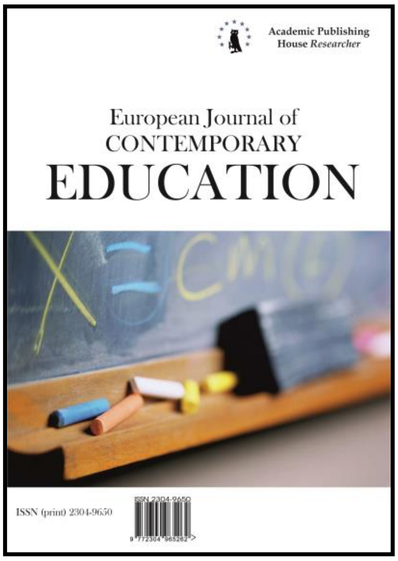
Published in the Slovak Republic
European Journal of Contemporary Education
ISSN 2304-9650
E-ISSN 2305-6746
2017, 6(4): 797-807
DOI: 10.13187/ejced.2017.4.797
www.ejournal1.com



Scenarios for Chemistry Teacher Training and Practice in Romania in 2030: Views of Chemistry Students

Roxana S. Timofte [a, *], Danuţ G. Cozma [b]

[a] Department of Science Education, Faculty of Psychology and Educational Sciences, Babes-Bolyai University, Romania
[b] Department of Inorganic Chemistry, Faculty of Chemistry, Al. I. Cuza University, Romania

Abstract

Four scenarios regarding Chemistry teacher training and practice in Romania in 2030 were developed by using the 2x2 matrix design for scenario writing. The two driving forces taken in account for the design of scenarios were migration and consumerism. In two of the proposed scenarios teachers are trained to teach socioscientific courses at class. One aim of this study was to collect Chemistry students' views on the developed scenarios for Chemistry teacher training and practice in Romania in 2030. From the N=111 students tested, 51.35 % of students selected the most auspicious scenario as the scenario for teacher training and practice in 2030, a scenario which did not include teaching socioscientific courses at class. This result was confirmed to be statistically significant by the Kruskal-Wallis test ($p<0.01$) and the Mann–Whitney *U* test ($p < 0.01$). This made us wonder if the students are aware of the consequences in time of migration and consumerism and if a more comprehensive study was necessary, to identify the predictors for their selection of scenarios.

Keywords: Chemistry education, Chemistry teacher training, ESD, STSE, Education, scenarios.

1. Introduction

Forecasting scenarios in education: the Romanian landscape

Organization for Economic Co-operation and Development (OECD) started the Futures project in 2000, to forecast future in education (OECD, 2000). The University Futures project was created with the aim to pinpoint the recent changes in the educational arena, to find the trends,

* Corresponding author
E-mail addresses: roxana.timofte@ubbcluj.ro (R.S. Timofte)

to offer space for strategic reflection on Higher Education (HE) system and not ultimately, to create scenarios for HE to 2030. For the development of future scenarios were taken in consideration six major themes, with the following associated questions to be answered (OECD, Centre for Educational Research and Innovation (CERI) - University Futures, n.d.):

Demographics – would HE system be restructured because of reduced population of students and associated lower budget?

Information and communication technology (ICT) – how ICT would influence HE? Would provide more access and reduced costs?

Globalisation – how is mobility of students, academics and programs affect HE policies? In this context, how would HE institutions deal with international competitions?

Market and quasi-market forces – how will market influence the HE system? The fact that HE are becoming more and more demand-driven would mean that the teaching and universities' mission would be changing?

University research – would the research be pursued in the future only at a restricted number of universities? To what extent would computing and internationalisation afect academic research? Would the link between teaching and research be still existing in the future?

Labour market demand – how woukd changes in economy and labor market influence the organisation of HE system?

