Social dimension of higher education: definition, indicators, models

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Abstract

The article deals with the problem of strengthening the social dimension of higher education. It discusses the definition of social dimension, its indicators, models of student retention and student engagement. The article argues that students should act as active researchers of the topic of social dimension and present the ways to update the content of university courses for Sociology majors, such as "Mathematical and statistical methods of social information analysis", "Social statistics and demography", "Multivariate data analysis", "Structural equation modeling" and other courses for bachelors, master students, and PhDs in Sociology.

Keywords

higher education, social dimension, education statistics, students training, EUROSTUDENT, social statistics, modeling, educational and migration backround of students, cloud technologies, R, NodeXL

1. Introduction

1.1. Setting of a problem

The social dimension of higher education has been the focus of attention of the European educational community since 2001 [1]. In general terms, the social dimension means compliance with the principles of equality, accessibility and diversity in the higher education system. The Rome Ministerial Communiqué (2020) [2] proposes a definition of vulnerable, disadvantaged and underrepresented groups of students, and sets out the principles that oblige public authorities and higher education institutions to develop the relevant concepts, or to improve their policies and strategies for strengthening the social dimension of higher education. Such principles

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include the continuous monitoring and collection of data for evidence-based statistics on the topic of the social dimension of European higher education. The recent Eurostudent VII Conference in Hannover, 2021 [3] featured the issue of the social dimension, the comparison of the results of monitoring of this issue among European countries, and he definition of common and special social dimensions. Consequently, the inclusion of the social dimension into national strategies for the transformation of higher education remains a priority for the countries of the European Education Area.

As an associate member of the EU, Ukraine is aiming to develop its higher education system in compliance with European priorities. Therefore, training of the specialists who can develop the social dimension of higher education is important task of Ukrainian universities.

Based on the conceptualization of the social dimension in higher education, its indicators and models, the article is aimed to show the paths of including this topic in the training sociology majors in Ukrainian universities.

1.2. Related work

The various aspects of computer modeling in education were summarized by Ukrainian scientists within CoSinE workshop (2019–2021). Semerikov et al. [4] studied computer simulation of neural networks; Bilousova et al. [5] discussed computer simulation in computational mathematics; Soloviev et al. [6] presented cognitive process modelling using complexity theory methods.

Burke [7], Hauschildt et al. [8, 9, 10], Mishra and Diesner [11], Salmi [12, 13], Unger [14] studied various questions of social dimension.

The problems of social and economic conditions of student life in Europe are summarized by Hauschildt et al. [8, 9], Unger [14] as part of EUROSTUDENT.

Many scholars are interested in the problems that arise in model building on student retention and student engagement: Tinto [15, 16, 17, 18, 19, 20], Spady [21, 22], Tight [23], Burke [7], Kerby [24], Kricorian et al. [25].

We share the Tight [23] view that modern student's success a not limited to learning. A wide range of issues related to their families, friends, social environment influences their ability to successfully complete studies and integrate. It is important that students participate in the study of the problem of the social dimension, even as researchers.

That is why the purpose of our study is to find ways to include content on social dimension of the higher education in the training of sociology majors. This training follows modern strategies of [26, 27]:

- Shifting the focus of statistical tasks within the curriculum from mathematical calculations to tasks of a practical nature.
- Integration of statistical thinking and statistical literacy into the curriculum of different disciplines;
- Development of problem solving skills: students are offered open problems and the teacher takes on the role of a "facilitator" in the learning process.
- Using real life examples in project work;
- Developing strategies to increase students' motivation;
- Using multidimensional models for understanding social phenomens.

The issues of preparing sociology students and PhDs to use statistical models and education statistics data are discussed in papers [28, 29, 30, 31].

2. Results

In London Communiqué, ministers agreed on the following definition of the social dimension: ”We share the societal aspiration that the student body entering, participating in and completing higher education at all levels should reflect the diversity of our populations. We reaffirm the importance of students being able to complete their studies without obstacles related to their social and economic background. We therefore continue our efforts to provide adequate student services, create more flexible learning pathways into and within higher education, and to widen participation at all levels on the basis of equal opportunity” [32].

The Rome Ministerial Communiqué (2020) [33] proposes a definition of vulnerable, disadvantaged and underrepresented groups of students.

- *Underrepresented students.* A group of learners is underrepresented in relation to certain characteristics (e.g. gender, age, nationality, geographic origin, socio-economic background, ethnic minorities) if its share among the students is lower than the share of a comparable group in the total population. This can be documented at the time of admission, during the course of studies or at graduation. Individuals usually have several underrepresented characteristics, which is why combinations of underrepresented characteristics (“intersectionality”) should always be considered. Furthermore, underrepresentation can also have impact at different levels of higher education – study programme, faculty or department, higher education institution, higher education system. This definition is complementary to the London Communiqué, ”that the student body entering, participating in and completing higher education at all levels should reflect the diversity of our populations”, but does not fully cover it.
- *Disadvantaged students:* Disadvantaged students often face specific challenges compared to their peers in higher education. This can take many forms (e.g. disability, low family income, little or no family support, orphan, many school moves, mental health, pregnancy, having less time to study, because one has to earn ones living by working or having caring duties). The disadvantage may be permanent, may occur from time to time or only for a limited period. Disadvantaged students can be part of an underrepresented group, but do not have to be. Therefore, disadvantaged and underrepresented are not synonymous.
- *Vulnerable students:* Vulnerable students may be at risk of a disadvantage (see above) and in addition have special (protection) needs. For example, because they suffer from an illness (including mental health) or have a disability, because they are minors, because their residence permit depends on the success of their studies (and thus also on decisions made by individual teachers), because they are at risk of being discriminated against. These learners are vulnerable in the sense that they may not be able to ensure their personal well-being, or that they may not be able to protect themselves from harm or exploitation and need additional support or attention.

