

## Technology-Enhanced Assessment at universities and in schools: An initiative

**Vladan Devedzic** \*, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, Belgrade 11000, Serbia

**Mirjana Devedzic**, Faculty of Organizational Sciences, University of Belgrade, Jove Ilica 154, Belgrade 11000, Serbia

### Suggested Citation:

Devedzic, V. & Devedzic, M. (2019). Technology-Enhanced Assessment at universities and in schools: An initiative. *International Journal of Learning and Teaching*. 11(3), 89-98.  
<https://doi.org/10.18844/ijlt.v11i3.4319>

Received: March 01, 2019; revised: March 31, 2019; accepted: June 10, 2019;

Selection and peer review under responsibility of Prof. Dr. Hafize Keser, Ankara University, Ankara, Turkey.

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### Abstract

Background: Technology-enhanced assessment (TEA) is a broad term that encompasses the diverse methods, by which technology can be used to support the management and delivery of assessment in educational institutions, in workplace and lifelong learning, in professional training and development, and so on. Purpose of Study: There is a new initiative at the University of Belgrade, Serbia, to explore computing technology underpinnings of the practice of TEA (computing underpinnings of the practice [CUP] of TEA), at universities and in schools in the country. Sources of Evidence: The CUP of TEA initiative starts from the current insight into current practices of assessment processes in different educational institutions. The data collected include assessment process descriptions from these institutions, specification of technologies used for the purpose, and specification of the educational profiles of participants in the process. Main Argument: The CUP of TEA initiative develops: A novel and comprehensive framework for TEA to lay the foundation for systematic, accurate, effective, and innovative application and use of TEA in educational institutions; specifically designated sets of information and communication technology (ICT) tools and services – ICT toolsets – that support practical application of TEA; several application cases that implement the TEA framework and use different ICT toolsets for TEA in different educational contexts, showcasing the integration of best TEA practices into curricula; and a set of policies that enable educational institutions and their teachers to officially establish the use of the framework for TEA in their courses and daily work. The CUP of TEA initiative covers both formative and summative assessment and supports formal, non-formal, and informal learning and assessment. Conclusions: The ultimate goal of the initiative is not just better, faster, and more informative assessment. It is the creation of a robust teaching and learning assessment approach that improves and advances the quality and efficiency of education.

Keywords: Technology Enhanced Assessment; assessment processes; application cases

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\* ADDRESS FOR CORRESPONDENCE: **Vladan Devedzic** , University of Belgrade, Serbia, 11000, Belgrade  
E-mail address: [vladan.devedzic@fon.bg.ac.rs](mailto:vladan.devedzic@fon.bg.ac.rs) / Tel.: +381 11 3950918

## 1. Introduction

An initiative in the broad field of education has been started in Serbia, by a number of teachers interested in advanced educational technology. The initiative puts emphasis on technological support for preparing, organizing, and conducting assessment in different educational institutions, as well as for validating, quantifying, scoring, and recognizing learning achievements. These processes, together with the related supporting information and communication technology (ICT) tools and services, are collectively referred to as technology-enhanced assessment (TEA) (Broadfoot, Timmis, Payton, Oldfield, & Sutherland, 2013).

The initiative does not aim at developing new pedagogical theories of assessment. It rather starts from well-established theories in the area of technology-enhanced learning (TEL) and focuses on ICT tools and services for TEA and on TEA pragmatics.

The objectives of the initiative are as follows:

- O1: To establish the practice and culture of using TEA in educational institutions in Serbia, thus following emerging trends in TEL/TEA in Europe
- O2: To develop extensive resources, guidelines, and policies for applying TEA across different levels of education.

## 2. TEA

TEA enables teachers to conduct assessment in a number of innovative, alternative ways. It places students in real-world situations and requires them to apply relevant skills and knowledge, rather than just reproduce facts that they have remembered and apply standardized problem-solving procedures. TEA supports assessment methods that require students to develop their own responses to a given situation, not just to follow one or more prescribed paths. It also requires students to apply higher-order thinking skills (Stayanachi, 2017) such as analysis, evaluation, and creation of new knowledge. These skills are not only more difficult to learn or teach but also more valuable because such skills are more likely to be usable in novel situations (i.e., situations other than those, in which the skill was learned). It requires different learning, teaching, and assessment methods than the learning of facts and concepts.

