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Open Content Development Model (OCD)

1. Introduction

The research group that, besides experienced and academic researchers, includes practitioners as well as students who are engaged in scientific student work and are attending their engineer and economist teacher evening courses while being present in school practice, was established in 2015 within the framework of the Department of Technical Education and the Teacher Training Centre of the Budapest University of Technology and Economics (BME) with the aim to implement a project focused on researching methods supporting learning, and initiated and financed by the Hungarian Academy of Sciences (HAS). Relying on this specific base of researchers and practitioners, our project undertook to develop and introduce new procedures based on the experiences and analysis of the educational methods used by vocational teachers during their work. By presenting the research topic, this paper intends to introduce the process, in this case the open content development and the work done in order to create a new model of this, which allows the active participation of students in research and development as well as the connection of smaller researches into bigger research projects.

2. Setting out – international and domestic tendencies

Within the frames of the call for methodological programs announced by the president of the HAS in 2016, we undertake, in accordance with the specialities in Hungarian vocational education, to develop a methodological training related to complex subjects. Building on our domestic and international research and development activities carried out in this field during the latest years, the developed methods and procedures will be applied in practice, the electronic learning resources elaborated and tested, and efficiency checked in a school VET environment. We implement our research, test the results and apply and analyse the effects and results of the vocational methodology in a development environment, by *implementing school practice and the network dissemination of the vocational methodological model at vocational training institutions* as well as preparing workshops and conferences and summarizing their outcomes and implementing researches in certain issues.

Concerning international trends, we must refer to the fact that during the economic crisis of the latest decade, it was typical in the world economy that successful economies, primarily the countries leading in technological development (the USA, Japan or England) came over the crisis as a result of an extremely intensive and focused process which included the renewal of their education and training as well. This process exerted an impact on the public opinion about technical-technological culture as well as the systems of vocational training, its internal structure and the applied methods. According to the comparative study by the CEDEFOP, in Hungary 73.8 percent of the pupils in secondary public education attend general, non-vocational education (level ISCED3), while 26.2 percent attend vocational education (*CEDEFOP, 2015*). In several developed countries with educational systems similar to that in Hungary (e.g. Austria, Belgium or the Netherlands), the rate of those attending

vocational training is higher, around 70 percent. In France and Germany, the share of general and vocational education at this educational level is 50-50 percent.

In progressive educational systems, vocational training has a special situation in the sense that this is the space where preparation for the widest labour division happens. In this dynamic process, inter-disciplinary views gain more and more space, and the development of the ICT environment of education prefers solutions more flexible in content and organizational frames against the traditional, rigid vocational education based on the system of subjects. This is justified on one hand by the extremely rapid development of professional content, the rigid nature of subject structures (in relation to Hungarian education we may also refer to the narrowing of the time frames dedicated to theoretical subjects and knowledge transfer in the latest decade), and on the other hand by the relatively low and decreasing tendency in the learning motivation of the students in vocational education (which is an international tendency as well). From an education theoretical view, the methodological modernization of VET searches for answers concerning problems of content and a wider pedagogical spectrum, as well, i.e. the question: *how is it possible to transform rapidly changing vocational content into learning resources, and to make learning more effective within the relatively limited time frames and by increasing students' learning activity*? The creation of open learning resource structures characterized by the constructive participation of active learners has become an important thread in the international educational development of content and methodology. Another feature is the possibility of mass access that is now supported by effective and interactive online interfaces. Although it is the higher education initiatives that lead in this field (MOOC – Massive Open Online Courses), in VET the high number of participants, their professional diversity and their growing age urge the methodological adaption of those solutions.

