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What should be assessed when assessing digital competences?
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1. Introduction

The field of assessment in education has faced a real challenge welcoming the era of competences. Assuming the new concept of Lifelong learning, rising from the various international policies presented in the LINKED papers on defining digital competence, forces educators to take a new approach on assessment that could not only measure students' skills better, but also enhance their learning. According to the articles examined for this review, a novel approach on assessment has been discussed in the literature, especially, related to the transformations in learning theories: the emphasis of currently favored theories is on students' own knowledge construction and cognitive processes that are strongly integrated with social and cultural factors.

The need for assessment tools that are better in line with the modern learning theories and the focus on competencies has inspired scientists from various fields. Researchers focusing on assessment have created theories to inform assessment practices; school librarians, who have widened our perception of literacy to include digital literacy, have also thought of effective ways to assess students' progress in that field; and both governmental and private agencies have developed tools for measuring learning in various fields.

In the reviewed articles, the role of assessment in the decision making process of school administrators was seen crucial as well as the use of assessment to help those pupils who struggle with the digital competencies (Schroeder & Zarinnia, 2007). Some articles also mentioned the need of assessment to measure the efficiency of digital competence teaching programs to ensure the learning of much needed digital skills for the higher education purposes (Seymour, 2007).

The question “What should be assessed when assessing digital competences?” and it’s sub-questions “How should digital competence be assessed?” and “Who should assess digital competences?” were derived from original questions asked by different education stakeholders from the LINKED-project’s partner countries. The questions are each answered on the basis of the articles that were found through the searches conducted for this review. For further information on the research procedures, please look at the methodology chapter.

2. What should be assessed when assessing digital competences?

Schroeder and Zarinnia (2007) agreed in their report that instead of focusing on specific subjects, pupils should be assessed in skills and competences. This was seen important for the personal
development of a single pupil. Lund (2008) saw the role of assessment as a communal practice as
the quality of assessment derives directly from “the capacity to take more than one’s own
perspective and coordinate perspectives of others with one’s own.” He also added that assessment
holds multiple purposes, examples of which can be seen in the work of Schroeder and Zarinnia
(2007), like assessment to help governmental decision making and pinpointing students who need
extra help. However, specific lists of skills that should be assessed are hard to find in the literature,
except for Internet Skills.

Van Deursen and van Dijk (2009) studied the assessment of internet skills. According to them, the
measurement of Internet skills is often only partial due to the tendency to divide the area into
multiple subcategories, such as button knowledge or information search behavior. In order to
compensate for this, the authors propose a model, including also detailed definition of concrete
activities, for measuring four different categories of internet skills:
1. Operational Internet skills: Operating an Internet browser (e.g., bookmarking websites),
   Operating Internet-based search engines, or Operating Internet-based forms;
2. Formal Internet skills: Navigating on the Internet, or Maintaining a sense of location while
   navigating on the Internet (e.g. by not becoming disoriented when navigating between
   websites);
3. Information skills: Being able to locate required information (e.g., by defining search
   options or queries); and
4. Strategic skills: Taking advantage of the Internet (e.g., by taking the right action to reach a
   particular goal)

Van Deursen and van Dijk concluded the model to be very useful if all parts are used together, but
they note also that it lacks the measurement of communication skills. Their model is based on the
work of previous researchers such as Larsson, Glister, Marchionini, Ellis, Greene et al.,
Livingstone, and Marchionini & White.

3. How should digital competences be assessed?

3.1. Methods for assessment

According to the reviewed articles, the methodology of assessing digital competences appears to
follow the basic assessment needs. To ensure the validity and fairness of assessment methods, tools
for assessment have to be carefully designed. Hohlfeld, Ritzhaupt and Barron (2010) presented
the following systematic protocol, originally introduced by Crocker and Algina (1986), for constructing
tests:
1. Identify the primary purpose(s) for which the test scores will be used.
2. Identify the behaviors that represent the construct or define the domain.
3. Prepare a set of test specifications, delineating the proportion of items that should focus
   on each type of behavior identified in Step 2.
4. Construct an initial pool of items.
5. Have items reviewed (and revise as necessary).
6. Hold preliminary item tryouts (and revise as necessary).
7. Field-test the items on a large sample representative of the examinee population for whom
   the test is intended.
8. Determine statistical properties of item scores and, when appropriate, eliminate items that
   do not meet the pre-established criteria.
9. Design and conduct reliability and validity studies for the final form of the test.
10. Develop guidelines for administration, scoring, and the interpretation of the test scores
    (e.g., prepares norm tables, suggest recommended cutting scores or standards for
    performance, etc.).
Hohlfield, Rizthaupt and Barron (2010) agreed on the basis of previous researchers’ work that the best way to measure technology skills is through complex, real world performance assessments.