EUROSTUDENT is an international survey project collecting data on the social and economic conditions of student life in Europe. The dataset of this project covers many of important

aspects of student life: access to higher education, students' demographic characteristics, their educational background, types and modes of study, time budget, students' income, employment, types of housing, international mobility. The seventh round of the EUROSTUDENT project started in June 2018 and finished in 2021. The purpose of project was to provide data on the social dimension of European higher education for researchers, ministers, teachers, students, policy-makers, and others. Data were collected in 18 countries in 2019. The version presented during the Hannover Conference covered 20 countries and the final version is to be released in August 2021. Author was a (virtual) participant of the Hannover conference that took place on May 18–19, 2021. After discussion, Eurostudent VII participants presented some ideas for imaging and innovating the social dimension of higher education after the pandemic (in two words, figure 1).

Figure 1: Imaging and innovating the social dimension of higher education after the pandemic (in two words). Source: https://twitter.com/EUROSTUDENTtwt/status/1394684695594639365

Unger [14] in his conference report showed the relation between social dimension measurement and EUROSTUDENT VII data. EUROSTUDENT provides the following data:

- On many underrepresented groups (by sex, educational background, access (routes), migration background, disability);
- On disadvantaged students (students with kids, disability, non-native speakers, delayed transition, working, financial difficulties);
- On vulnerable students (direct: minors etc., and indirect: satisfaction, integration, difficulties in study).

This data set allows to combine various parameters of the student body; different routes to enter a university; drop-out intention; likelyhood to complete the studies by study intensity, drop-out intention, satisfaction, various difficulties. EUROSTUDENT data not provided: specific

national (minority) groups or issues; ethnicity, details on gender and sexual orientation; students from alternative care.

Social dimension is directly connected to student retention. Undergraduate retention is an institution of higher education's ability to "retain a student from admission until graduation" [34]. The earliest studies of undergraduate retention in the United States occurred in the 1930s and focused on what was referred to at the time as student mortality [35]. In 1975 Vincent Tinto presented student integration model. By Tinto [15], students who socially integrate into the campus community increase their commitment to the institution and are more likely to graduate.

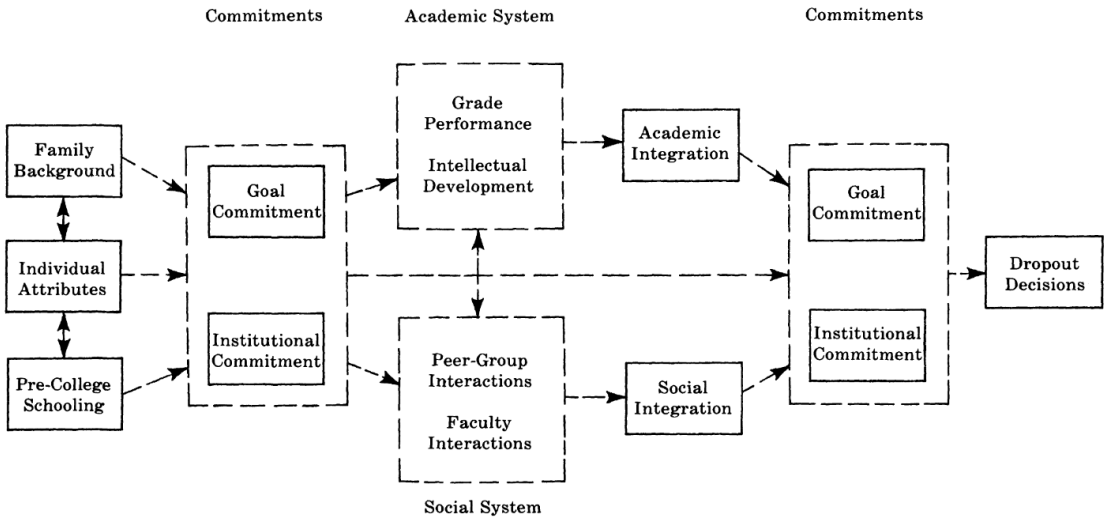

Figure 2: Tinto's model of dropout process [15, p. 95].

Tinto's student integration model has changed over the course of the 45 years from when it was originally introduced [15, 16, 17, 18, 19, 20]. In the recent versions motivational variables have included. The following motivational theories from educational psychology and social psychology have been applied to theoretical developments and practice of undergraduate retention: articular theory, attribution theory of motivation; expectancy theory, goal setting theory, self-efficacy beliefs, academic self-concept, motivational orientations and optimism [34].