In Hungary, the legal regulation of public education and VET was renewed between 2011 and 2015, and the system of teacher training took a turn. The Regulation no. 8/2013 (30.I.) by the Ministry of Human Resources on the common requirements in teacher training and the training and output requirements of the teachers' preparation regulated the system of general and vocational teacher training which succeeded the Bologna system and is in force today. It is a general requirement towards teacher training that graduate teachers be prepared and able to:

- implement the tasks determined in the National Curriculum, on the basis of the development fields and pedagogical objectives, transmit the values of educational-pedagogical work as well as knowledge contents, build knowledge and recognize and develop key competences;

- implement pedagogical work in the phases of school work determined in the Act on Public Education in the institutions of the public educational system within the knowledge field of the approved framework curricula based on the National Curriculum as well as in the institutions of training outside the school system and in adult education in the fields corresponding with their scientific and vocational studies;

- actively participate in education development programs according to their knowledge and practice.

Our methodological research is focused, also considering the lessons learnt from international trends and amongst the specific domestic frameworks, on the differentiated

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direction of teachers' classroom work and the adoption of effective pedagogical methods and processes. Vocational methodology is of outstanding importance in this context also because through teacher training – as most of the students are practitioners who possess engineer-economist degrees and work at vocational training schools – it is possible to transplant the research results into practice at a pace corresponding to that of the dynamic professional development described above, and in the future, vocational teachers may play a multiplier role by applying the new methodology.

We have focused our work on **the development of vocational methodology and vocational knowledge and the support, organization and direction of learning** because developing open education resources with the active participation of students can improve vocational knowledge (of the students as well as the teachers), and the new way of supporting learning can – according to our experiences – considerably improve the effectiveness, organization and guidance of learning.

The objective of our MSc training implemented within vocational teacher training is to prepare students to teach certain vocational subjects at „the grades of school education offering preparation for vocational qualification, in vocational training and secondary vocational education within and outside the school system, in adults' training and further education as well as the vocational trainings determined in the National Qualifications Register (NQR). From a methodological aspect, it is an important difference, if compared to the methodological researches on general education, that vocational teachers are not only allowed to teach in school system vocational training but outside the school system as well, so besides being prepared to teach the age group of 14 to 18, they must also be prepared to participate in the vocational training of the young adults and SN students. In this respect, our research represents the aspects of life-long learning as well, and beyond formal teaching, it may contribute to the development of non-formal and permanent training, too.

In the present system of vocational teacher training, vocational training can adapt to the changes illustrated by the number of lessons mainly through its professional and methodological content. An important feature of adaptation is the adjustment of education content to the NQR trade group and sectoral vocational training system requirements, i.e. assuring the preparation for the students graduating from vocational teacher courses so that they become prepared to teach as wide range of vocational subjects as possible. This is also reasonable because this is the best way of warranting employment for the vocational teachers at secondary vocational schools and vocational training schools. Preparation to teach the vocational subjects of trade group and sectoral vocational training means that in addition to preparing them to teach 5-6 (or often 4-14) vocational subjects, other competences must be improved as well.

Preparation to teach trade group and sectoral vocational training content is highly limited by the fact that many of the school books supporting the teaching of vocational subjects at vocational training schools and vocational secondary schools, especially those for vocational training schools, are lacked, so teachers are only guided by the aspects defined in the system of requirements of the certain subjects in the vocational framework curricula. At the same time, they lack experiences in content development or methodological preparation, and students' learning can also be considerably limited by the features they face in classes which they did not meet at the preceding grade of their education. All these made it reasonable that content development and so a new vocational methodology was put into the focus of

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our activity striving to modernize teacher training within the wider framework of which we established by successful vocational teacher training TÁMOP (Social Renewal Operative Program) projects between 2011 and 2015.

3. The professional background of development

BME is a leading institution in Hungarian vocational teacher training and further education with considerable professional references. Teacher training has been a continuous activity within the university for almost one and a half century, and during the latest 50 years, our institution, within the frames of the pedagogical department and institute, has implemented vocational teacher training of the highest volume in Hungary, and these results have always been completed by vocational methodological developments. Relying on these preliminaries and the measures of the new act on higher education, BME Teacher Training Centre was established within the frames of the Faculty of Economics and Social Sciences, continuing by the activity of the Department of Technical Education as well.