In addition to specific tests, assessment can also draw from multiple methods including self-assessment, portfolio assessment and observation to name but a few. Different methods for assessment are reviewed in and suggested by the examined articles as follows: In choosing the methodology for assessing a school library program’s effect on learning, Schroeder and Zarinnia (2007) stressed an overall approach acknowledging the needs of different stakeholder groups and the resources that school librarians has for the tracking task. They recommended both quantitative measurement, such as circulation records, and qualitative measurement, such as interviewing.

Since standardized test are still only a few in the field of digital literacy, Schroeder and Zarinnia (2007) recommended direct examination of student work. To help tracking the evaluation process and standardize it, they recommended the use of rating scales and checklists. They suggested, for instance, designing grading requirements in small groups of teachers and other stakeholders to reflect on the state or national requirements lists, or pre and post assessment tests to measure the effect of actual teaching situations. They also mentioned the use of secondary grade education tests as a starting point for use in designing test scenarios for high school students. For qualitative assessment data, they recommended self evaluation or simple short summaries of the lecture content made by students. They also suggested analyzing the products of a lesson, for example, by evaluating the quality of search words and the end results of a lesson related to information search.

According to Schroeder and Zarinnia (2007), assessing students' will and ability to use technology outside the testing situation is difficult. They cite the work of Williams and Wavell in the following indicators: expression of enthusiasm, willing participation, application and absorption in the task, continuation of an activity, verbal and written expression of enthusiasm, and change in attitude towards work over time. Schroeder and Zarinnia also mention the indicators of independence by the same authors to enable the identification of students who are able to proceed by themselves: Confidence to continue in a task unaided, awareness of the need for help, confidence to seek help if needed, use of initiative to use resources beyond those required or in other situations, use of initiative, continuing a project elsewhere, and awareness of the need for time management and organization.

Portfolio assessment has been included in the curriculum in many higher education institutions in the hope of better achieving the principles of lifelong learning. According to Habib and Wittek (2007), it is used both for learning and assessment. They see the portfolio as a tool suitable for many fields, given that the focus of the portfolio is shifted according to the special needs of every field. They recognize two movements within the portfolio tradition, one developed around the competency movement to work as a sort of an enhanced CV, the other providing a more learner centered approach for advancing reflection and collaboration.

Habib and Wittek (2007) presented multiple references to positive outcomes from portfolio use (e.g., on increased student motivation) and to research results judging the quality of empirical evidence behind such positive outcomes. They saw portfolio both as the physical tool itself as well as the patterns of use etc. surrounding it. They proposed a structure for modeling different aspects of a textual portfolio. One interesting concept emerged from their research: the appropriation of an assessment model, meaning the extent to which a student takes an interest in the assessment item so that it changes their internal learning methodology as a whole. According to Habib and Wittek, in the case of portfolio assessment, well introduced use of portfolios may promote the use of portfolio like tools in the life after school, but bad examples show the opposite in cases where the appropriation of the concept has been scarce.
Wall, Higgins, Miller and Packard (2006) made interesting remarks on the use of digital portfolios as an assessment tool as well: In their study focusing on the views of pupils on this kind of assessment, digital portfolios are acknowledged as a powerful tool supporting continuous, long lasting learning with emphasis on reflecting the whole learning process for the benefit of the student’s own process. Reflecting on the findings of previous studies and the ideas behind research of the modern learning processes, the team considered the possibility of enhancing the process of learning through providing a clearer picture for the learner of their own thought processes behind learning and the goals and assessment criteria for different subjects by using digital portfolios. They also considered the possibilities of this kind of assessment to assess skills and other areas of expertise which are not easily assessed with the more commonplace tools, for example exams, which tend to reflect only a narrow part of the abilities of the pupils. To investigate the usage of portfolios, the team conducted 14 case studies in 12 schools with children from the nursery schools to 6th graders. In this study, digital portfolios were used to gather “snapshots” of the learning taking place in various teaching settings. To ensure that the answers of the pupils were as unbiased as possible, the researchers developed a special template which had the children as the thinker and the actor of the learning process to be recorded.

Wall et al. (2006) found similar results to those suggested by previous researchers: Children saw the use of digital techniques as enabling them to reflect on and review their learning and they found a permanent record of the different phases of their projects to be beneficial. The pupils also reported the portfolios to be an excellent tool for communicating with each other as well as with their parents and teachers about the learning taking place in school. In addition, the pupils found that the portfolios gave them a sense of achievement as they saw their progress and they thought the portfolios helped them advance in ICT skills. In general, the portfolio tool was found to be a good assessment tool for use in those subjects usually difficult to assess.