Tight [23] remarks that "student retention is the older of the two concerns, at least in research terms, and was formerly also known by other, more negative, synonyms, such as student withdrawal, attrition and dropout. Student engagement, through which the student is involved in the higher education experience as deeply as possible, though a more recent concern, represents an obvious positive response to the problem of student retention. In other words, the more engaged a student is – with their higher education and the institution from which they are receiving it – the less likely they are to voluntarily leave higher education before they have completed their studies". The researcher provided bibliographic search using Scopus (2018) the numbers of times the exact words 'student retention' and 'student engagement' appeared in the titles of published English language (figure 3).

The conclusions of the research and the data collected during this study will enrich the

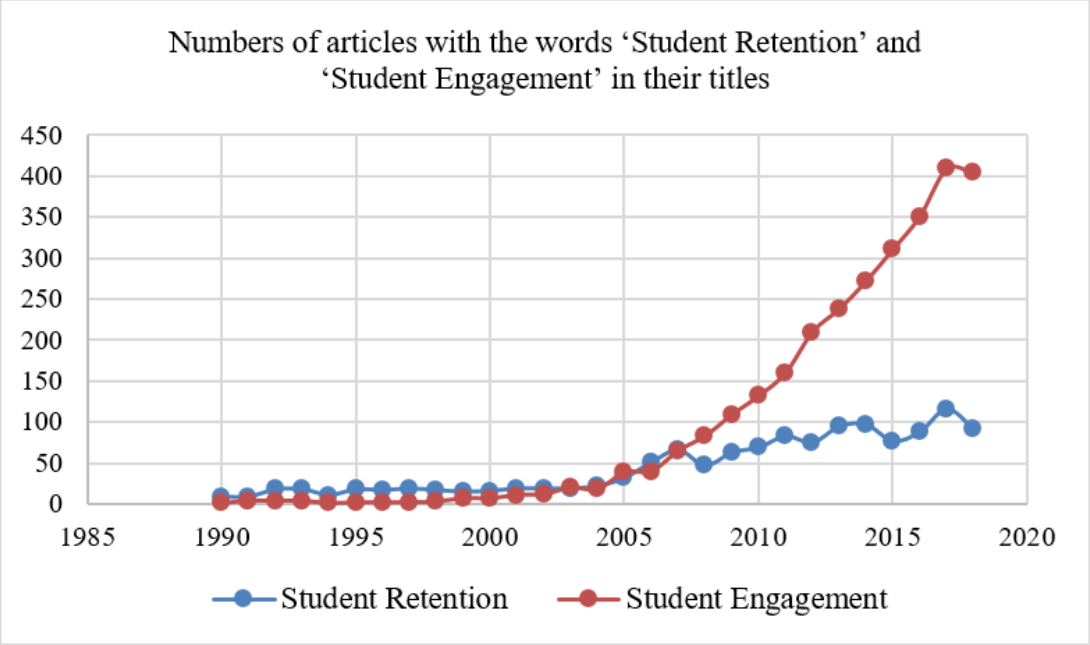

Figure 3: Numbers of articles with the words ‘Student Retention’ and ‘Student Engagement’ in their titles [23].

content of university courses. In particular, this applies to the NTUU ”IS KPI” course on Social Statistics (and Education Statistics, which is a component of the said course); to the courses on the Methods and Methodology of Sociological Research and Data Analysis, to the PhD courses on Multidimensional Research Methods; Master courses on Cross-National Research in Sociology, and Quantitative Methods of Social Processes Analysis.

An important problem in data analysis teaching is the development of student’s motivation. One example of the development of positive educational motivation, in our view, is the use of interesting data sets relevant to learner’s area. Social statistics course is a second-year course for sociology majors. This course is preceded by a mathematical methods course, so there is every reason to use these methods when analyzing social statistics data.

One of the most important sections of social statistics is education statistics. One of the main objectives of the statistical study of education is the social and economic life of students.

Social dimension is important topic of measurement in education statistics. Consider how we can use the EUROSTUDENT data in teaching the analysis of education statistics.

Therefore, first, we recommend that students visite the following page: http://database.eurostudent.eu/. There they will see the following parameters:

A. Demographics
B. Transition and access
C. Types and modes of study
D. Socio-economic background

E. Housing situation
F. Students' expenses
G. Students' resources
H. Employment and time budget
I. International student mobility
J. Assessment of studies

Table 1
Students' satisfaction with their current study programme: Organisation of studies (Slovakia) (based on Eurostudent VI data).

	Female (in %)	Male (in %)
Organization of studies: (very) satisfied	53.8	58.6
Cat.3 – unlabelled	24.2	24.6
not satisfied (at all)	22	16.8

In all figures and tables, the following abbreviations are used to refer to the participating countries: AL Albania; AT Austria; CH Switzerland; CZ Czech Republic; DE Germany; DK Denmark; EE Estonia; FI Finland; FR France; GE Georgia; HR Croatia; HU Hungary; IE Ireland; IS Iceland; IT Italy; LT Lithuania; LV Latvia; MT Malta; NL The Netherlands; NO Norway; PL Poland; PT Portugal; RO Romania; RS Serbia; SE Sweden; SI Slovenia; SK Slovakia; TR Turkey.

