showed an excellent internal consistency for the whole instrument, with a Cronbach's alpha of .91. In April 2018, the German translation was tested by 22 teachers in Germany and evaluated with the help of comment fields as well as orally afterwards.

However, these trials also revealed that some answer options were not selected by users and the feedback collected on the user experience indicated that some items did not meet user expectations. The subsequent consultations with 20 experts (researchers and teachers) in a workshop in May 2018 and through involvement of the DigCompEdu community led to a collaborative redesign of the answer options. As a first step, the 20 subject-matter experts supervised the item revision process by discussing the relevance and representativeness of the items to the framework. After each revision made, all items were made available to the DigCompEdu community on the European Commission website so that the community members, consisting of interested teachers, lecturers, researchers and experts, could comment on the items and test the survey. The review process was repeated until no more comments or remarks were made.

In October 2018 a new version was made available in English and German. The main changes with respect to the early version published in March 2018, concern the creation of different versions for different educator audiences and the stronger alignment of the answer scale with the DigCompEdu framework progression. The answer options were more adapted to the descriptors and the progression foreseen in the DigCompEdu framework. The experts agreed that, as in the previous version of the tool, each competence should continue to be represented by only one item and that the total digital competence should then consist of all 22 items. Therefore, in some cases, a choice had to be made between different aspects crucial to a given competence. However, care was taken to select the most generic and basic concept. For example, for competence *2.3 Managing, protecting, sharing*, it was decided to focus on data protection, rather than on copyright rules or the use of shared content repositories.

Similarly, the framework's competence progression in six stages was transformed into a five-point-scale, which was guided by considerations about the different implementation stages expected to be prevalent among current teachers. As the progression in the framework, the self-assessment tool assumes that digital competence development comprises the following stages: *no use - basic use - diversification - meaningful use - systematic use - innovation*.

In some transpositions of the framework into the self-assessment tool, the categories of meaningful and systematic use were merged, as it was deemed difficult for users to differentiate between the two options. In other cases, where it was expected that current usage patterns were unlikely to yet display innovative strategies, the highest competence level, C2, was left out. Sometimes both strategies were combined to allow users more choices at the lower end of the competence range by splitting the "no use" category into two answer options: a) no experience with the practice at hand and b) experience with the practice, but not with using digital technologies within the practice.

The resulting instrument employs five answer options for which points ranging from 0 to 4 are scored. In the feedback report generated, the total score - ranging from 0 to 88 points - is mapped onto the six different proficiency levels. For the initial allocation of score intervals to proficiency levels, the mapping of answer options onto the proficiency scale was taken as an orientation. Based on the expert consultation, the allocation of the total score to the six levels was discussed and adjusted.

Additionally, the feedback report indicates scores per area, in order for teachers to determine their relative areas of strength and their specific needs for further training. For these, only an indicative proficiency level was provided as a first orientation.

The instrument also included items addressing demographic information and information on school type and equipment, teaching activities and attitudes towards digital technologies.

3.1 Sample

From 24 September until 29 November 2018, data of 335 teachers were collected online via EUSurvey. At three German-language conferences during the same period, posters and flyers were used to promote participation in the online self-assessment survey. In general, the participation in the study was voluntary. No rewards or incentives were offered.

In total, 168 (50.1 %) women and 146 (43.6 %) men took part in the survey; 21 (6.3 %) persons preferred not to report their gender. The age of 90.4 % of the participants was between 25 and 59 years. 10.1 % of teachers teach in primary schools, 25.4 % in "Gymnasium" (one type of secondary school) and the rest in other types of schools. 134 (40 %) of participants teach STEM subjects, of which 41 (12.2 %) are computer science teachers.

Participating teachers have indicated how many years they have been teaching and how many years they have been using digital technologies in class (Table 1). In total, 24.5 % have been using digital technologies in class for more than 10 years. Of these, 80.95 % are STEM teachers.

