# EXPLOITATION OF OPEN EDUCATIONAL RESOURCES IN ENGINEERING EDUCATION - PURPOSE OF RESEARCH

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**Abstract:** *The issue, as a discrepancy between the known and unknown attributes, is partially stated in the theme of the research plan: which are the learning paradigms according to which the learning process takes place in the present, what are the influences of the open educational resources on the learning process in general and specifically on the engineering education?*
*The strategy of research as any other social research follows multiple ways: it is about to describe and explain a complex educational phenomenon: learning.*

**Keywords**: *Open Educational Resources (OER), high-school student/university student/Z generation, quality of education, learning results.*

## 1. Argumentation of Choosing the Research Theme

In my activity as a principle and preuniversity teacher, I noticed that the current student generation is interested in achieving the information in a different way, the books and notes are not primary in their interests, and characteristics of Z generation are present: they live in a symbiosis with the digital universe, they like studying in the virtual environment, they grow along with the online world and are willing to build a life correlated to it, they very well know where and how to find the information, wish to be active part of it, to be on YouTube and video blogs, spend over three hours per day on the computer, developed short term attention, they rather scan than read, do not wish to read but interact on social networks, no sport activities but enjoy video games, they are not obedient but ambitious and in the same time independent and pragmatic.

The education system, as a component of public policy, was defined as „a set of institutions or social organizations and human communities in a predetermined society, which directly and/or indirectly, explicitly and/or implicitly, performs certain functions and assumes a teaching role under the form of an organised activity" [4].

Europe and the world in general confront with a higher demand for education and the objective of the Europe 2020 strategy is to increase the number of graduating students to a 40%. Similarly Europe confronts with a deficiency of competences and not in the least there is a pressure of costs in educational systems. Romania is a participant of the Bologna Process from the very beginning of its launch in 1999. The restructuring of the

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university studies to the levels of BA, MA and PhD for the differentiation of the levels of higher qualifications imposed reconsideration of domains and specializations in higher education [12]. In 2013, the European Committee launched the initiative called "Opening up Education "presenting the measures that were to be applied. It launched as well OpenEducationEuropa.eu website to help users find the open educational resources they need and to promote the great number of quality resources produced in Europe [7], [14].

Among the new education transforming phenomena, the digitalisation of the system is present also in Romania. Several educational institutes or the ones in the economical domain are trying to discover new opportunities in online teaching, platforms and portal in courseware. Considering the upsides of the open educational resources (OER) both from the institution's point of view and from the one of the student, it is desirable for these resources to be used as widely as possible in the university and preuniversity education as well. Among the advantages of open educational resources we can mention: low costs, possibility to improve the access to different materials, performance provided by easily and quickly accessible data usage, development of the community through making available a new way of collaboration and cooperation between the teachers and also between the students, development of open educational resources can achieve the mission of making learning and knowledge available for everyone [1], [5], [7].

## 2. Short Enumeration of the Theories from which the Base Idea of the Topic Originates

What are the Open Educational Resources and what is their impact?

Before opening a topic about one of the main educational themes which is the open education and open educational resources, it is necessary to specify what the concept stands for. According to wikieducator the „open educational resources" term concernes the educational resources (lesson planning, guides and instruction modules) with free usage, adaptation and redistribution rights [19]. This term was first used in the year 2002, by UNESCO. According to Bucher, clarified in The Open Education Resources Guide, these resources are „available for free, without paying for licence or copyright, for teachers and students" [3]. In „Orizont 2013 - Higher Education", it is demonstrated that the impact and usage of OER will grow in the immediate future. The report also shows that using TIC and OER in education has to become of mass usage, the mobile technology will be present in the learning activity as much in the classroom as outside of it [8]. Downes feels that the fast growth of Open Educational Resources and the massive development of Online Open Classes will change many of current traditional practices of teaching and learning [6]. According to Demann, OER is based on the simple but powerful idea according to which the global knowledge is a public good comparable to water and that the access to it must be free for anyone [5]. Opposed to the formal structure specifics of the traditional learning, the presence of OER leads faster towards informal education, less predictable and controllable, specially with the recent huge speed of social networking that generates an active participation architecture [10]. Pawlowski, in Open Education 2030, mentions the necessity of some commune overboard actions involving the communities from different European countries with the purpose of staying on the market on the global education market. At the same time it issues some recommendations concerning the open education: to create an OER inventory, integrate the existing European communities, curricular integration, creation of some regional