Students must select focus-group. These groups are:

- All students
- Age group
- Sex
- Educational background
- Type of higher education institution
- Type of study programme
- Field of study
- Study intensity
- Transition route
- Educational origin
- Dependency on income source
- Students in paid employment
- Financial difficulties
- Migration background
- Impairments
- Housing situation
- Access route

Table 2
Students' satisfaction with their current study programme: Study facilities (Slovakia) (based on Eurostudent VI data).

	Student without impairments (in %)	Student with impairments (in %)
Study facilities: (very) satisfied	63.3	50.2
Cat.3 – unlabelled	23.1	27.9
not satisfied (at all)	13.7	21.9

We can obtain actual tables by combining features "Assessment of studies", "Sex" and "Impairments" for a single country or several countries. We can observe and discuss gender differences and differences related to impairments (tables 1-2).

Using Eurostudent VI Appendix C3 Metadata, we can compare the percentage of student aged 30 and older in European countries (figure 4) and percent of students with impairments (figure 5).

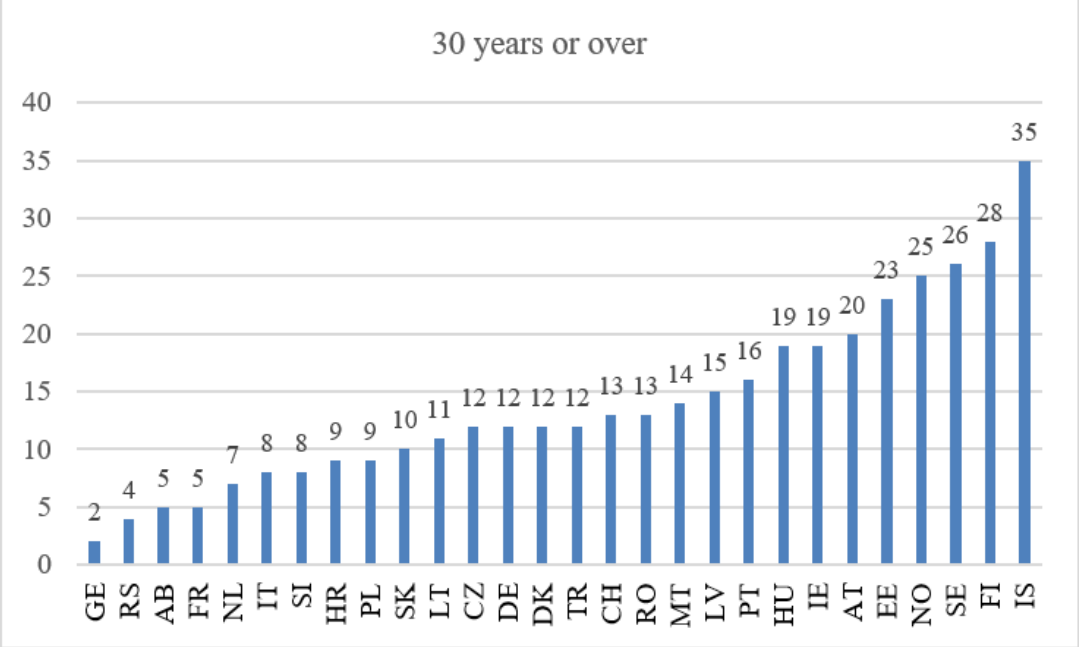

Figure 4: Percentage of students aged 30 and older (based on Eurostudent VI data).

It is interesting to compare these data with the data of the State Statistics Committee of Ukraine.

We can also apply correlation analysis, hypothesis testing, and discriminant analysis to these data by raising relevant research questions (i.e. educational and migration background and others).

In the table 3 we summarized the path to integrate the topic "Social dimention of higher