In addition, a multiple-choice question was asked as to which digital tools they were already using with their students in class. Presentations (89.9 %), watching videos or listening to audios (87.5 %), online quizzes (59.4 %) and interactive apps (54.3 %) were the most frequently mentioned. On average, teachers use 4.2 digital tools in class.

Table 1: Professional and media experience in class.

	How many years have you been teaching?	How many years have you been using technologies in class?
I have not used digital technologies in class yet	-	1,2 %
Less than 1	20,6 %	21,2 %
1 - 3	9,9 %	18,5 %
4 - 5	8,4 %	13,10 %
6 - 9	8,4 %	16,7 %
10 - 14	14,9 %	13,1 %
15 - 19	14,9 %	8,1 %
20 or more	19,1 %	3,3 %
I do not want to say.	3,9 %	4,8 %

3.2 Data Analysis

A number of quantitative research methods were applied to establish evidence for the validity and reliability of the instrument. We assessed the whole instrument with 22 items and each of the six competence areas for internal consistency using Cronbach's alpha reliability technique. To test the validity of the instrument we used the known-groups method (Hattie and Cooksey, 1984). The method states that as a criterion for validity, test results should differ between groups which - based on theoretical or empirical evidence - are known to differ. We therefore formulated hypotheses about the different results expected to be obtained by sub-groups of the sample with known attributes, which, according to empirical evidence, differ as concerns their level of digital competence (hypotheses 1a, 1b, 4). We furthermore investigated hypotheses based on conceptual assumptions underlying the DigCompEdu framework (hypotheses 2, 3a, 3b):

Hypothesis (1a): STEM teachers have a higher total test score than teachers who do not teach STEM subjects.

Hypothesis (1b): Computer science teachers score better in the test than teachers who do not teach computer science.

Hypothesis (2): The more years a teacher already uses digital technologies in teaching practice, the higher the teacher's digital competence and thus the overall test result.

Hypothesis (3a): The number of digital tools used in teaching correlates with the digital competence of the teacher, i.e. with his or her overall score in the test.

Hypothesis (3b): Teachers who use more than the average digital tools in class score better in the test than teachers who use up to 4 different tools.

Hypothesis (4): Teachers with a negative attitude towards the benefits and use of digital technologies in teaching will have a lower overall score in the test than teachers with a positive or neutral attitude.

To further support the validity of the instrument participants were asked to assess their digital competence as teachers based on the six proficiency levels (A1-C2). We expect a high correlation between the self-assessed level and the level calculated on the basis of the total score.

To test the hypotheses, the Mann-Whitney U test was used and the Spearman's rank correlation coefficients were calculated.

4 RESULTS

A total of 88 points can be achieved. Looking at the results of this study, the median of the total score is 45 points (minimum 11 points and maximum 88 points). The Kolmogorov-Smirnov test showed that these data deviate significantly from the normal distribution and are therefore not normally distributed.

Table 2: Cronbach's alpha reliability coefficient for internal consistency.

	Number of items	Internal Consistency (Cronbach's alpha)
Whole instrument	22	.934
Area 1: Professional Engagement	4	.779
Area 2: Digital Resources	3	.687
Area 3: Teaching and Learning	4	.798
Area 4: Assessment	3	.690
Area 5: Empowering Learners	3	.752
Area 6: Facilitating Learners' Digital Competence	5	.823

The entire instrument with 22 items has an excellent internal consistency with a value of .934 for Cronbach's alpha. Table 2 lists Cronbach's alpha by area, which range from .687 to .823. According to George and Mallery (2003), this range is considered to be acceptable to good with the exception of area 2 and 4, which are lower than .7 and therefore questionable. Cronbach's alpha of area 4 would increase from .69 to .716 and the Cronbach's alpha of the whole instrument would increase from .934 to .935, if the second item of area 4 (item 4.2) was omitted. This is the only item that, if omitted, would lead to an increase of the internal consistency. Also the Corrected Item-Total Correlation of only this item is conspicuously low (.413), but nevertheless acceptable (Gliem and Gliem, 2003). For all other items the Corrected Item-Total Correlation is above .50.