TEA methods and tools provide rich learning experience, improve learning efficiency, and increase knowledge retention (Broadfoot et al., 2016). Some of the TEA methods and tools often used in modern assessment include self-assessment, peer assessment, e-portfolios, e-checklists, e-rubrics, concept maps, journal entries, digital storytelling, collaborative development projects using Social Web tools, and presentations and discussions using e-communication tools.

TEA nicely aligns with problem-based learning (PBL). “PBL is an approach that challenges students to learn through engagement in a real problem. It is a format that simultaneously develops both problem-solving strategies and disciplinary knowledge and skills by placing students in the active role of problem solvers confronted with an ill-structured situation that simulates the kind of problems they are likely to face as future managers in complex organizations.” (SFSU, 2016) Likewise, TEA aptly implements triangulation, as the process by which a teacher collects evidence about student learning from three different sources: Conversations, observations, and artifacts that the students create (Bilash, 2009).

## 3. Computing underpinnings of the practice (CUP) of TEA initiative

The initiative to advance the quality and efficiency of assessment in educational institutions in Serbia runs under the acronym CUP of TEA. It addresses several open problems in TEA: Systematization of TEA tools and methods used in different educational contexts, their

standardization, and setting policies for their effective use (Broadfoot et al., 2016). The initiative intends to conduct research, development and application of TEA using a number of new ICT tools and services for TEA, and will also develop some of them.

### **3.1. Major points**

CUP of TEA initiative will develop:

- A novel and comprehensive framework for TEA that will lay the foundation for systematic, accurate, effective, and innovative application and use of TEA in educational institutions
- Specific ICT toolsets that support practical application of TEA
- Several application cases (ACs) that will implement the TEA framework in different educational contexts, showcasing the integration of best TEA practices into curricula
- A set of policies that enable educational institutions and their teachers to officially establish the use of the framework for TEA in their courses and daily work.

All these major pillars of CUP of TEA will be generic in nature, i.e., will be applicable across different educational institutions (with adaptations reflecting different levels of education and different target groups of students) and in workplace and lifelong learning.

An assessment-related webpage from the website of the University of Reading, UK (<https://www.reading.ac.uk/engageinassessment/using-technology/eia-introducing-technology-enhanced-assessment.aspx>), specifies:

“TEA is a broad term that encompasses the diverse methods by which technology can be used to support the management and delivery of assessment. TEA does not mean simply replacing existing assessments with digital versions but rather making use of technology to tackle some of the operational and pedagogic issues of assessment. TEA is therefore by no means a magic bullet, but rather one method of supporting the pedagogy and best practice relating to assessment.”

This is the starting point of the CUP of TEA initiative. It uses the term “technology” to denote computing technology (digital resources, internet, ICT tools and services, etc.) that enables development, establishment, application, and active use of TEA in educational institutions, in workplace and lifelong learning, in professional training and development, and so on.

### **3.2. Needs**

The CUP of TEA initiative team has recognized the needs of educational institutions in Serbia, and their students and teachers to advance assessment and reporting by deploying TEA tools and services to gradually change the way assessment tasks are developed, delivered, and scored. More specifically, the needs include:

- More accurate automated interpretation of test results
- Improved precision of measuring difficult to measure constructs in assessment submissions
- Support for assessment of higher-order thinking, inter- and intra-personal skills (transversal/soft skills)
- Better alignment of assessment to instruction
- Increased engagement and motivation of students
- Assessment experience as a journey of personal development that enables students to conduct independent inquiry, to feel that they “use their minds” and have learned something that they can use in their careers in the long run, not just “for the test”

- Knowledge and skill assessment and validation mechanisms that enable recognition of both formal and informal learning
- More focus on formative assessment and feedback provision (throughout the learning process), instead of focusing on summative assessment only (as is the current practice)
- Delivery of high-quality feedback information that helps students to self-correct and provides them opportunities to reflect and act on feedback
- Removal of current achievement ceilings imposed by traditional assessment and scoring.

### **3.3. Rationale**

CUP of TEA aims at increasing the relevance of assessment results to students, teachers, educational institutions, employers of prospective graduates, educational policymakers, and other stakeholders. The project wants to integrate TEA tools and services with PBL, thus making assessment results better indicators of the extent to which the acquired knowledge, skills, and competencies can be applied in real-world situations.

### **3.4. Research objectives and expected results**

- CUP of TEA is structured around four research objectives:
- Development of the CUP of TEA framework
- Development of CUP of TEA toolsets
- Development of ACs
- Development of CUP of TEA policies.