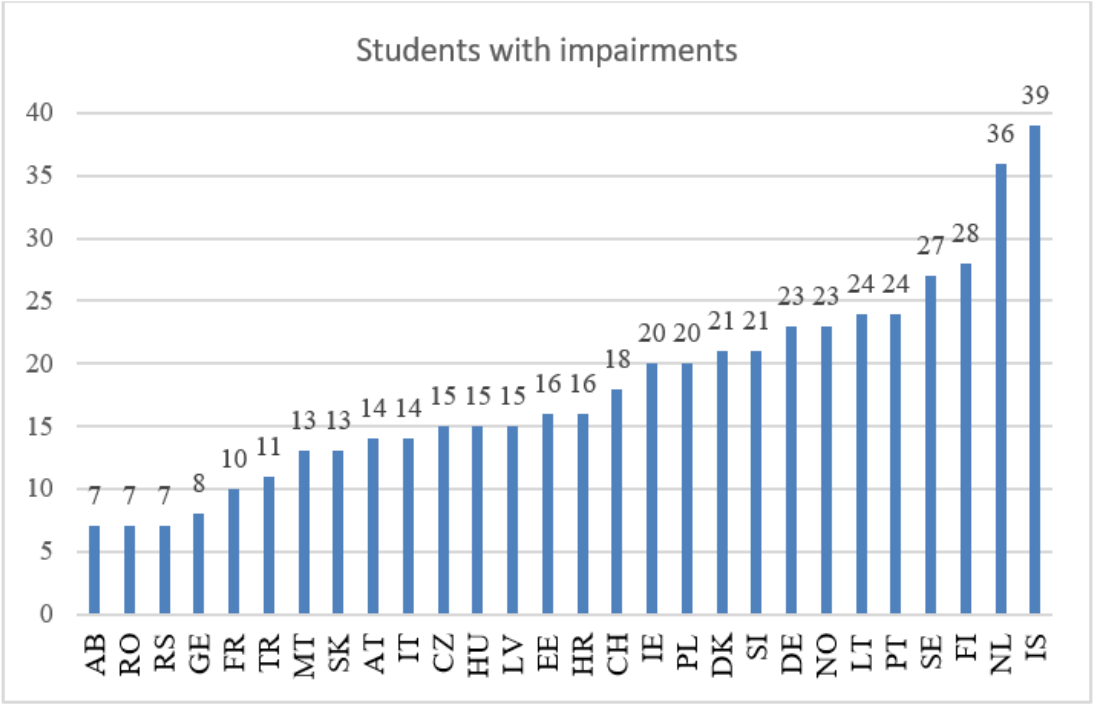

Figure 5: Percent of students with impairments (based on Eurostudent VI data).

education" into sociology students training (on example of National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute").

Here are two examples.

In the course "Structural equation modeling" students are asked to analyze the model built by researchers from Luxembourg with Eurostudent VII microdata (figure 6) [36]. Research questions of this model are as follows: "How do individual characteristics impact the dropout intention via student commitment and integration? Does institutional support mediate this effect/relationship?". Original conclusions obtained by researchers are: 1) gender as an individual characteristic showed no effect on any of the factors; 2) social integration regarding fellow students had no effect on study commitment, while social integration regarding University teachers showed the expected positive effect. As a case study, it is proposed to test this model in other countries and discuss the results.

The course "Social networks analysis" is selective and enrolled by students of various specialties. During the course, students learn to receive data from social networks and analyze them. One of the cases is the search queries about topics of the social dimension of higher education in Twitter, in particular with the hashtag #Eurostudent. The graph of the network with clusters is presented in figure 7. The data were obtained in the free version NodeXL for the period 25–29 November 2021. Students analyze this data using cloud tools: R environment, NodeXL, Gephi; they calculate and interpret key social networks metrics, at the user, group and network levels; visualize a graph of the network. For example, one of didactics task: to find and describe the

Table 3
Integration of topic "Social dimension of higher education" into sociology student training.

Discipline name	Level of education	Year taught	Content
Mathematical and statistical methods of sociological data analysis	Bachelor	1-2	Integration of the SD topic into practical classes and individual projects: descriptive statistics, correlation, regression. Use of Eurostudent YI, YII, Eurostat, Ukrstat databases
Methodology and methods of sociological research	Bachelor	1-2	Integration of the the SD topic into practical classes and group projects: survey, focus-group with underpresented studemts, data ethics, expert survey.
Social statistics and demography	Bachelor	2	Integration of the SD topic into practical classes and individual projects: education statistics unit. Use of Eurostudent YI, YII, Eurostat databases and others.
Social networks analysis	Bachelor	4	Twitter data analysis about topic social dimention in R Studio, NodeXL, Gephi. Twitter search with #Eurostudent
Multidimensional data analysis	Master	2	Integration the SD topic into practical classes and individual projects: Anova, discriminant analisys, factor analysis, cluster analysis models.
Actual problem of sociology research	PhD	2	Integration of the SD topic into theoretical and practical classes and individual projects: focus-group interview, data ethics, Eurostudent YII microdata, Ukrstat.
Structural equation modeling	PhD	2	Integration the SD into practical classes and individual projects: student retention and student engagement SEM models, Eurostudent YII microdata, Ukrstat.

social mediators of the network: the actors with both high betweenness and high in-degree centrality values (German Centre for Higher Education Research and Science Studies (DZHW); Praxis Centre for Policy Studies (Praxis), Estonia).

3. Conclusions and perspectives of further research

Strengthening the social dimension of higher education is a priority task in the EHEA [10, 12, 37]. The students from vulnerable, disadvantaged and underrepresented groups are not sufficiently and systematically researched in Ukraine [38]. This includes the groups of students directly involved in the armed conflict, i.e. young people from the uncontrolled regions of Crimea and Donbas; students from internally displaced families, children of the participants of the anti-terrorist operation, students with special educational needs, foreign students, and female students in STEM (Science, Technology, Engineering and Mathematics).