The research group undertaking activities within the project has implemented several researches during the latest years. The professional program of the coming period can organically be built on the projects entitled "Establishment of service and research networks supporting vocational teacher training (TÁMOP-4.1.2-08/2/B/KMR-2009-0002)" and "Teachers' training for BME educators (TÁMOP 4.1.2-08/2/C/KMR – 2009 – 0005)" both of which were implemented between 2009 and 2011. Teacher Training Centre ensures a vocational methodological background and development resource meaning the impact of which will be felt in the long run. These two projects were followed by the one entitled "E-teaching culture and digital content development at BME (TÁMOP-4.1.2. A/1-11/1-2011-0023A)" which was implemented between 2011 and 2013, and is the direct preliminary of our present project.

The target groups of the developments are:

- participants of MSc vocational teacher training of cyclic and uniform systems, BSc vocational educators;

- concerning humanities, students attending teacher training in health care, pedagogy or special education in the cyclic system;

- teachers and mentors of the vocational training institutions leading and mentoring pedagogical and personal field practices that make parts of teacher training;

- teachers and mentors of vocational training institutions receiving career starter trainees.

The research topic is basically connected to the developments that have already begun: human resource development, teachers' communication and methods, distance education, e-learning, *best practices* in further education, life-long learning, non-formal learning and the development of technical competencies. In our work group established to implement the research tasks undertaken in the project, the BME Teacher Training Centre connects to the creation of complex subjects in vocational training, in addition to its professionals involved in the research and education of vocational methodologies, by implementing researches in the fields of system theoretical, ICT and mathematical knowledge and educational resource representation, offering a creative representation of the theoretical approach. It is an important factor that teachers who possess practical experiences in vocational education

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and may provide valuable contribution to the aspects of practice and applicability through their valuable Scientific Students' Circle researches, outstanding methodological practice, experiences gained in the development of ICT learning resources, methodological solutions adapted to special needs (SN students) and their connection to model schools are also involved in the work. The vocational teachers working at schools offer the possibility of testing our methodological developments, within the frames of a long-term cooperation established with the BME Teacher Training Centre, at the following partner institutions:

- József Öveges Secondary Vocational School and Vocational Training School of the Budapest Mechanical Vocational Training Centre

- János Bolyai Secondary Technical School and Boarding-school of the Budapest Technical Vocational Training Centre

- „Budapest" Baptist Secondary Vocational, Grammar and Sports School

- Elek Kada Secondary Vocational School of Economics of the Human Vocational Training School of Kecskemét

4. The core elements of the concept

In addition to the digital education resource development preliminaries introduced above as references, the concept worded in our current project is content development realized with the active participation of students and teachers, a process in which we form strong and organic connections between visual learning and practical education. The realization of the importance of the vocational methodological paradigm to be elaborated in relation to VET was greatly urged by the "Visual Learning Lab" (VLL) established at BME in 2008 which offered domestic and international scientific and innovation background as well as the international communication process within the frames of which the VLL Conference Series (I-VI.) created a representation interface (http://vll.mpt.bme.hu/index.php?lang=hu), and a book in English (*Visual Learning I-V, Peter Lang Verlag, 2011-2015*) was published each year (*Benedek, Nyíri 2013, 2014, 2015*).

From a pedagogical point of view, it is evident, and does not need to be proven in VET either, that pictures have always played an important role in human communication. "Visual homecoming" (*Nyíri, 2015*) exerted an increasing impact on everyday communication, and so on education and institutional education as well, especially around the Millenary. The massive spread of ICT tools exerted a considerable effect on learning processes, and at the beginning, it was exactly institutional education (schools, universities) where it was very difficult to bring these into compliance with the knowledge planned and represented according to the algorithms included in the curricular schemes. The visual content and the proportion of the electronic materials representing the current development of the technical infrastructure in the traditional school books has not changed much during the latest one and a half or two decades.

