Dimensions of digital competence and its assessment in basic school

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Summary

Digital competence is one of the competencies of the 21st century, which has been theoretically described by both international and Estonian expert groups but whose dimensions have been indistinguishable in empirical studies. Therefore, the analysis of empirical data is still relevant in order to understand the dimensions of digital competence. This article relies on two datasets – the EU Kids Online survey (Smahel et al., 2020; Sukk & Soo, 2018) and the Estonian Digital Competence Test – and analyse their structure.

The EU Kids Online project assessed a youth’s digital competencies as part of a more comprehensive study. It was done using a five-dimensional Internet Skills Scale with an acceptable level of fit indicators from a study of adults conducted by van Deursen, Helsper, and Eynon (2016). The dimensions of this scale were the following: (1) operational, (2) information navigation, (3) social, (4) creative, and (5) mobile. However, the structure of the scale in the sample of students has not been empirically evaluated. It should also be noted that this is a self-assessment tool, and it is not known how objectively students are able to assess their knowledge and skills with a self-assessment tool.

In the Estonian Digital Competence Test (see Digipädevuse tasemetöö 2019, 2019), tasks were also divided between five areas that were somewhat different from those described in the EU Kids Online study but more clearly in line with the DigComp model (Vuorikari et al., 2016): (1) information and data literacy, (2) communication and collaboration in digital environments, (3) digital content creation, (4) safety, and (5) problem-solving. At the same time, to the best of our knowledge, the distinction between these dimensions has not been empirically confirmed in former studies, nor has it been done on the basis of the Estonian Digital Competence Test.
Based on the information mentioned above, it is possible to conclude that digital competence has been interpreted somewhat differently in studies conducted in Estonia, but at least some of the dimensions overlap. Therefore, it might be meaningful to look for a similar structure in the data collected with different assessment tools to develop a framework for assessing digital competence.

To solve this problem, we set the goal of clarifying the empirically distinguishable dimensions of digital competence assessment. Specifically, we formulated two research questions:

1) What are the empirically distinguishable dimensions of the digital competence of basic school students?

2) What tasks can be used to assess the digital competence of basic school students?

Attempts have been made to explain the dimensions of digital competence in various empirical studies, but so far, relatively little is known about the structure of digital competence based on empirical data. This is because theoretical and empirical studies have yielded contradicting results (see Reichert, Zhang, Law, Wong, & de la Torre, 2020; Jin, Reichert, Cagasan, de la Torre, & Law, 2020). In the past, the focus of the assessment of digital competence has often been based on self-reports. The problem of validity has been considered a major limitation of this because respondents might not be able to adequately assess their competence (see Aesaert, van Nijlen, Vanderlinde, & van Braak, 2014) and might rather overestimate it (Porat, Blau, & Barak, 2018).

Siddiq, Hatlevik, Olsen, Thronsen and Scherer (2016) conducted a systematic literature review and found 38 tests to assess digital competence. These had been used in 66 studies. In most cases, communication, collaboration, safety, and problem-solving skills were assessed, but the authors noted that these studies often had problems with the adequacy of assessing the quality of assessment tools. In conclusion, based on the literature review of Siddiq et al. (2016), in those studies where dimensionality had actually been checked, it had almost always been concluded that digital competence or digital literacy is a unidimensional construct. However, some exceptions point to the need for further research. Thus, based on the synthesis of assessment tools, we suggest that the DigComp model, which otherwise covers all different assessment tools, should be supplemented with a technical, operational dimension (basic technical skills, solving technical problems, identifying needs and technological responses). However, even this approach does not cover all areas of digital competence, such as attitudes towards technology.
To solve the problem raised in this study, the data of the 9th-grade Estonian Digital Competence Test collected in 2019, and the Estonian data collected in the international EU Kids Online survey in 2018 were analysed. The analysis of this data was used to describe the structure of digital competence and to find tasks suitable for assessing the different dimensions of digital competence.

The confirmatory factor analysis of the EU Kids Online survey data showed that the five-factor model has acceptable fit indices but a strong correlation between some factors. The exploratory factor analysis showed that it is reasonable to distinguish three factors, and 13 out of the original 23 questions were chosen to describe them. The three distinct dimensions were the following: operational, social, and creative.

In the Estonian Digital Competence Test, the tasks were first categorised according to the theoretical framework, on the basis of which behaviour in the digital world, attitudes, skills and knowledge were distinguished. A total of 116 tasks were identified. However, based on the confirmatory factor analysis, the model had some poor fit indices (RMSEA = 0.053, CFI = 0.665, TLI = 0.653, SRMR = 0.070). A follow-up exploratory factor analysis showed that it would be reasonable to distinguish eight factors. Examination of the new theoretical model on the basis of 43 questions selected for the model yielded good fit indices, and the correlations between the factors were not too strong either. Thus, it was confirmed that on the basis of the Estonian Digital Competence Test, it is possible to distinguish eight digital competence factors: (1) operational knowledge and skills, (2) content creation factor 1, (3) content creation factor 2, (4) attitudes towards technology, (5) self-assessment of digital skills factor 1, (6) self-assessment of digital skills factor 2, (7) safety-related behaviour in the digital world, and (8) problem-solving related behaviour in the digital world.

The content analysis of the questions used to describe the different factors specified the names of the factors and how the two close factors in content creation or the two in self-assessment of digital skills differ. In summary, the results of the analysis of the two datasets were synthesised into a digital competence model, in which nine dimensions were distinguished:

1) performing operations with digital tools: knowledge and skills acquired by solving problems using digital tools (common activities necessary for managing digital tools and using them in the learning process);
2) communicating in the digital world: knowledge and skills needed to communicate securely in the digital world according to the netiquette;
3) creation of digital materials: knowledge required for the creation of digital texts or visual materials;
1) programming digital content: knowledge and skills required for programming;
2) assessment of coping in digital environments: self-assessment of how well the respondent can cope in digital environments;
3) comparative assessment of digital competence: self-assessment of the respondent's digital competence compared to peers;
4) legal behaviour in the digital world: assessment of the lawfulness of the respondent's behaviour in the digital world (e.g., how likely they avoid using illegal software);
5) protecting themselves and others in the digital world: an assessment of the respondent's ability to protect themselves and others in the digital world from viruses and other threats;
6) attitudes towards technology: attitudes based on which students prefer to perform various activities with a digital device in comparison to other options.

For each of these dimensions, sample tasks that can be used to assess and develop digital competence in designing new tasks were also described.

In conclusion, the study specified the dimensions that can be distinguished when describing digital competence and revealed suitable tasks for their assessment. These results can be further used not only for research but also for the systematic description, development and monitoring of digital competence in schools. Follow-up research should focus on verifying the dimensions found with an evaluation tool that uses only tasks that fit the established framework. In addition, it would be necessary to assess the discrimination index and difficulty measure of the tasks, for example, by IRT analysis.

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