Each objective envisions one major expected result. These results are described in detail in the following subsections. The implementation section describes activities to be conducted to achieve these results.

### **3.5. The CUP of TEA framework**

The CUP of TEA framework for innovative application and use of TEA in educational institutions and in other learning contexts will include:

Theoretical foundations (including elaborated specifications of different TEA contexts)

Application guidelines

The CUP of TEA matrix, i.e., a highly elaborated table with guidelines for matching pedagogical approaches and TEA tools and services to subject areas

The CUP of TEA application program interface (API) (analogy: API, the term used in software engineering, [https://en.wikipedia.org/wiki/Application\\_programming\\_interface](https://en.wikipedia.org/wiki/Application_programming_interface)) – a set of routines, protocols, recommendations, and tools for implementing TEA in different educational contexts. CUP of TEA API will be elaborated from application guidelines and the CUP of TEA matrix, as well as from the policies and procedures for introducing and establishing TEA (integrated with PBL) in educational institutions (see the CUP of TEA policies below).

Examples of practical implementations of the CUP of TEA framework in specific courses.

### **3.6. CUP of TEA toolsets**

Another expected result of the CUP of TEA initiative is specific ICT toolsets that support practical application of TEA in educational institutions (in both formative and summative assessment), in informal learning, and in organizational learning. Each toolset will correspond to a specific TEA context to be defined in the CUP of TEA framework. These CUP of TEA toolsets will remix existing TEA tools and services, those to be developed overtime, innovative use of creative media, and online peer and self-assessment.

The toolsets will not be limited to multiple-choice questions, drag and drop of digital objects to correct locations, and similar simple interactions; they will enable students to demonstrate their knowledge more authentically, in a much wider variety of ways (a central skill in PBL). For instance, such a toolset may include a personal learning portfolio creation tool, a discussion forum tool, a web graphics design tool, and a video creation tool. Students can be required to use this toolset to present a certain topic in a highly creative way, to include their own reflections on it, and to discuss it with peers and the teacher in a forum, as a way of assessing their knowledge in a more authentic way.

To ensure richer, more relevant, more engaging, and more authentic assessment experiences that can resemble real-world scenarios, the CUP of TEA toolsets will rely on the following TEA technologies:

#### **3.6.1. Technology-enhanced items (TEIs)**

TEIs are computer-delivered items that include specialized rich interactions for collecting response data (<https://edulastic.zendesk.com/hc/en-us/articles/204066665-What-is-a-Technology-Enhanced-Item->).

Numerous examples can be seen at [http://www.nationsreportcard.gov/science\\_2009/ict\\_tasks.asp](http://www.nationsreportcard.gov/science_2009/ict_tasks.asp) and <https://www.pinterest.com/ohostetter/technology-enhanced-items/>

TEIs enable:

- Adaptive testing (tailored to each student in terms of their previous knowledge, current responses, difficulty level, estimated score, selection of the next question, etc., instead of presenting the same questions to all)
- More accurate scoring
- Effective self-assessment.

TEI templates can be used across grade levels and content areas. As new technologies become available, they can be adopted when required for students to produce new forms of evidence.

#### **3.6.2. Open badges (OBs)**

OBs (<http://openbadges.org/>) have evolved as novel, online means of recognizing and credentialing skills, competencies, creativity, and achievements in various learning settings (formal or informal, online or traditional classroom). They contain information about badge issuing organization, the criteria for issuing the badge, the work completed to get it and the evidence of the accomplishment, all attached to the badge image file, hard-coding the metadata for future access, and review.

### **3.6.3. Other TEA tools and services**

To create rich assessment experiences, it is also possible to use TEA tools and services that support self-assessment, peer assessment, digital storytelling, and work on collaborative development projects using Social Web tools. To support the development of creativity and more comprehensive assessment and feedback provision, the one can use tools for developing personal learning portfolios (e.g., <https://edublogs.org/>, <http://www.wix.com/>) and repositories of open educational resources (OERs; <http://bit.ly/1kXCDG5>).

A useful survey of performance assessment and mastery-tracking tools that the CUP of TEA intends to use can be found at <http://bit.ly/1VVKy6o>

### **3.7. ACs**

CUP of TEA experts will develop several ACs to demonstrate how the CUP of TEA framework can be implemented in different educational contexts, using different CUP of TEA toolsets. These ACs will be implemented in selected schools and universities as part of regular courses and will demonstrate how best TEA practices can be integrated into curricula. Then several ACs will be implemented in other educational settings (e.g., MOOCs, centers for professional development and training sessions).