networks, creation of global programs, issuing open educational resources policy [11]. According to Duşe and Duşe in the column *În întâmpinarea profesorilor: proiectul EU-StORE* the materials and declarations made during the conferences in 2012 and 2015 concerning OER talk about the necessity that European educational systems should bring the learning experiences closer to the requests on the labour market. They also tell us that the contribution of TIC should be more accentuated, among others in the engineering education as well in teaching as in learning with special focus on use of open educational resources [7]. Ally and Samaka states that the education is very expensive for many countries in the world, the only solution being the inclusion of open educational resources (OER) or of open education (OE) in the educational system curriculums [1].

OER project examples:
(1) in January 2001, Wikipedia launched the online encyclopaedia, with wide possibility to be edited;
(2) in 2002, Massachusetts Institute of Technology (MIT), launched the project OpenCourseWare: materials and online classes with open usage and distribution;
(3) other similar initiatives (WikiEducator, OER Commons, and Connexions).

Examples of OER in engineering education:
(1) The Pennsylvania State University: Petroleum & Natural Gas Engineering, Course Author: Michael Adewumi;
(2) University of Portsmouth: School of Engineering/Postgraduate Research Opportunities;
(3) UNSW Australia Engineering: School of Petroleum Engineering, Open Learning Program;
(4) Massachusetts Maritime Academy: Engineering [15-18].

According to the OER best practices quide, issued by a work group of the Association for Technology and Internet, Fundaţia Soros România and National Association of Librarians and Public Libraries of Romania, at this time in Romania we can not speak about an enhanced framework for the development and exploitation of OER. There are some efforts in the activity of the practicians. In this guide we find a reference to the activity of Holotescu (2012), who draws a map of the open resources in Romania. We find the descriptions of project and initiatives sharing the OER philosophy: Dida Tec, Moodle România, didactic.ro, educaţie.inmureş.ro [14].

According to Kulcsár, Siemens and Downes issues in 2008 a new theory of learning for the digital era: connectivism or the theory of learning networks, crossroad of informatics sciences, pedagogy and network science [9]. Siemens (2014) states, that after behaviorism, constructivism, for the digital era the connectivism is a new instance of learning. The development of technology in the last decades has reorganised our lives, way of communication and way of learning. The need to learn and the learning theories describing the principles and processes should be reflective and representative for the base of social media. Learning will be a way of human existence: a suite of attitudes and individual or group actions using the trials to be up to date with different kinds of events. In the same time he states that our ability to assimilate the necessary information for the future is of higher importance than what we know today [12].

*Synthetic table: Open Education, OER and Connectivism*        Table 1

| Authors | Objectives of Research | Results |
|---|---|---|
| **Busher** (2011) | Clarification of the concept of *Open Educational Resources* | These materials are freely available, without paying for licence or copyright, for professors and students. |
| **Jonson (2013)** | Impact and usage of OER | It is demonstrated that the impact and usage of OER will grow in the immediate future. The report also shows that using TIC and OER has to become of mass usage, the mobile technology will be present in the learning activity as much in the classroom as outside of it. |
| **Downes** ( 2011) | Clarification of the concept of *Open Educational Resources* | The fast growth of OER and the massive development of Online Open Classes will change many of the current traditional practices of teaching and learning. |
| **Demann** ( 2012) | Clarification of the concept of *Open Educational Resources* | OER is based on the simple but powerful idea according to which the global knowledge is a public good comparable to water and that the access to it must be free for anyone. |
| **Pawlowski** (2013) | Open Education 2030 Global Open Education: *A Roadmap for Internationalization* | To remain successful on the global educational market Europe needs to engage a broad community in cross-border collaboration towards better education and global outreach. |
| **Ally & Samaka** ( 2013) | Including OER and mobile technology in the activity of suppressing the learning differences | The education is very expensive for many countries in the world, the only solution being the inclusion of open educational resources (OER) or of open education (OE) in the educational systems curriculum. |
| **Siemens** (2005) | Connectivism: A Learning Theoy for the Digital Age | After behaviorism, constructivism, for the digital era the connectivism is a new instance of learning. Our ability to assimilate the necessary information for the future is of higher importance than what we know today. |

## 3. Specifying the Research Problem / Research Objectives and Research Hypothesis

The issue, as a discrepancy between the known and unknown attributes is partially stated in the theme of the research plan: which are the learning impacts according to which the learning process takes place in the present, what are the influences of the open educational resources on the learning process in general and specifically on the engineering education?