Kuhlemaier and Hemker (2007) acknowledged self-evaluation questionnaires as a cost-efficient tool with which a number of competences can be evaluated simultaneously. However, they also referred to studies that found students to both over-evaluate and under-evaluate their competences. Over-evaluation is often related to internet skills and under-evaluation is often observed in relation to general competency on computer technology. Over-estimation is also more evident in those student groups whose actual skills are scarce.

Clarke-Midura and Dede (2010) described, in their paper, a research on the development of virtual assessment tools. Various programs for assessment via technological tools has been developed around the world. Clarke-Midura and Dede claimed that common paper and pencil -testing is often insufficient and proceeded to propose better tools for assessment. However, they admitted that assessing technology related skills is difficult because of problems to ensure the fairness, reliability, and validity of sophisticated intellectual assessments. They claimed that the standards of current high-stakes assessment, practically meaning pen and paper tests, also direct teaching and learning as a whole to a direction focusing on teaching receipt-like patterns for exams. Attempts in the early 90’s on developing task based assessment failed through the incapability to administrate the testing circumstances. Testing suggested by Clarke-Midura and Dede tried to compensate for this by using virtual situations. In favor of virtual test environments, the authors concluded that testing in real world situations is psychometrically unreliable, impractical, expensive and task dependent. They also added that with virtual testing, complex situations can be enacted with tacit clues, scientific instruments and co-operation can be simulated, and the system can be adaptive to students’ choices. In addition, everything can be recorded in data streams. The data streams can then be automatically used for internal assessment inside the testing systems. Further advantages of virtual testing include cost effectiveness, easier administration and scoring as well as the ability to address task and occasion sampling variability through design. Easier administration increases the validity of the
testing as the need of special training for the teachers and other administrators are alleviated. Virtual test environments also enable the easy set up of virtual laboratories for hands-on tasks as well as the use of effective visual material including models for phenomena that are unable to be observed with the naked eye.

3.2. Some governmental and commercial assessment tools

The discussion surrounding assessment has produced both governmental and private endeavors to develop assessment tools for the digital age. The following include a few that were mentioned in the reviewed articles.

Seymour (2007) introduces two assessment programs developed for higher education. She encourages school librarians to work together with academic librarians and to use the mentioned assessment programs as a guide. Project SAILS (Standardized Assessment of Information Literacy Skills), developed in the Kent University in 2002, has been used to evaluate the information literacy learning outcome during college. It uses multiple choice questionnaires to establish a base line for the incoming freshmen and tracks their learning through college. Seymour claims that these multiple choice questionnaires could be adapted also for high school level. The other assessment program, “ICT literacy assessment”, concentrates on evaluating also the traditional information literacy skills in addition to digital literacy, and may also be adapted for use on high-school seniors. Seymour also mentioned a free assessment tool developed for schools called TRAILS. She describes that the measurement areas of these different tools are the measurement of understanding information gathering tools for project SAILS, measurement of students’ competencies in applying information literacy skills for TRAILS, and the ability to apply technology skills to specific learning tasks for the ICT Literacy Assessment. Seymour concluded that all three should be used together to estimate the effect of library program on K-20 students.

The paper by Somerville, Smith and Macklin (2008) introduced a commercial iSkills tool, which is a problem-based, web-based and scenario-based assessment tool designed for various ICT-skill assessment purposes. The authors emphasized the need for a web-based evaluation tool for postsecondary education. According to them, iSkills measures students’ capabilities to define, access, manage, integrate, evaluate, create, and communicate information in a technological environment. The tool is proposed to gain better measurement quality as it tries to measure the skills in a scenario setting and as web-based it offers better distribution. The tool tries to evaluate both the process and the outcome of completing the assessment tasks.

In conclusion of the assessment on different test types, Kuhlemaier and Hemker (2007) concluded that a knowledge based test, like a multiple choice test on skills, may be the best alternative. They then proceed to present a test called “Internet skills for school” (ISFS). The test tries to unite the best properties of computer based performance tests and knowledge based tests, providing an indirect measure of students’ digital skills. The test items present students with realistic problems in a variety of authentic situations and ask them to describe how they would act or what would happen in a similar, real situation. The tool is recommended for use on a K13 level to screen for low-skilled individuals who need advanced support to develop their skills. For this purpose, national norms for the test have been developed. The test presents the students with multiple choice questions on internet skills together with a corresponding screen capture of the situation evaluated.