It was exactly the VLL within the frames of which the current interpretation of the nearly half-century long debate on engineer training, which possesses the most important traditions in technical education (*Ferguson, 1977),* has pointed out the fact how limited the current educational paradigm is in building on the enormous potentials hiding in visual learning. The growing importance of practical orientation, which is brought into the foreground in vocational training in our days, urge methodological developments to break

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with traditions in the new subject constructions, and to utilize the new technical opportunities offered by digital environment. This environment is especially up-to-date in vocational education, which makes a special part of public education, where teachers are to teach this type of practices and working activities to the students.

Primarily owing to the spread of business IT applications (*Kampffmeye, U.; 2006*), *content management* is used in a wide range of contexts; the lecture, however focuses on the narrower field striving 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 peculiar framework is provided by the fact that the innovation, which takes open source content development as one of the approaches of reforming teacher training, is connected to a technical university of long-existing traditions (*Benedek, A; Molnár, Gy, 2014, 2015*).

The theoretical background of this topic is partly of VET didactical features (*Gessler, M.; Herrera L. M.; 2015),* and is partly connected to the endeavours which strive to shape the alternatives of the traditional VET curricula in a learning environment determined by modern IT and which 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 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 LMS systems, memory independent management of complex visual elements and the flexible management of micro-contents) is capable of surpassing traditional, school- and notebook based teaching.

The methodological speciality of our research was modelled based on theoretical analysis and relying on which curriculum development tasks were implemented with the participation of engineer and economist teacher trainees. Some tasks completed in the process of elaborating the online curriculum headed towards the creation of a *content management* model. The queries and interviews made with the students and the management of the micro-contents elaborated by the students can be looked at as new procedures.

The core of our research was to involve students (future vocational teachers) into the process of OER development, and to provide them with a methodological knowledge that can be used in the permanent improvement of active learning using community content development elements. Thus from a methodological aspect, we consider this procedure to be **Open Content Development (OCD)**. This methodological approach is built on the following recognitions:
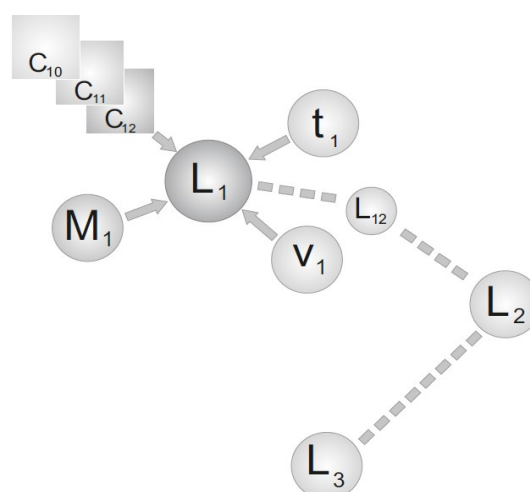
Starting from the school environment and the students' motivation to learn, which in some cases denies traditional solutions, in our research we presupposed that by relating image learning and practical solutions to the learning material, those undertaking knowledge representation and the learners can be provided with the possibility of improvement in a more organic way. At the level of conclusions, this approach might lead to new pedagogical apprehensions, and we have good reasons to suppose that further research and

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development work bears the opportunity of the real methodological modernization of teaching and learning.

Concerning traditional learning material constructions, the improvement of the efficiency of education dominated by verbal elements and the new methodological approaches (co-operative methods, project works, forms of community learning) (*Siemens, 2005*) are rather limited because of considerable time and information capacity needs as well as slow correction mechanisms. The "modern" learning materials having developed by the end of the 20th century remained unchanged concerning their linear structure, the dominance of written texts (80 percent in average), static image conveyance in terms of verbal, and image communication. Although electronic learning resources and multimedia e-learning representations include more dynamic (flash, video) content, the "logic" of building up learning materials has changed little – in fact, visual content is only a (written and oral) completion to verbal communication. Therefore, as a core element of our concept, we strive to make the process of content development open, and involve teachers and students/pupils as active participants by dedicating constructive activities, the results of which can be suitable to complete or colour the learning material, or represent possibilities of practical adoption.