To test our hypotheses (1a, 1b, 3b, 4) we used the Mann-Whitney U test, a nonparametric test which does not require the assumption of the data being normally distributed (Mann and Whitney, 1947). Table 3 summarizes the results of the Mann-Whitney U test and the respective effect size.

Table 3: Results of Mann-Whitney U test.

Hypo-thesis	U	p (asymp. sig. (2-tailed))	z	Calculated effect size $r = \left\|\frac{z}{\sqrt{N}}\right\|$
1a	10889.5	.003	-2.97	.16
1b	3933.5	.000	-3.60	.20
3b	3896.0	.000	-11.27	.62
4	10085.5	.000	-4.347	.24

In order to test the hypotheses regarding the expected correlations, we have calculated Spearman's rank correlation coefficients (Spearman's rho), a nonparametric and distribution-free rank statistic, to measure the strength of the association (Hauke and Kossowski, 2011). Table 4 shows the results for Spearman's rho.

Table 4: Results of Spearman's correlation coefficients.

Hypothesis	p (sig. (2-tailed))	Spearman's rho r_s
2	.000	.32
3a	.000	.68
Self-assessment compared to level determined by total score	.000	.71

Our first hypothesis predicted that STEM teachers would score higher in the test than teachers who do not teach STEM subjects. We found a significant difference between STEM teachers compared to teachers of other subjects. The effect size of r = .16 indicates a weak effect. The calculation of the quartiles has shown that the first quartile, the median and the third quartile of the STEM teachers (Q_1 = 40, median = 47, Q_3 = 58, n_{STEM} = 134) are clearly higher and over a shorter range than those of the non-STEM teacher (Q_1 = 32, median = 42, Q_3 = 55, n_{nSTEM} = 201). We then considered the computer science teachers separately and compared their overall results (Q_1 = 43.5, median = 52, Q_3 = 64.5, n_{CS} = 41) with those of the non-computer science teachers (Q_1 = 34, median = 43.5, Q_3 = 55, n_{nCS} = 294). Again, we found a significant difference with a weak effect size (r = .2).

To test hypothesis 2, we examine whether the number of years in which teachers have had continuous experience and engagement with the use of technology in teaching practice is related to their digital competence and thus to their total score in the test. We found a positive correlation of medium strength (r_s = .32), which is statistically significant.

We furthermore expected (hypothesis 3a) the number of digital tools used in teaching to correlate with the teacher's digital competence and thus with his total score in the test. The analysis shows that this correlation is significant at a .01 level and Spearman's rho is r_s = .68. According to Cohen (1988), this value is indicative of a strong correlation. Likewise, for our hypothesis 3b, which states that teachers who use digital tools more than average, i.e. who use 5 to 9 different digital tools in class, achieve a higher overall score than teachers who use 0 to 4 tools, we have found a significant difference with a strong effect size (r = .62). In this case, STEM teachers were not dominant in the group of more than 4 tool users and only slightly overrepresented when compared to non-STEM teachers: In total, there were 146 teachers using more than 5 digital tools, 71 (48.63 %) of them were STEM teachers.

Hypothesis 4 uses data collected across seven questions on participants' general attitudes towards technology and their self-efficacy in using of digital technologies for general purposes, using a five-point Likert scale (from "strongly disagree" to "strongly agree"). To test hypothesis 4, we divided participants into two groups: Teachers who responded negatively to at least one of the seven questions are compared to the remaining teachers. The Mann-Whitney U test revealed that there is a significant difference between the two groups. However, the effect size is .24, which indicates a weak effect.

The comparison between the digital competence assessed by the participants themselves and the level determined by the total score showed a strong, positive Spearman rank correlation, which is statistically significant (r_s = .71, p = .000). A closer look at the frequencies of self-assessments that are equal to, underestimating or overestimating the calculated level shows that 55.5 % and thus the majority of the participants underestimated themselves. Only one third of the participants assessed themselves according to the level calculated by the total score. 11 % judged themselves to be better.