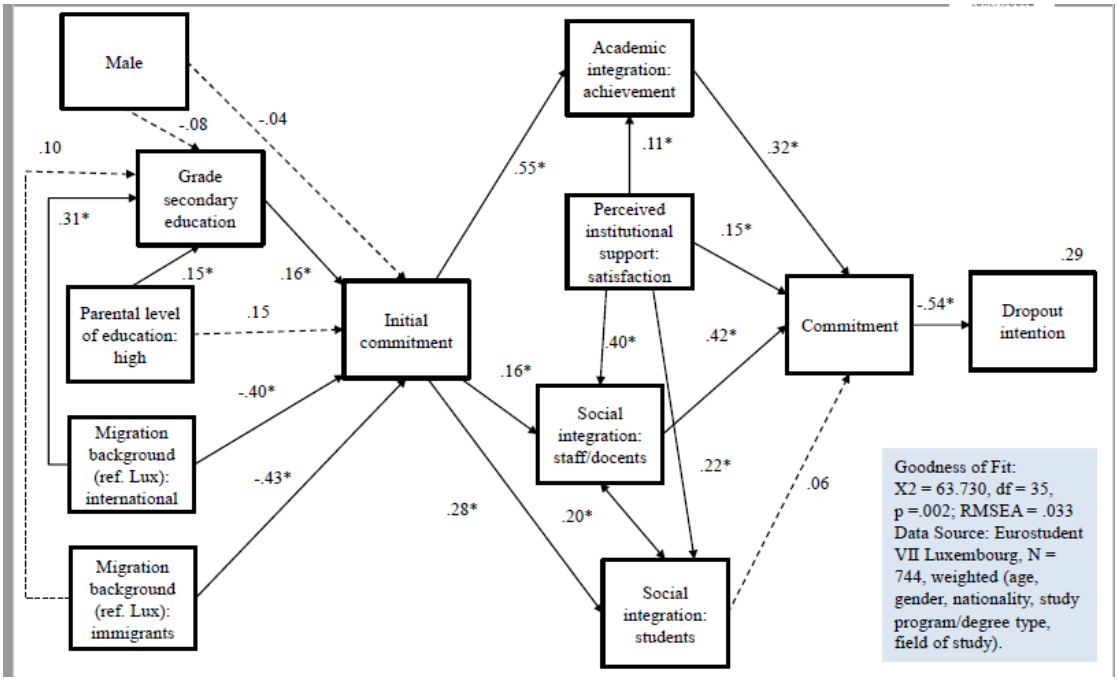

Figure 6: SEM model "Roles of individual characteristics and institutional support in students' higher education drop out intention in Luxembourg" [36].

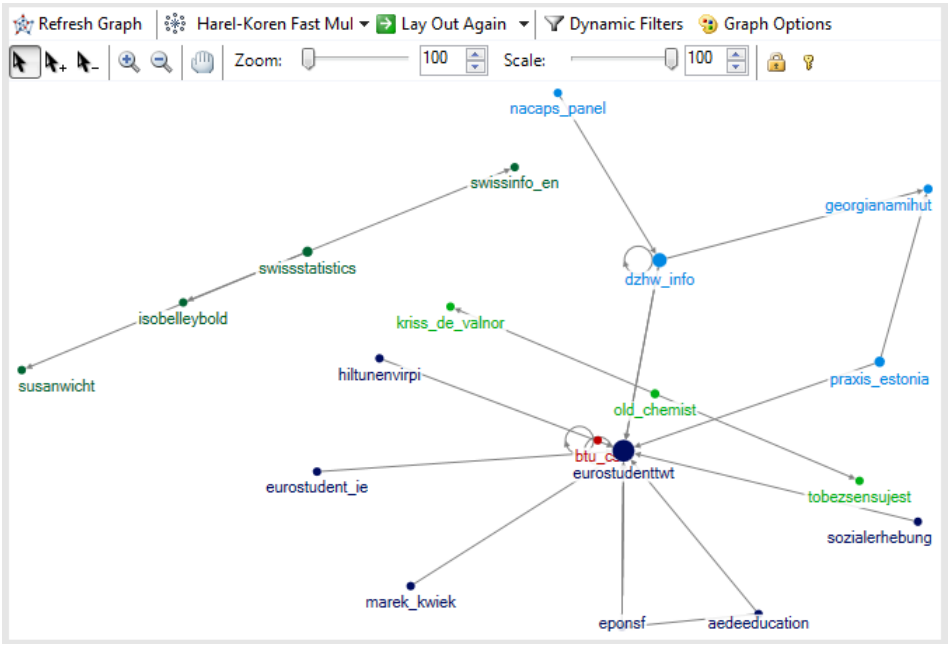

Figure 7: Twitter search with hashtag #Eurostudent. Network was obtained in the free version NodeXL for the period 25–29 November 2021 in the course "Social network analysis".

Modeling methodology helps to determine the effectiveness of educational innovations in different contexts of social dimension, and to study phenomena in their interrelations and latent factors.

This article presented the ways to update the content of the following university courses for sociology bachelors, master students, PhDs: “Mathematical and statistical methods of social information analysis”, “Social statistics and demography”, “Multivariate methods data analysis”, “Structural equation modeling”.

Further work in this direction includes the creation and study of structural equations model on student engagement and student integration with the help of Eurostudent data set.

References

[1] Prague Communiqué (Towards a European Higher Education Area): Communiqué of the Meeting of European Ministers of Education, 2001. URL: http://www.ehea.info/page-ministerial-conference-prague-2001.