A core characteristic of the introduced paradigm is the increased share of the visual content elements in order to achieve a more effective construction and learning of the information to be transmitted. This increase, however, should not be of an unproportioned measure but should comply with certain interconnections, which could assure that the rate of the two necessary forms (verbal and visual) can evolve in compliance with the specialties of a certain topic, age and vocational didactics. From a methodological point of view, especially in the cases of mathematics and scientific disciplines as well as the applied sciences closely related to these (technical sciences and their application offer good examples of these), at the theoretical dimension, learning resources usually contain verbal elements in the form of texts (*t*) that are completed with visual elements (*v*) and mathematical formulas (*M*). Traditional learning material representations (notes, books) generally include the combinations of these, and are mainly organized sequentially, in a linear way. For example: explanation, figure, explanation of a formula, etc. In many cases, the example or case (*C*) referring to practice and introducing certain special applications is casual and incidental.

In the course of our researches on new digital learning material constructions we do not visualize the knowledge elements (*L₁...L₃*) sequentially (which in most cases means printing) but, with the help of electronic tools and procedures, in a virtual space, where the knowledge elements *L₁...L₃* are placed on the surface of a quasi-endless plain. Later new and new knowledge elements can be added here. As a domestic preliminary, we can refer to the Hungarian Virtual Encyclopaedia in which image representation shows the essence of the structure, i.e. that knowledge elements can be organized into a scale-independent system. *Figure 1.* shows all this in a simplified way:

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Figure 1.: Knowledge elements(L) and their visual (V), verbal (t) and mathematical (M) components

In the cases of open learning material structures, new components can be built in "between" the learning elements. At the same time, it is an important possibility that the graph structure can be completed with case studies and examples (**C** components) which can make the resource unique, and provides the opportunity of active participation and creation for the student and the teacher, the motivation impact of which is probably of considerable strength. *Figure 2.* represents the connection of knowledge elements: in case it is wanted or necessary, an optional set of **C** components can be added to the learning material elements.
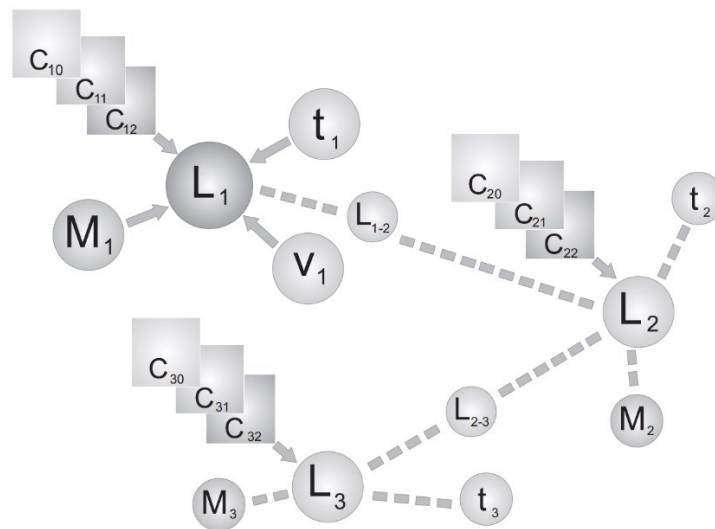

Figure 2.: Connection of knowledge elements $L_1 – L_2 – L_3$ and the possibility of completion (L_{12} and L_{23})

Our conception is aimed at involving students and willing teachers and undertaking active participation in building a learning material construction that is created with an open access approach – providing the possibility of community content development for the concerned learners' groups or classes as well. It is also an innovative activity of ours to provide huge background storage and cloud services which this process needs. This way, we are able to provide a development infrastructure for the teachers, teacher trainees or students involved in the development of the vocational methodology and the learning resources better than ever before, directly through the Hungarian Academy of Sciences and indirectly through the utilization of the services.