(1) Determination of knowledge and usage degree of OER in Engineering Universities in Romania.

(2) What are the learning methods of Z generation in a high-school in Sibiu and ULB Sibiu?

(3) We wish to find out if the learning results improve by using OER. Finally we aim to the development of a learning model in engineering education exploiting OER.

For the 2nd research question the hypothesis is: Usage of OER is higher in informal learning environment both for the high-school students and engineering students. x

determines y, where x is OER, an independent variable, and y is the result of learning, dependant variable, observations noticed: a) in formal environment, b) in informal environment.
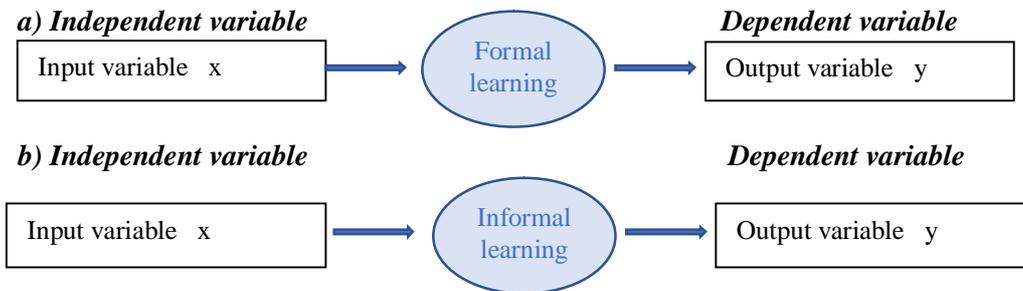
**a) Independent variable**          **Dependent variable**

Input variable   x   →   Formal learning   →   Output variable   y

**b) Independent variable**          **Dependent variable**

Input variable   x   →   Informal learning   →   Output variable   y

Fig. 1. *Image of 2nd hypothesis schema*

For the $3^{rd}$ research question: following to the usage of OER, the learning results improved.

**Independent variable**          **Dependent variable**

Input variable   x   →   Learning   →   Output variable   y

Student, Z Generation     Quality of education
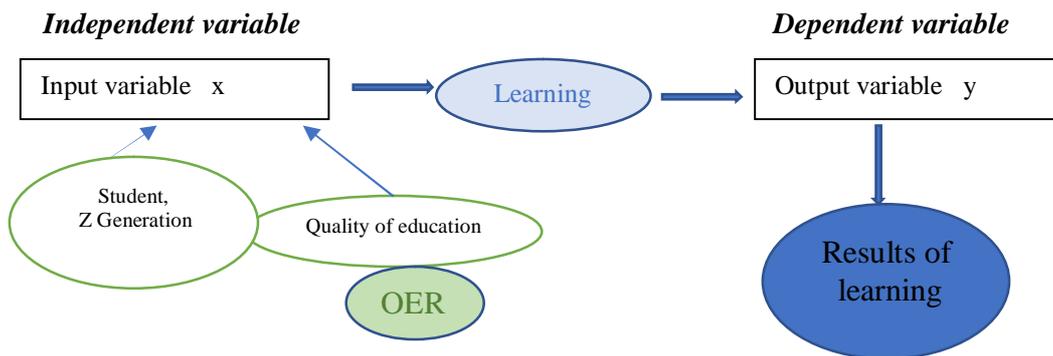
OER

Results of learning

Fig. 2. *Image of 3rd hypothesis schema*

## 4. Operational Definition of the Concepts

The concepts used in this research: open educational resources (OER), high-school student/university student/Z generation, quality of education, learning results, learning. The operationalization: stating of the operations involved in the measurement of variables:

• Operationalization of open educational resources (OER): digital materials and other accessible resources, licence free through the following questions: a) Guides for the dimensions of learning contents: Uses individuals in the research sample: Online classes/ study materials? Supplementary teaching materials: movies, images, images connected to the study materials? Creates learning contents that are posted? Distributes learning contents? b) Indicators form technology dimension in the use of OER: Uses desktops or laptops? Uses mobile technology (I phone, Smart phone, tabloid)?