[2] Rome Ministerial Communiqué (Conference of Ministers of Higher Education of the European Higher Education Area ”Embrace the challenge, create new opportunities and cancel differences” (Rome, Italy, 19.11.2020), 2020. URL: http://www.ehea.info/Upload/Rome_Ministerial_Communique.pdf.

[3] EUROSTUDENT VII final conference (Hanover, Germany, 18-19 may 2021), 2021. URL: https://eua.eu/partners-news/672-eurostudent-vii-final-conference,-18-%E2%80%93-19-may.html.

[4] S. Semerikov, I. Teplytskyi, Y. Yechkalo, O. Markova, V. Soloviev, A. Kiv, Computer simulation of neural networks using spreadsheets: Dr. Anderson, welcome back, CEUR Workshop Proceedings 2393 (2019) 833–848. URL: http://ceur-ws.org/Vol-2393/paper_348.pdf.

[5] L. Bilousova, O. Kolgatin, L. Kolgatina, Computer simulation as a method of learning research in computational mathematics, CEUR Workshop Proceedings 2393 (2019) 880–894.

[6] V. Soloviev, N. Moiseienko, O. Tarasova, Modeling of cognitive process using complexity theory methods, CEUR Workshop Proceedings 2393 (2019) 905–918.

[7] A. Burke, Student Retention Models in Higher Education: A Literature Review, College and University 94 (2019) 12–21. URL: https://www.aacrao.org/research-publications/quarterly-journals/college-university-journal/issue/c-u-vol.-94-no.-2-spring.

[8] K. Hauschildt, E. M. Vogtle, C. Gwosc, Social and Economic Conditions of Student Life in Europe: Eurostudent VI 2016-2018: Synopsis of Indicators, W. Bertelsmann Verlag, Bielefeld, 2018. URL: https://www.eurostudent.eu/download_files/documents/EUROSTUDENT_VI_Synopsis_of_Indicators.pdf. doi:10.3278/6001920cw.

[9] K. Hauschildt, C. Gwosć, H. Schirmer, F. Wartenbergh-Cras, Social and Economic Conditions of Student Life in Europe: EUROSTUDENT VII Synopsis of Indicators 2018–2021, wbv Media GmbH & Co. KG, Bielefeld, 2021. URL: https://www.eurostudent.eu/download_files/documents/EUROSTUDENT_VII_Synopsis_of_Indicators.pdf. doi:10.3278/6001920dw.

[10] K. Hauschildt, C. Gwosć, H. Schirmer, F. Cras, The social dimension of student life in the European higher education area in 2019. Selected indicators from Eurostudent

VII, 2019. URL: https://www.eurostudent.eu/download_files/documents/Eurostudent_brochure_WEB.pdf.

[11] S. Mishra, J. Diesner, Capturing signals of enthusiasm and support towards social issues from twitter, in: Proceedings of the 5th International Workshop on Social Media World Sensors, SIdEWayS'19, Association for Computing Machinery, New York, NY, USA, 2019, p. 19–24. doi:10.1145/3345645.3351104.

[12] J. Salmi, Social Dimension Within a Quality Oriented Higher Education System, in: A. Curaj, L. Deca, R. Pricopie (Eds.), European Higher Education Area: The Impact of Past and Future Policies, Springer, Cham, 2019, pp. 300–312. doi:10.1007/978-3-319-77407-7_10.

[13] J. Salmi, Violence, integrity and education, Global Crime 10 (2009) 396–415. doi:10.1080/17440570903248445.

[14] M. Unger, What can EUROSTUDENT data tell us about the social dimension?, in: Eurostudent VII Final Conference, 19.05.2021, 2021.

[15] V. Tinto, Dropout from higher education: A theoretical synthesis of recent research, Review of Educational Research 45 (1975) 89–125. doi:10.3102/00346543045001089.

[16] V. Tinto, Leaving college: Rethinking the causes and cures of student attrition, 2d ed., The University of Chicago Press, Chicago, 1994.

[17] V. Tinto, Taking Retention Seriously: Rethinking the First Year of College, NACADA Journal 19 (1999) 5–9. URL: https://meridian.allenpress.com/nacada-journal/article-pdf/19/2/5/2223517/0271-9517-19_2_5.pdf. doi:10.12930/0271-9517-19.2.5.

[18] V. Tinto, Linking learning and leaving: Exploring the role of the college classroom in student departure, Reworking the student departure puzzle, Vanderbilt University Press, Nashville, 2000, pp. 81–94. URL: https://silo.tips/download/linking-learning-and-leaving-exploring-the-role-of-the-college-classroom-in-stud#.

[19] V. Tinto, Student retention and graduation: Facing the truth, living with the consequences, Occasional Paper 1, The Pell Institute, Washington, 2004. URL: http://www.pellinstitute.org/publications-Student_Retention_and_Graduation_July_2004.shtml.

[20] V. Tinto, Research and practice of student retention: What next?, Journal of College Student Retention: Research, Theory & Practice 8 (2006) 1–19. doi:10.2190/4YNU-4TMB-22DJ-AN4W.