### **3.8. CUP of TEA policies**

Active use of CUP of TEA result needs a set of regulating policies to guide the implementation of ACs in different educational institutions. Two levels of these policies are envisioned:

- Institution-level policies, targeting higher and secondary education institutions in Serbia
- National-level policies to be promoted with educational policymakers with the objective of improving existing standards and competency frameworks in Serbia with recommended TEA practices, tools, and services.

### **3.9. Participants**

The CUP of TEA initiative gathers different institutions and researchers, based on their complementary expertise needed to achieve the results described above. At the time of writing, the expertise of 30+ researchers and a dozen of educational institutions included in the CUP of TEA initiative is truly interdisciplinary: TEL, TEA, software development, internet technologies, pedagogy, data analysis, statistics, learning analytics, quality assurance, brand management, financial management, cloud computing and more.

## **4. Implementation**

The CUP of TEA activities have started relatively recently. They build on earlier projects and activities of the participants and include a number of ongoing development tasks and pursuits.

### **4.1. Roadmap**

At the moment, CUP of TEA participants are conducting a thorough state-of-the-art analysis of the actual usage of TEA and PBL at schools, universities, and other educational contexts in Serbia and elsewhere. This analysis should clarify typical TEA approaches used in different educational contexts,

as well as pros and cons, and typical experiences of teachers and students in such contexts. Based on this analysis, the core CUP of TEA team will specify the methodology and requirements for further development. It is expected by the end of 2019.

Simultaneously, applications for grants will be made to relevant education programs and agencies so that the initiative gets properly funded.

The largest chunk of CUP of TEA activities will be research and development (R&D) activities. This is where the CUP of TEA framework, toolsets, and policies will be developed. In fact, these activities have already started and are carried out by different CUP of TEA participants. An example of such activities is presented in the next subsection. The time frame set for the envisioned R&D activities is 3 years. In the 1st year, CUP of TEA will pilot the first version of the CUP of TEA framework, toolsets, and policies in selected educational institutions and will enable critical evaluation of the initial results and performance.

Selected CUP of TEA will then conduct a comprehensive analysis of the effectiveness of the overall CUP of TEA approach and suggest possible improvements. In fact, the first of the 3 R&D years will be the opening of the CUP of TEA ACs in partner institutions.

In the 2nd and 3rd R&D years, the ACs developed in the 1st year will continue to live in the conceptualization-development-application-evaluation-improvement cycles. New ACs will be developed overtime and put to practice in partner institutions and in educational institutions external to the project partnership.

Throughout the R&D activities, a dedicated CUP of TEA team will take care of the quality of all of the CUP of TEA outputs and outcomes. In the beginning, this team will develop the initial versions of the quality plan, the evaluation plan, and the risk management plan. All CUP of TEA leaders will enforce adherence to these plans in the corresponding activities of their institutions.

A series of dissemination activities, directly related to the project objective O1 (establishing the practice and culture of using TEA in educational institutions in Serbia) will start simultaneously with the R&D activities and will include a range of networking and dissemination tasks to be conducted by all participants, in Serbia and internationally. The dissemination strategy and plan will be established early and will be enforced throughout the R&D activities.

International collaboration and cooperation are encouraged and are already being conducted.

#### **4.2. Example**

An example of CUP of TEA R&D activities is the case that teachers of demography from the University of Belgrade, Serbia, are developing (Table 1 and Figures 1 and 2). Their AC includes assessment and grading of undergraduate students of demography who are expected to master data collection, analysis, and visualization of demographic indicators. In addition, students need to do fieldwork and field data collection (questionnaires, interviews, and the like).