Hohlfield et al. (2010) described in their article a pilot study on evaluating a new tool, the ST₂L, a system for low-stakes assessment of students’ digital literacy. The system, funded by the Office of Technology Learning and Innovation at the Florida Department of Education (FLDOE), is looking for providing an automated and objective method for assessing digital literacy. The indicators for
standards and benchmarks for testing were drafted by specialists from different fields related to assessment. The validity of the indicators was assured with a wide survey on educational stakeholders. Educational specialists and teachers constructed the initial assessment items in an iterative process based on the indicators. The team developed both action based items and multiple choice items. Minding the diverse software and hardware among the future users, test items were kept general. The items were developed as independent items. The final version of the ST2L was composed of six separate sections:

1. Software Use and File Manipulation
2. Ethics, Safety and Acceptable Use
3. Graphics, Presentation, and Video Editing
4. Spreadsheets
5. Browser Use and E-mail
6. Word Processing and Flowcharts

4. Who should assess digital competences?

On the basis of the literature available for the researchers, no clear conclusion can be made about who should assess students' digital competences. The reviewed articles examined assessment mostly from the viewpoints of school librarians and governmental decision makers (Schroeder & Zarinnia, 2007; Seymour, 2007). In the studies describing commercial readymade tools, the tendency seems to be often to minimize the need of special assessment skills on the part of teachers and other test administrators (for example iSkills by Somerville et al., 2008).

5. Summary

Digital competences and the paradigm of lifelong learning need new ways of assessment. Assessment is seen to be an important tool for decision making and directing the teaching resources in the benefit of the pupils in need of more support. Assessment should reflect the views of the learning community as a whole and assess the digital skills of pupils in real life situations if possible. Different methods of assessment include readymade commercial and governmental tools as well as portfolios, observations, interviews, self-evaluations and virtual testing. The administration of tests is usually made easy and automatic with readymade tools, but no consensus exists of what skills an administrator needs to make reliable observations or use alternative assessment methodology.

6. Methodology for answering the questions

6.1. Search procedures

The searches were conducted using EBSCOhost, which is an on-line retrieval system of scientific articles related to educational, psychological and behavioral sciences. The searches were targeted to two databases in the system: Academic Search Complete and Education Research Complete. The results from these databases were narrowed down by the following restrictions: Articles were to be peer reviewed, in English, published in between 2005-2010 (originally in between 2000-2010, but due to vast amounts of irrelevant hits this was further restricted) and finally the full text was to be available through EBSCOhost with the rights purchased by the University of Helsinki.
The search words used in the process were mainly derived from the vocabulary of the original questions collected from practitioners and their synonyms. In addition to these, some terms were added using the professional knowledge of the researchers involved in the process.

The process was started with a more general search shared with all the questions related to Digital Competence. This was conducted to roughly estimate the workload and adjust parameters for the search. The search words used in the general search were:

- digital competence* (all text)
- digital skill* (all text)
- digital literac* (all text) AND education (subject terms) AND school (subject terms)
- ICT skill* (all text) AND education (subject terms) AND school (subject terms)
- ICT competenc* (all text) AND education (subject terms) AND school (subject terms)
- ICT literac* (all text) AND education (subject terms) AND school (subject terms)

In addition the following searches were conducted especially for this theme, including searches that produced 0 results:

- “ICT skill*” (all text) AND assessment (subject terms)
- “ICT literac*” (all text) AND assessment (subject terms)
- “digital literac*” (all text) AND assessment (subject terms)
- “digital literac*” (all text) AND evaluation (subject terms)
- “ICT literac*” (all text) AND evaluation (subject terms)
- “ICT competenc*” (all text) AND evaluation (subject terms)
- “ICT skill*” (all text) AND self-reflection (subject terms)
- “ICT competenc*” (all text) AND self-reflection (subject terms)
- “ICT literac*” (all text) AND self-reflection (subject terms)
- “digital literac*” (all text) AND self-reflection (subject terms)

(The term indicated between the parentheses describes which parts of the database the search words were directed to.)

The searches produced 15 articles that were chosen for further evaluation (i.e. Reading through the whole article). From these 10 were used in writing the actual answer as 5 were excluded due to irrelevance, too little empirical evidence or in one case failure to represent evidence usable for this purpose.

6.2. Constructing the answer

In constructing an answer a narrative like approach was used as the articles scarcely included similar approaches to assessment and it was considered relevant to evaluate the approach of the authors to the assessment methodology in question as a whole, instead of reaching a simple conclusion.
7. References