[21] W. G. Spady, Dropouts from higher education: An interdisciplinary review and synthesis, Interchange 1 (1970) 64–85. doi:10.1007/BF02214313.

[22] W. G. Spady, Dropouts from higher education: Toward an empirical model, Interchange 2 (1971) 38–62. doi:10.1007/BF02282469.

[23] M. Tight, Student retention and engagement in higher education, Journal of Further and Higher Education 44 (2020) 689–704. URL: https://eprints.lancs.ac.uk/id/eprint/131095/1/tight.pdf. doi:10.1080/0309877X.2019.1576860.

[24] M. B. Kerby, Toward a new predictive model of student retention in higher education: An application of classical sociological theory, Journal of College Student Retention: Research, Theory & Practice 17 (2015) 138–161. doi:10.1177/1521025115578229.

[25] K. Kricorian, M. Seu, D. Lopez, E. Ureta, O. Equils, Factors influencing participation of underrepresented students in STEM fields: matched mentors and mindsets, International Journal of STEM Education 7 (2020) 1–24. doi:10.1186/s40594-020-00219-2.

[26] S. Tishkovskaya, G. Lancaster, Teaching strategies to promote statistical literacy: review and implementation, in: ICOTS 8 proceedings: International Conference on Teaching Statistics 2010, Ljubljana, Slovenia, International Association for Statistical Education, Auckland, New Zealand, 2010. URL: http://icots.info/8/cd/pdfs/contributed/ICOTS8_C193_TISHKOVSKAY.pdf.

[27] L. F. Panchenko, Training sociology students in computer analysis of demographic processes and structure, Information Technologies and Learning Tools 65 (2018) 166–183. URL: https://journal.iitta.gov.ua/index.php/itlt/article/view/2034. doi:10.33407/itlt.v65i3.2034.

[28] L. Panchenko, H. Korzhov, T. Kolomiiets, M. Yenin, PhD student training: principles and implementation, Journal of Physics: Conference Series 1840 (2021). doi:10.1088/1742-6596/1840/1/012056.

[29] L. Panchenko, N. Samovilova, Secondary data analysis in educational research: opportunities for PhD students, SHS Web of Conferences 75 (2020) 04005. doi:10.1051/shsconf/20207504005.

[30] L. Panchenko, Methodology of using structural equation modeling in educational research, CEUR Workshop Proceedings 2393 (2019) 895–904.

[31] L. F. Panchenko, V. Y. Velychko, Structural equation modeling in educational research: a case-study for PhD training, in: S. Semerikov, V. Osadchyi, O. Kuzminska (Eds.), Proceedings of the Symposium on Advances in Educational Technology, AET 2020, University of Educational Management, SciTePress, Kyiv, 2022.

[32] London Communiqué (Towards a European Higher Education Area: Responding to the Challenges of Globalization): Communiqué of the Conference of European Ministers responsible for Higher Education; London, 16-19 May 2007, 2007. URL: http://www.ehea.info/Upload/document/ministerial_declarations/2007_London_Communique_English_588697.pdf.

[33] Annex II Rome Ministerial Communiqué, Principles and Guidelines to Strengthen the Social Dimension of Higher Education in the EHEA, Produced by the BFUG Advisory Group 1 for Social Dimension. Edited by Co-Chairs Schmidt Scukanec Ninoslav (Croatia) and Napier Robert (ESU), 24 June 2020, 2020. URL: http://www.ehea.info/Upload/BFUG_DE_UK_73_9_b_PaG_SD.pdf.

[34] C. Demetriou, A. Schmitz-Sciborski, Integration, motivation, strengths and optimism: Retention theories past, present and future, in: R. Hayes (Ed.), Proceedings of the 7th National Symposium on Student Retention, 2011, Charleston, The University of Oklahoma, Norman, OK, 2011, pp. 300–312. URL: http://web.archive.org/web/20130223222447/http://studentsuccess.unc.edu/files/2012/11/Demetriou-and-Schmitz-Sciborski.pdf.

[35] J. B. Berger, G. Blanco Ramírez, S. Lyon, Past to present: A historical look at retention, in: A. Seidman (Ed.), College Student Retention: Formula for Student Success, Rowman & Littlefield, Lanham, MD, 2012, pp. 7–34.

[36] A. Hadjar, C. Haas, I. Gewinner, The roles of individual characteristics and institutional support in students' higher education dropout intention in Luxembourg, 2021. URL: https://wwwde.uni.lu/content/download/136307/1556785/file/Spady_Tinto_4May2021.pdf, Presentation of report in Eurostudent VII conference, Hannover.

[37] Eurydice (European Education and Culture Executive Agency), Chapter 4: So-

cial dimension, in: The European Higher Education Area in 2020, Bologna Process Implementation Report, Publications Office of European Union, Luxembourg, 2020. URL: https://eacea.ec.europa.eu/national-policies/eurydice/sites/default/files/ehea_bologna_2020_chapter04.pdf. doi:doi/10.2797/851121.

[38] Strategy for the development of higher education in Ukraine for 2021-2030, 2020. URL: https://mon.gov.ua/storage/app/media/rizne/2020/09/25/rozvitku-vishchoi-osviti-v-ukraini-02-10-2020.pdf.