Reserach in the field of HE scenario writing have flourished in the last years, Eur J Futures Res offering a topic series of Education in 2030, and other articles on futures education were published in Journal of Futures Studies or Futures. However, a review of articles in this field is not the aim of this paper. A limited number of scenarios regarding education in Romania were developed. Andreescu et al. (2012, 2013) have developed four university scenarios in Romania of 2025. The Delphi method was used and the academic community from Romania was involved in the development of scenarios. The five thematic areas for development of scenarios were: the development of human capital, knowledge genaretion, relationship with business and the community, social values, and international competitiveness. The four scenarios were not conceptualised as being alternative to one another, but as partly overlapping foresights of the future. The four scenarios were: the university of life and work (the university is provinding its students with skills necessary for life and emplyement), the knowledge constellation (the knowledge is accesible and ubiquitous, and universities are the places where knowledge is created and scrutinized), the athenaeum (the HE system is higly regarded by both society and government, and the students are prepared at universities to face the market requests), and the blue ocean (there are three archetypes of universities: internationally-renewed universities, entrepreneurial universities and vocational universities). Iucu et al. (2013) have developed scenarios for the training of mentors who would be mentoring beginning teachers. The authors have chosen three criteria for the development of scenarios: level of regulations, training providers and types of program. Two scenarios were proposed: a) a highly regulated, centralised scenario and b) a more flexible, low regulated system. The scenarios were developed by taking in account the local education, political and social issues. Maybe the next venture in developing scenarios for future education in Romania is to select punctual social issues around which to develop the scenarios.

The Romanian context: would migration and consumerism shape the future of education system?

Many strategies could be involved in scenario writing (Amer et al., 2013). The four quadrants matrix or the double uncertainty or 2x2 matrix approach uses two criteria or driving forces which would shape the future. These two criteria are considered to be the most important and the most uncertain factors. Scenarios are developed in each of four quadrants of a grid, the scenarios being written around the two driving forces. Considering the fact that it is well known that migration and consumerism are two important issues which affect the entire globe (OECD, 2008 and Taylor et al., 2015), these were considered the two societal driving forces for scenario writing in this study. According to the data issued by the National Institute of Statistics in Romania (Sustainable Development Indicators in Romania (SDIR), n.d.), the resident population of Romania decreased from 21.52 million of people in 2004 to 19.87 million people in 2015. The declin of population number in Romania has three factors: international migration, low number of births, and mortality (Migration, n.d., 2014). The consequence was aging of Romanian population habitating in

Romania: the average age of residents in Romania has increased from 37.8 years in 2002 to 40.9 years in 2013. A large percent of the emigrants are people with the age between 25-64 years. This percent increased over the time: this class of people (age 25-64) was 74 % in 2012 and 65 % in 2002. (Migration, n.d., 2014). Metadata from the National Institute of Statistics in Romania (Sustainable Development Indicators in Romania (SDIR), n.d.) have shown that resource productivity increased from 0.67 (thousands of RON in prices of year 2010/ton) in 1994 to 0.80 in 2013. On the other hand, the domestic material consumption per capita also increased from 13.68 (Domestic Material Consumption / capita) in 1994 to 22.4 in 2013. The rate of recyclation of waste at municipal level increased from 0.29 % in 2003 to 13.21 % in 2013 to 13.07 % in 2014. Electricity consumption of households have also increased from 2004 to 2014 by 1.48 times. Average meat consumption per inhabitant have increased from 2000 to 2015 by 1.43 times. The development of scenarios around migration and consumerism topics would inevitably connote that the effects of present migration and consumerism would be recognisable in scenarios for education in 2030.

Implemeting the issues of Education for Sustainable Development (ESD), Science, Technology, Society, and Environment (STSE) Education into Chemistry Education

The idea of inclusion of education for susatinable development (ESD) in chemistry education class and in Chemistry teacher training is not new (see for examle Burmeister et al., 2012). The most common model for sustainable development involves a focus on sustainable development in areas such as ecology, economics and society (Burmeister et al., 2012). Implemenatation of principles of sustainability in chemistry field emerged as the twelwe principles of green chemistry: prevention, atom economy, less hazardous chemical syntheses, designing safer chemicals, safer solvents and auxiliars, use safer solvents and reaction condition, increase energy efficiency, use renewable feedstocks, avoid chemical derivatives, use catalysts, not stoichiometric reagents, design chemicals and products to degrade after use, analyze in real time to prevent pollution, minimize the potential for accidents (Anastas et al., 1998). Clearly, teaching and learning plain chemistry will not increase students' knowledge and ablities in sustainability area. Burmeister et al. (2012) proposed four models of implemeting issues of sustainable development into chemistry education: a) implementing the twelve principles of green chemistry in laboratory work, b) including the strategies for sustainability in chemistry education curriculum, c) addressing sustainability issues in scoio-scientific themes integrated in chemistry education, and d) chemistry education as part of schools development programes for ESD. Furthermore, it is considered that an important outcome of ESD is fostering competences for a sustainable future. Jegstad et al. (2015) developed a list of nine ESD competences: systems thinking, problem-solving, creativity, critical thinking, action competence, future thinking and belief, normative competence, communication and collaboration.