5 DISCUSSION

The results of this study indicate that the self-assessment instrument developed is reliable and valid and thus suitable for measuring teachers' digital competence.

As concerns the reliability of the instrument, we observe an excellent internal consistency (Cronbach's alpha) of the instrument. However, this finding should not be taken to imply that teachers' digital competence may be considered a unidimensional construct (Gliem & Gliem, 2003, p. 87). Future research should investigate the internal structure and determine the dimensionality.

Compared to the pre-piloting of the English version with 160 teachers (Benali et al., 2018), the internal consistency has increased even further after the items have been revised. Nevertheless, the analysis has shown that two areas have a lower internal consistency. In particular, one item would slightly increase the internal consistency of the instrument by being omitted. Initial considerations of the research team suggest that both the item and the competence differ from the majority of other items and competences by the fact that they do not focus on practical digital tool use, but on the interpretation of data. Additionally, since the competence as it is described in the framework, presupposes a high level of digital tool use, for the questionnaire a version with a slightly less pronounced technological focus was opted for. To better understand the consequences to be drawn from the fact that the removal of this item would lead to an increase in the internal consistency of the tool it is proposed to involve an expert panel in a new item revision process, including the reflection on the focus and scope of the corresponding competence as it is described in the framework.

When investigating the validity of the instrument, all hypotheses could be confirmed, suggesting that the tool is a valid means of ascertaining teachers' digital competence.

The expectation that STEM-teachers and especially computer science teacher score higher than non-STEM and non-computer science teachers was based on previous studies showing significant differences between STEM and non-STEM teachers (e.g. Jang and Tsai, 2012; Endberg and Lorenz, 2017) and further supported by the fact that due to school curricula require computer science teachers to extensively use digital technologies in class. Our dataset not only confirms the frequent and long-standing use of technologies in STEM teaching practice, but also our study hypotheses that these practices lead to a higher level of digital competence, as it is measured by the DigCompEdu self-assessment instrument. STEM and computer science teachers do have a significantly higher total score in our test. However, the effect size is weak, which can be explained by the fact that the DigCompEdu framework does not focus on technical or general digital skills. It explicitly puts pedagogical and methodological considerations that are specific for teaching processes at the core of the framework, spelling out how these are transformed when digital technologies are used. So this effect should not be too high. Otherwise either the framework or the instrument developed would put an overly high importance on STEM-specific or technical digital skills and not adequately apply to all subjects, which would be contrary to the framework design. Another reason for the weak effect size could be explained by the results of the PISA 2015, which state that the STEM subjects in Germany, in particular, still have room for improvement in the way they use digital technologies (Reiss et al., 2016).

The second hypothesis postulated a correlation between the years of experience in using digital technologies in education with the competence level obtained. This hypothesis is based on the framework assumption that digital competence improves with digital practice, so that teachers who have had more years of experience in using digital technologies in teaching should be more fluent in doing so, and therefore, overall, more digitally competent. The data confirms this assumption; there is a positive correlation of medium strength between the number of years of experience in using digital tools in teaching with the overall score obtained. However, the vast majority of long-term technology users are STEM-teachers, indicating that hypotheses 1 and 2 are interrelated. It is therefore difficult to attribute the effect observed to either one or the other specific characteristic considered in hypotheses 1 and 2.

Hypothesis 3a and 3b approaches the effect of digital practice on digital competence from a slightly different perspective, not looking at experience and exposure over time, but at the diversity of digital strategies employed. Since the DigCompEdu framework suggests that the digital competence improves as more and more different digital tools are included in a reflective practice, if the instrument correctly reflects the frameworks assumptions, there should be a high correlation between the total score achieved and the number of different digital technologies used. Hence, hypothesis 3 tries to capture one of the fundamental assumptions of the DigCompEdu framework that it is the diversity of digital strategies that contributes to raising educators' digital competence.

