

Case Studies in Teaching Systems Thinking

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Abstract: The education of systems thinking needs prepared teachers, descriptive examples and case studies easy to understand by the students. Why could not this latter be collected and “explored” by the students? These small case studies might make the learning resources more interesting and more personal, and so studying might become more effective. Our paper deals with the questions of seeking a pedagogical paradigm related to the ‘Systems and control are all around us’ approach. During our endeavours made to develop Open Education Resources (OER) within the frames of our experiment implemented in 2015, we found that student participation offered great potentials in relation to the content and the methodology, as well. Traditional teaching relying upon school books can considerably be modernized by the IT solutions applied during the experimental development of learning materials for vocational education and training (Systems in VET). By introducing the experiences of the experimental phase, this article summarizes the steps made towards establishing a new form of system teaching based on case studies and applicable in VET in a wider range.

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1. INTRODUCTION

This topic has, in some aspects, a theoretical background of didactical features connected to Vocational Education and Training (VET) (Gessler, M.; Herrera L. M.; 2015), and is partly connected to the endeavours that have been made to shape the alternatives of the traditional VET curricula in a learning environment determined by modern IT and that require interactivity not only in the learning process but during the construction of the curriculum, as well (Colons, A.; Halverson, R. 2009; Benedek, A.; Molnár, Gy. 2015). For community-based curriculum development, teacher training might provide especially good conditions which we exemplify by presenting our research data. Developing Open Educational Resources (OER) with students’ participation means a potential of content and methodology that, through the pilot curriculum development (Systems in VET) and the applied IT solutions (open source and commercial Learning Management Systems (LMS), memory independent management of complex visual elements and the flexible management of micro-contents) allows us to surpass traditional, school- and notebook based teaching.

The development of the learning environment is dominated by the spread of ICT. Around the Millennium “visual homecoming” (Nyíri, 2014) had an increasingly strong impact on the way we learned communication, and on education content development in particular. The mass penetration of ICT tools turned learning processes rather spontaneous; no wonder, it was very difficult to make them compatible with the visual contents of curricula designed and

objectivized in algorithms that had been in turn designed in the framework of the curricula.

Primarily owing to the spread of business IT applications, content management is used in a wide range of contexts; the lecture has, however, a narrower focus, and tries to find the new forms of educational content and the possibilities of permanently renewing it. Technological development and the relatively slow nature of content renewal in the VET systems both require innovative solutions differing from the traditional ones in creating and transmitting educational content and supporting learning. Concerning the research introduced, a kind of unique framework is provided by the fact that the innovation, which takes open source content development as one of the approaches to reforming teacher training, is connected to a technical university of long-existing traditions (Benedek, A; Molnár, Gy, 2014, 2015).

This process affects the different forms and methods of learning. These dynamic changes are the phenomenon of atypical (less regulated) learning in adult, part-time, and online learning processes related to working life. The slow changes in formal education are determined by complex social and financial mechanisms, and the interrelations could be investigated from the points of different disciplines. This paper explores the psychological aspects of atypical learning at the level of the individual, such as motivation, attention, learning skills and the opportunities of development.

2. CURRICULUM DEVELOPMENT

In 2014-2015, within the frames of a new curriculum development project at the Budapest University of

Technology and Economics (BME), we created 29 digital materials the authors of which – all of them excellent professional – were obliged to attend a short preparation course which, in accordance with the principles of up-to-date Open Education Resource (OER) development, demanded of the authors really significant visual objects and was organized as a training. To demonstrate the traditional aspects of education resource analysis: after analysing 10 incidentally selected resources which were made within the frames of the project and included differentiated professional content, although most of them related to teacher training, we can state that the learning materials make 4.5 sheets or 90 pages in average, are optimized for screens and altogether they include 602 visual objects (illustrations, photos, tables). This means that these new resources supporting online learning, as well, contain visual objects only on every 1.5th page in average. 42% of these objects are tables, 36% are illustrations (drawings) and only 22%, nearly one-fifth of them, are photos. All this indicates the fact that it is not possible to develop new electronic education resources in the traditional structure, the knowledge built in a linear manner within the traditional frames is not sufficiently open to the relating new contents.

Even "modern" curricula that were developed by the end of the 20th century had a linear structure and the dominance of verbal content (80% on average) was diminishing very slowly, giving way to visual content, which in turn was mostly composed of static pictures. Although online curricula and multimedia-based e-learning representations include more dynamic visual content (e.g. flash, video), in our opinion, the "logic" of curricula design has not changed. Visual content is still considered only a supplement to verbal (written and oral) messages.

The phenomenon of changing learning spaces and style appears in the facts that:

- the number of those who are committed to online courses is growing;
- they feel at home in ICT environment;
- the role of learning communities is increasing;
- the classical teacher-student roles can hardly be seen;
- potentially every downloader becomes an uploader.

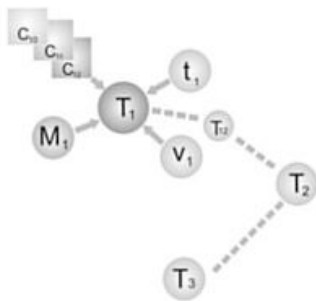


Fig. 1. The schema of complex learning content net

Concerning methodological questions, with special regard to mathematics and other disciplines of natural sciences and the related applied sciences such as technical sciences and their

applications, the curricula are based on descriptive verbal elements (Text – t) that are supported by visual elements (Pictures – V) and mathematical formulas (Math – M) (see Fig. 1). Traditional curricula (published in the format of textbooks) usually include the combination of these, structured in a rigid linear sequence, such as ‘explanation, figures, formulation, explanation’ and so on. In many cases only random examples are given as case studies (Case – C) to illustrate practical applications. The visual representation illustrates the most important features of the structure as knowledge elements are organised into a system which is independent of scale. For curriculum design developed in open access, cloud services offer a development infrastructure surpassing all previous solutions. Showing other connections between these elements in order to develop a dynamic network was typically hindered by disciplinary and temporal restrictions knowledge on systems.

This new curriculum, where verbal and visual elements are presented in a one-to-one ratio and where knowledge elements are organized into a network, would be scale-independent and structured as a graph; it would also be supported by a mathematical representation to enhance both its theoretical and practical aspects, and users would be allowed to extend it by means of case studies and practical examples.

Our project titled ‘E-teaching Culture and Digital Content Development’ and implemented between 2013 and 2015 was aimed at developing content, methodologies and services related to the competitiveness of higher education and the structural changes and at meeting the challenges of knowledge-based economies. Matching the peculiarities of higher education, we developed methodology training for complex subjects to develop the educational competences needed for designing and applying complex curriculum units in the training of teachers. The majority of these programs have been integrated into the regular university curricula; these are continuously applied and updated in each semester.

The project rooted in the idea that the strategic goals of the university, as well as those of vocational training, presume the continuous development of the quality and excellence of teachers, which in turn points to the development of a teacher-researcher habit essentially independent of the limitations represented by subjects or faculties. Developing curricula represented challenges in the fields of digitizing, multimedia editing and on-line publishing. Meta-data structure, Sharable Object Reference Model (SCORM) conversion (converting contents into SCORM format with interactive elements) and formats matching the relevant criteria were defined as required by e-learning. Interests of students related to the principles above

- improved and updated curricula,
- access to competitive learning contents,
- extension of flexible learning forms,
- contents and curricula for independent learning.

Our analyses proved that the measurable elements of learning activities show such time-dependent characteristics that

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