• Operationalization of the high-school student/student of Z generation: Birthdate? (Indicator: youth born after 1995); Preliminary information: (grades, ratings on the studied subjects); Preliminary motivation (established with standard pschychology tests).

• Operationalization of the learning results concept: Results on semestrial exams/ Results on performance tests; Motivation degree.

• Operationalization of quality of education concept: Questions form the handbook" Quality assurance in education".

• Operationalization of learning concept: Exhaustive operationalization of this concept may seem impossible, in the present research project we are interested in two dimensions: the formal and the informal one. a) Formal dimension (questions and indicators): Number of hours spent studying the paper educational materials (in the teaching institution or out of the institution but according to school schedule); number of hours spent in studying the materials on digital support (in the teaching institution or out of the institution but according to school schedule); Number of preparation hours for exams and tests. b) Informal dimension: Number of hours in learning activities outside the school schedule; Studying materials on paper; Studying materials on digital support.

## 5. Specification of Research Method and Motivation of Choice

The research strategy as in any social research is a multipath action: will describe and explain phenomena from the educational domain. The analysis units are institutions or individuals, the temporal dimension is a transversal one.

*Objective 1*. In case of the first stated objective of the research project, the proposed research method is: Discreet research - Analysis of existing statistics. The measure and analysis unit is the educational institute.

*Objective 2*. We address the description of a very complex phenomenom: learning. As well in formal and in informal environment. The observation, the measurement will be made by applying the random research method. The analysis unit will be the individual.

*Objective 3*. According to objective number 3 we build an experiment: a) Establishing an intervention program, based on the learning scenes that uses OER; b) Establishing the experimental group and the control group; c) Applying the intervention program at experimental group; d) After testing application at both groups.

## 6. Building Research Instruments

Questionnaires are used in the research as special instruments to gather useful information for the analysis. The questions / to be analyzed items are formulated taking into consideration the presented operationalization concepts. At the formulation of the questions we consider the following methodological recommendations: make difference between open and closed questions, clear statement of questions, avoid questions with double purpose, keep questions as short as possible, ask relevant questions, avoid negative questions, to avoid judgemental terms and questions, pay attention to the sequence of the questions, clear statement of the instructions.

For establishing of the motivation degree we use standard psychological tests.

At the accomplishment of objective number 3 of the research, we use questionnaires at the application of the experimental method as well. The questionnaire issue criteria are the same as the ones present above. The questionnaires used for pre-testing will not be identical with the ones used for after-testing, but will be isomorphic from a logical point of view (content validity).

## 7. Description of Population and Sample Specimen

The population for which we generalize:

*Objective 1*. Institutions (Measure unit and also analysis unit) - Engineering Universities in Romania.

*Objective 2*. High-school students from technical profile high-schools and the students from the *Lucian Blaga* University from Sibiu, Engineering Speciality.

*Objective 3*. In the experimental and also in the control group 1$^{st}$ year students will participate from *Lucian Blaga* University Sibiu, Engineering Speciality.

In the research we will use a probabilistic sampling that identifies a group of subjects with representative characteristics for a larger population.

## 8.  Data Processing Procedures (Description and Motivation)

In the proposed research the data will be converted in a numerical form for statistic analysis. We will use SPSS or MiniTab software. The filling in of questionnaires will be mostly qualitative, this is the reason why we will translate the answers through the coding process - allocation of an individual code number to each item in the questionnaire - will ease the analysis process. Considering that the data will be collected using questionnaires, the coding can be done right on the questionnaire. An other alternative is building a coding sheet.

## 9. Data Analysis Procedures (Description and Motivation/Analysis Method)

Once the data is quantified in the computer we can start the quantitative analysis. In the proposed research project we will achieve a descriptive and explicative quantitative analysis taking into consideration several variables. According to Babbie "the quantitative analysis is the numerical representation and management of findings in purpose of description and explanation of the noticed phenomenon" [2]. We will use the multiple choice analysis to analyse the simultaneous relations between several variable, will accomplish the analysis of the main tendencies (average, median, modus), dispersion. We will use the descriptive statistics to describe the sample and the relations between the variables of the chosen sample, but will also use the inferential statistics. Given that one of the dependant variables in the proposed research is the learning result, we will use the multiple regression analysis, a form of statistical analysis used to identify the equation which represents the impact of several independent variables on one dependent variable.

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