In 2015, we undertook to elaborate a new complex curriculum that, on the one hand, offered a framework for a general course on the analysis of system theory, and on the other hand, allowed students to prepare case studies by which they could participate in the development of the curriculum of the course. We followed the general rules of OER development, and in the autumn of 2015 we started teaching the "System theory" course to a major group of the students questioned in our survey; an e-learning resource was also

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made for the course (*Bars, Vámos, Nagy, Monos, Max, Benedek (ed), 2015*), and the solutions of the exercises were administered in the Moodle system.

The e-resource was created within the frames of a development which strived to surpass the usual forms of traditional learning materials and even their e-learning adaptions. We do not consider the written resources closed and finished, the curriculum is supplemented by exercises completing it with visuals (pictures and illustrations) thus learning will be even more closely related to activities and practice. The examples might urge the reader, the students elaborating the materials in groups and within study frames, to participate in further common thinking.

Since 2015, a tool - **Sysbook**[1] - is linked to the learning material; it makes, in terms of openness, the thematic connections more colourful and perhaps even raises them to a higher level by visual and mathematical inter-connections and complex examples. This possibility is, of course, dependent on the vocational interest and previous competences of the users of the resource as well. We introduce this type of perspective through several everyday examples: for instance, we analyse the processes of cooking or car driving to discuss what our system and its environment is like, how it can be modelled and how we can influence our system so that it will behave the way we wish it to. System perspective helps professionals with no engineering background as well, so that they will be able to examine the systems of their own professional field with this type of outlook, too, and so be able to make decisions that are more advantageous. Fields like this are, for example, health care, medical technology, economics, etc.

The very wide spectrum of VET and the dynamics demanding continuous changes mean a permanent development task in the case of education resources as well. In our case, the dual functional linkage of teacher training (learning and transmission) gave us the opportunity to examine the first phase of the evolution of student activity, the nature of their attitudes. This is followed by the construction phase in which the students actively participate in the development of OERs by elaborating case studies and micro-contents.

According to our hypothesis based on the previous researches, the mutual connection system of knowledge elements, at the level of the micro contents used in an increasingly wide range in education development, can appear in complex learning materials. Adopting micro-contents as micro learning units in practice seemed also reasonable owing to the fact that with the spread of "smart" devices the information gathering habits have also changed. The common features of the most popular mobile communication applications are the provision of the experience of promptness, the possibility of directly addressing the others involved in the service and the "quantum-like" nature of the transmitted information, having

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[1] The original objective of the Sysbook, which has permanently been and is still being developed since 2014, and which is now registered in the volunteer work registry by the National Office of Intellectual Property (Registration no.: 004873), was to introduce the basic notions of system theory and control engineering in a descriptive way easily comprehensible by anyone on one the hand and more deeply through explanations and mathematical descriptions on the other. This is partly more than the students dealing with this topic in vocational teacher training must undertake. Therefore, from the aspect of teaching methodologies and teaching itself, it was especially important to indicate the optional relations to **Sysbook** in the learning resource by providing links in the curriculum.

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been tailored to fit size. This latter is dependent on the size and resolution of the mobile display, the limited nature of the user's divided attention, the characteristics of the user interface of the certain application and the strategy to neglect the disturbing environmental effects caused by mobility.

The vocational learning material that can be modelled in a scale independent graph structure helps the acquiring and control of knowledge mainly by connecting verbal and visual knowledge elements, mathematical representation (both theoretical and the type offering practical aspects) and case studies and practical examples allowing the users to complete them. The applied ICT solutions make it possible that each of the elements of the graph-like knowledge lumps forming in the virtual space is to be completed by an information text, an image-centred material which demonstrates visual representation and is easy to be transmitted to young people and, if possible, a mathematical representation fitting the knowledge of the certain age group.

Owing to the complex nature of VET, the knowledge elements being formed on a wide professional platform and possible to be verified by the teachers' methodological culture can summarize the interconnections described at a theoretical and general level in an up-to-date form and at an optimal length. Resulting from the open structure, this system is more suitable than traditional solutions for having new components presenting interdisciplinary knowledge elements built in. In addition, case studies and examples may make learning more effective and, supposing there are relevant solutions, can make community content development (done by students and teachers alike) more rapid and targeted. The case studies, good examples and practical applications can make the acquisition of the material, which in many cases seems to be merely theoretical, livelier.