Inclusion in science curricula of issues regarding the connections between science, technology, society, and the environment (STSE Education) is also not a new trend in Science Education (Pedretti et al., 2011). The STSE education current emerged at the confluence of STS (Science-Technology-Society) current (for a description of STS current see Aikenhead, 1994) and environemntal issues. Ample research in the field of STSE education was pursued by Canadian researchers across the years. Two of the authors commited to undertake research in this field described the field in their publications:

At a macro level, STSE education situates science in rich and complex tapestry—drawing from politics, history, ethics and philosophy. It presents an opportunity to learn, view, and analyze science in a broader context, while recognizing the diversity of needs of students and classrooms. (Pedretti et al., 2011, pp. 618)

Although STSE education has focused students' attention on some significant potential social and environmental problems associated with fields of science and technology, including, for example, those pertaining to cell phone uses […], climate change […] and genetics issues […], emphasis has tended to be restricted to making students aware of different stakeholders' positions and then encouraging them to develop reasoned arguments to defend their personal stances on issues. Much less emphasis has been placed on encouraging and enabling students to engage in sociopolitical action projects aimed at overcoming potential personal, social and/or environmental problems associated with fields of science and technology […]. (Bencze, 2013, pp. 120)

The teaching strategies used in class to cover the STSE education issues are not typical for a science class and they are, for example: debates, simulations, and role-play (Pedretti et al., 2006). Furthermore, dealing with issues related to STSE education at class involves utilisation of higher-order cognitive skills by students, for example decision making (Zoller et al., 2012). It appears that teachers covering issues related to STSE education at class encounter a few problems: identity issues, issues regarding curriculum and its politicisation through STSE topics (Pedretti et al., 2006). Murray (2014) conducted a Delphi study to identify the views of 130 experts regarding the future of science education in Canaday. At the end of this study it was revealed that amongst the trends affecting science eduation in future at global level are: Science, Technology, Engineering & Mathematics (STEM), Science and Education for Sustainability, Science Education for Economic Competitiveness, Re-conceptualizing the Purposes of Science Education. Among the themes for the foundations of science curriclum in Canada were selected Science Education for Global Citizenship, Science Education for Sustainability, Science, Technology Society and the Environment (STSE). The panel of experts selected ESD and STSE as prioritar foundations for Canadian science education with a consensus level of 92.86 %.

To the best of our knowledge, no such futuristic studies were undertaken up to date for Chemistry or Science education in Romania. Teacher training and practice plays a key role in educating the future generation of professionals and citzens. The present initial teacher training system in Romania requires attendance to a psycho-pedagogycal module during Bachelor and Master studies. This module comprises both theoretical courses and teaching practice in schools and is described in detail by Salajan et al. (2017). Apart from courses of Green Chemistry, at this moment topics ESD and STSE are not embeded in compulsory curricula at Chemistry degree level in Romania. If ESD and STSE Education topics or courses would be included in Chemistry curricula at secondary and tertiarty degree level, this would demand changes in teacher training and science education. Education plays a pivotal role in achiving the transformation of society and in training the decision-makers, change agents and layman. Therefore, universities must provide programmes for initial and continous training of teachers and professionals to practice in the field of sustainable development (Dannenberg et al., 2016).

2. Aims and Research Questions

The first aim of this study was to develop four scenarios of teacher training and practice in 2030 in Romania, by employing the 2x2 matrix strategy for scenario development (driving froces: migration and consumerism). The next aims were to identify which scenarios were most frequently selected by students for education in 2030, from the sets of higher education scenarios developed by Andreescu et al. (2012, 2013) and from the sets of scenarios for Chemistry teacher training and practice.

RQ1: Which of the four scenarios of Chemistry teacher training and practice in 2030 is the most frequently selected by students?

H0: The values of mean ranks of options for Scenario A, Scenario B, Scenario C and Scenario D are equal.

H1: The values of mean ranks of options for Scenario A, Scenario B, Scenario C and Scenario D are not equal.

RQ2: Which of the four scenarios of higher education scenarios is the most frequently selected by students?

3. Methods

A 2x2 matrix scenario writing strategy was used for development of scenarios for Chemistry teacher training in 2030, using migration and consumerism as driving forces.