Instead of assessing students' level of mastery of these activities by organizing traditional laboratory tests and examinations, the teachers involved in this AC are planning on evaluating the evidence of the digital artifacts that the students submit and issue OBs such as those shown in Figure 1. The TEA approach used in this AC is based on triangulation and the ASSURE model of instructional design (Kurt, 2015). The students are asked to work on real-world data collection and analysis assignments, individually or in small groups. In direct communication with the students, the teachers explain what they expect the students to upload as the assignment results and as the digital evidence of their mastery of the topics of interest. These digital artifacts typically include original and extended/transformed datasets, output from statistical and visualization tools, and the like. The teachers evaluate the artifacts, provide feedback to the students, and discuss with them on possible and/or required improvements. For each activity involved in the assignment (data collection,

fieldwork, data analysis, etc.), students can earn one or more badges, some of which are shown in Figure 1. When they accumulate certain badges, it is the equivalent of passing the examination with a certain grade. Note that multiple courses can issue some of these badges (Table 1). The teachers are also planning on developing a number of other relevant OBs, to cover a variety of courses.

**Table 1.** Specification of a CUP of TEA AC (adapted for presentation from the real-world case)

Context/AC	Institution: Faculty of geography, University of Belgrade, Serbia
	Courses: Demographic aging; Fertility; population projection methods
	Students: 30 students; IV, V, and VIII semester
	Assessment type: Formative
Application guidelines	Observation of students' mastery of relevant topics in class
	Skills in data search in individual and group assignments
	Capability of data analysis and dataset extensions based on fieldwork
	Tabular and graphical data presentation
Pedagogical approach	Triangulation, problem-based learning, assure model of instructional design
Toolset	Statistical tools, Google forms, open badges
TEA: Technology-enhanced assessment, AC: Application case, CUP: Computing underpinnings of the practice	

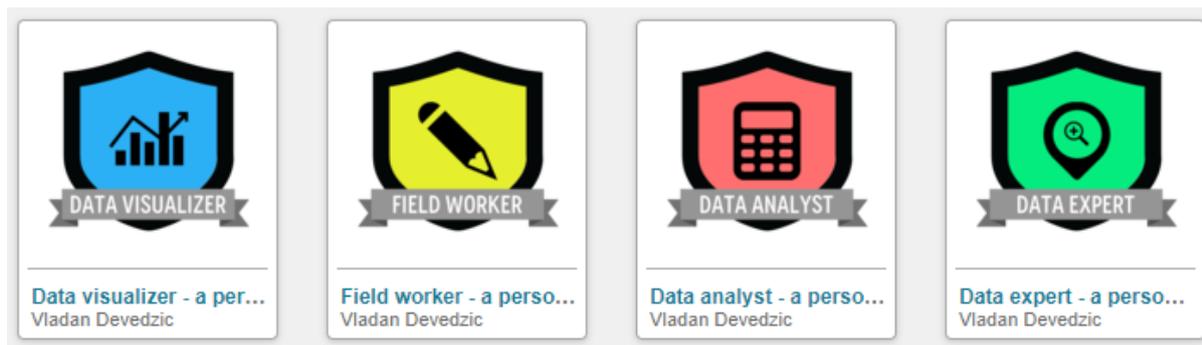


Figure 1. Badges in this application case

Figure 2 illustrates what an open badge in this AC looks like. When students claim a badge, they are required to upload the evidence of their work that can be verified by the teachers, by other students, and by a third party alike.

Badge Details	Issuer Details
<p>Title</p> <p>Data analyst - a person knowledgeable in population statistics, who can use analytical indicators and interpret them.</p> <p>?</p>	<p>Issuer</p> <p><b>Vladan Devedzic</b></p>
<p>Description</p> <p>Transformation of data from basic sources into demographically relevant information, trends, patterns, processes and the like.</p>	
<p>Criteria</p> <p>A data analysis case, uploaded <a href="#">here</a> (dataset, computation of demographic indicators, description of results, outcome).</p>	
<p>Issue Date</p> <p>04/17/19</p>	
<p>Evidence</p> <p><a href="#">View evidence</a></p>	

Figure 2. Data analyst badge details

## 5. Conclusions

The envisioned social impact of the CUP of TEA initiative includes:

- Increased quality of education in Serbia by improving knowledge and skill assessment processes, in terms of making them closer to real-life problems. The CUP of TEA assessment approach will better prepare students for jobs after they graduate, by promoting more flexible learning pathways
- Improved assessment of formal, non-formal, and informal learning achievements
- Increased students' engagement. Formative TEA provides useful feedback to students and leads to increased motivation and interest.

True, it is a long way to go to achieve all of the charted objectives. However, the initial results are promising and indicate high interest of relevant actors in the field of educational technologies.

## Acknowledgment

The work presented in this paper is partially supported by the Ministry of Education, Science and Technological Development of the Republic of Serbia, under the project grants III 47003 and III 47006.

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