The first learning resource construction of this type has been being elaborated as part of the new type of electronic learning resource meant for teachers working in the secondary level vocational training entitled "*Introduction to systems*" (*Bars, Vámos, Nagy, Monos, Max, Benedek (ed.), 2015*) within the frameworks of the digital education resource development mentioned as a preliminary of these researches, which was initiated and is done with the participation of academician Tibor Vámos, since our preparation for the first methodological tender call announced by HAS and the informal birth of the research team (2014).

Another topic of the research important from a methodological aspect was the use of cloud services. This means the storage of complex **open access methodological materials** (being continuously completed in terms of contacts and elements) in clouds. According to the present ideas, this would offer a service for school users in the course of which the certain service would not be provided on a concrete, dedicated hardware but dividedly, on the supplier's hardware; i.e. a high level of availability of divided and redundant servers would be provided together with a strong protection against data loss. The core of the *open access* principle is the provision of open access where the progressive adoption of security protocols is not an obligatory factor. The possibility of collaborative work, continuous data synchronization and backup, automatic refreshment, the shareability of contents and data encryption are all advantageous factors.

5. Expected results

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The result of the four-year research will be the birth and practical introduction of a new vocational methodological learning resource development model which is aimed at the open (active participation of students and teachers) development of learning content (OCD) and its practical application. With regards to the complex subject feature of VET, the new electronic learning resources will be elaborated and tested, the results checked and the research results summarized in a wide spectrum of vocational training – mechanics, informatics, electricity and economics – and in terms of the subjects of secondary level vocational training.

Since the narrow research group includes the academic representatives of various disciplines as well as methodological professionals working in vocational teacher training and the school practice of vocational training, as a working method, we organize one-day expert workshops for 15-20 people in every half a year, and plan to have conferences providing professional publicity and dissemination possibilities. From the aspect of the introduction of the first results of our research activities, the preparation of these events is a working form offering the possibility of intensive cooperation and constructive debate for each of the participants of the researches. These workshops are also important documentation phases in terms of the preparation, the plans and the programs that can give important input impulses to the common work.

During research and development, it is a highly stressed task to assure the active participation of the vocational training partner institutions and their teachers in the first phase of the project (2016-2018) at the four vocational training institutions mentioned above. After the first phase of the vocational methodology development process, which is testing, we prepare the extension of the vocational development model in the second part of the project period in a wider range of vocational education institutions, establishing an innovative methodological network consisting of 10-12 schools in which we will analyse the possibilities of student-teacher interactive open education resource development in practice as well, and evaluate its impacts. Relying on the experiences gained in this process, we will make proposals concerning a wider range of testing at vocational secondary schools and vocational secondary grammar schools, and include the lessons learnt from the experiences into vocational teacher training.

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6. Referred literature

Bars Ruth, Vámos Tibor, Nagy Dezső , Monos Emil , Max Gyula,Benedek András (szerk.) (2015) *Rendszerek a szakképzésben,* (ISBN 978-963-313-206-7), Budapest: BME Tanárképző Központ,   123   p.

András Benedek, Kristóf Nyíri (eds.) (2015) *Beyond Words: Pictures, Parables, Paradoxes* (Visual Learning; 5.),(ISBN 978-3-631-66385-1) Frankfurt/M.; Berlin; Bern; Bruxelles; New York; Oxford; Wien: Peter Lang Internationaler Verlag der Wissenschaften,, 2015. 260 p.

András Benedek, Kristóf Nyíri (szerk.) (2014) *The Power of the Image: Emotion, Expression, Explanation.* (Visual Learning; 4.),(ISBN 978-3-631-64713-4) Frankfurt/M.; Berlin; Bern; Bruxelles; New York; Oxford; Wien: Peter Lang Internationaler Verlag der Wissenschaften, 287 p.