When considering the diversity of digital tool use in teaching, we obtain a high positive correlation (hypothesis 3a). This means that teachers who use a variety of tools more frequently have a significantly higher total score. It is underpinned by the strong effect size of the significant difference between the groups of teachers who use above-average (5-9) and less than average (0-4) tools in class (hypothesis 3b). About half of the teachers who use more than 4 tools are STEM teachers. Hence, this strong effect cannot be attributed solely to subject profiles, but seems to, in fact, confirm the assumption that digital competence increases with the diversity of digital tools employed. However, this finding is limited by the fact that the quality or frequency of use of the various digital tools was not surveyed.

The stipulation of hypothesis 4 is based on results of previous studies, such as ICILS 2013, which have shown that the confidence and positive attitude of teachers towards the use of digital technologies is linked to the perceived pedagogical value of the technological tool and the frequency of use (Lorenz, Endberg and Eickelmann, 2017; Huang et al., 2013; Petko, 2012). Therefore, teachers with a negative attitude towards the benefits and use of digital technologies in teaching should have a lower overall score in the test than teachers with a positive or neutral attitude. The results show that this difference, although with a weak effect size, is significant, which is another indicator of the instrument's validity.

The fact that the expectations users had on their competence level is significantly correlated to the score obtained, with a positive and strong rank correlation, suggests that the instrument also fulfils this condition. However, more than half of the participants consider themselves to be at a lower level than the level determined by the total score. Possible reasons could be, on the one hand, a lack of information for the participants about the meaning of the proficiency levels or the lack of competence to assess oneself in this respect, or, on the other hand, a not yet fully developed calculation of the proficiency levels from the total score. Further studies and expert consultations should shed more light on this effect.

In addition to the limitations already mentioned, there are further limitations of the study that should be considered. The data collection was not conducted under a controlled setting. The survey was available online for anyone to use, so that it is impossible to ascertain that all participants are, in fact, teachers, who truthfully filled in the survey. In addition, all results are based on self-reported data that are known to be subject to individual and cultural biases. When assessing teachers' digital competence, for example, it would also be useful to supplement teachers' self-reports with knowledge-based tests, student questionnaires or observation data. This could also improve the measurement of the quality of the use of digital technologies in teaching practice.

6 CONCLUSIONS

Based on the DigCompEdu framework we developed a self-assessment instrument for teachers' digital competence. The aim of this study was to investigate the reliability and validity of this instrument. The data collected on the German version of the self-assessment tool for teachers with this sample of 335 teachers suggests a high internal consistency. Future work will consist of further increasing these by discussing and adapting questionable items. In order to verify the validity of the instrument, several hypotheses about theoretically expected differences between subgroups of the sample were formulated and confirmed by the analyses. From a conceptual point of view, it was crucial that there are differences between teachers who have many years of experience with technologies in teaching or who already use a variety of tools in practice. The existing but small difference between STEM and non-STEM teachers or computer science and non-computer science teachers confirms that the instrument correctly represents the key assumption of the DigCompEdu framework as a framework applicable to all teachers and teaching contexts. Teachers with more years of experience in using technologies in teaching tend to have a moderately higher score and teachers using a greater variety of digital teaching strategies tend to have a substantially higher score, indicating that the instrument reflects the framework's assumption that digital competence develops with experience and by diversifying digital strategies. Despite a strong rank correlation between the self-assessed level and the level calculated from the total score, the future goal should be to further increase this correlation.

The instrument provides a promising starting point for the development of further DigCompEdu assessment tools. To verify these findings for other language versions and the contextual adaptations for higher and adult education, similar studies should be conducted with the different variants of the tool.

This tool gives teachers the opportunity (1) to learn more about the DigCompEdu framework, i.e. of what it means to be a digitally competent educator, (2) to get a first understanding of their own individual strength, and (3) to get ideas on how to enhance their competences. Likewise, teacher trainers could identify the needs and strengths of their CPD participants and, e.g. select or design suitable training courses. Prospectively, we plan to conduct studies to further validate the instrument and thus also to evaluate the suitability of the feedback. Especially in individual feedback we see the potential to help the educators to further develop their digital competence.

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