Benedek András, Nyíri Kristóf (eds.) *How to Do Things with Pictures: Skill, Practice, Performance*
(Visual Learning; 3.) (ISBN 978-3-631-62972-7) Frankfurt/M.; Berlin; Bern; Bruxelles; New York; Oxford; Wien: Peter Lang Internationaler Verlag der Wissenschaften, 2013. 224 p.

Benedek András - Golnhofer Erzsébet (szerk.) (2013) *Tanulás és környezete.* Tanulmányok a neveléstudomány köréből, (ISBN 978-963-508-751-8), MTA Pedagógiai Tudományos Bizottság, Budapest, 298 p.

András Benedek, György Molnár (2014) *ICT in Education: A New paradigm and old obstacle In: Arno Leist , Tadeusz Pankowski (Eds.) ICCGI 2014 :* The Ninth International Multi-Conference on Computing in the Global Information Technology . (ISBN: 978-1-61208-346-9),   Sevilla   ,   Spain,   pp.   54-60.

András Benedek, György Molnár (2015) *New Approaches to the E-content and E-textbook in Higher Education*, In: L. Gómez Chova, A. López Martínez , I. Candel Torres (eds.)INTED2015 Proceedings: 9th International Technology, Education and Development Conference. (ISBN 978-84-606-5763-7) Madrid, Spain, International Academy of Technology, Education and Development (IATED), pp. 3646-3650.

Cedefop (2015) *Vocational education and training systems in Europe. Spotlight on VET*, Luxembourg, doi: 10.2801/5006-978-92-898-1374-8, 70 p.

Ferguson, Eugene S. (1977) "The mind's eye: Nonverbal thought in technology." *Science* 197. 4306: 827-836.

Grenfield, P. (2009) „Technology and informal education. What is taught, what is learned." *Science*. 323, pp. 68-71.

Gessler, Michael; Herrera, Lázaro Moreno (2015) *Vocational didactics: Core assumptions and approaches from Denmark, Germany, Norway, Spain and Sweden*, International journal for research in vocational education and training 2,) 3, S. pp. 152-160.

_____

Kampffmeyer, U. (2006), *Enterprise Content Management*, Unternehmens beratung Dr. Ulrich Kampffmeyer GmbH.http://www.project-consult.net/Files/ECM_White%20Paper_kff_2006.pdf (letöltve: 2016.04.19.)

Kristóf Nyíri (2014) *Meaning and Motoricity-Essays on image and time* (ISBN: 978-3-631-65134-6) Frankfurt/M.; Berlin; Bern; Bruxelles; New York; Oxford; Wien: Peter Lang Internationaler Verlag der Wissenschaften, 152 p.

Molnár, György (2014) *Modern ICT based teaching and learning support systems and solutions in higher education practice*, In: Milan Turčáni, Martin Drlík, Jozef Kapusta, Peter Švec (ed.) 10th International Scientific Conference on Distance Learning in Applied Informatics. 654 p. Praha: Wolters Kluwer Law and Business, pp. 421-430.

Molnár György (2014) *Pedagógiai megújulás tapasztalatai a szakmai tanárképzésben - új IKT alapú eszközök és koncepciók a tanárképzésben*, In: Ollé János (szerk.) VI. Oktatás-Informatikai Konferencia Tanulmánykötet. Budapest: ELTE PPK Neveléstudományi Intézet, pp. 434-452.

Siemens, G., Connectivism (2005) "A learning theory for the digital age." *International Journal of Instructional Technology and Distance Learning* (ISSN 1550-6908),Vol 2. No. 1. http://www.itdl.org/journal/jan_05/article01.htm (letöltve: 2016.04.20.)

Sysbook (2016) - Készült a Magyar Tudományos Akadémia Automatizálási és Számítástudományi Intézete tudományos programjának keretében a Budapesti Műszaki és Gazdaságtudományi Egyetem Alkalmazott Pedagógia és Pszichológia Intézetével együttműködésben, http://sysbook.sztaki.hu (letöltve: 2016.04.20.)