A number of N=111 students participated in this study, 77 participants from Babes-Bolyai University (Cluj-Napoca, Romania) and 34 participants from Al. I. Cuza University (Iasi, Romania), 93 female (83.78 %) and 18 male (16.22 %). All the participants in this study were enrolled at psihopedagogical module, to train for becoming a Chemistry teacher. After a brief discussion regarding ESD and STSE and the strategies for scenario development, the students were given the scenarios. The university scenarios used were the scenarios developed by Andreescu et al. (2013).

4. Results and Discussion

The 2x2 matrix used for scenario development is depicted in Fig. 1.

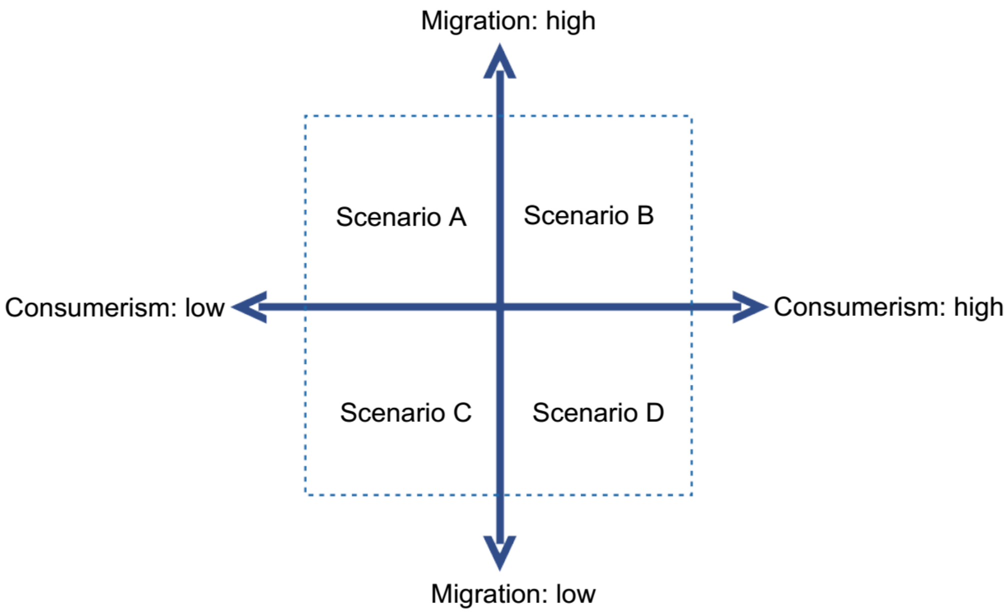


Fig. 1. 2x2 Scenario matrix, having migration and consumerism as driving forces

The characteristics of Scenario A (*Teacher / student ratio: 1 / 5*) are : low number of students, among students are students with parents working and living abroad, there are enough resources (energy, water, food, etc).

The characteristics of Scenario B (*No resources, no students*) are: low number of students, among students are students with parents working and living abroad, resources of all types are limited (water, energy, money, etc), people must use resources in a very careful manner, the society must be trained for sustainabile development, people must become aware of the consequences of their actions on environment, universities provide courses related to STSE Education.

The characteristics of Scenario C (*Prosperity*) are: normal number of students, the migration rate was reduced, there are enough resources (energy, water, food, etc).

The charcteristics of Scenario D (*Sustainability is a must*) are: normal number of students, migration rate was reduced, resources of all types are limited (water, energy, money, etc), people must use resources in a very careful manner, the society must be trained for sustainabile development, universities provide ESD courses.

The scenarios were developed and their content was adjusted after a focus group discussion with N=7 Chemistry master students. Full texts of scenarios are provided in Annex 1.

The most selected teacher training and practice scenario was scenario C (*Prosperity*), followed by B (*No resources, no students*), then scenario D (*Sustainability is a must*) and A (*Teacher / student ratio : 1 / 5*) (Table 1).

Table 1. Frequency of selected teacher training scenarios

Scenario	Count	Cumulative – Count	Percent	Cumulative – Percent
A	15	15	13.514	13.514
B	21	36	18.919	32.432
C	57	93	51.351	83.784
D	18	111	16.216	100

The scenario most frequently selected by students (51.35 % from N=111 students) was the most optimistic scenario, scenario C (*Prosperity*), in which both consumerism and migration levels were low. In Scenario C teachers did not prepare to teach socioscientifc issues at class. The Kruskal-Wallis test (N= 444) revealed that this result is statistically significant [H=14,096 at p =0,0028 (p<0.01)]. The values for sum of ranks and mean-ranks are depicted in Table 2.

Table 2. Sum of ranks and mean-ranks of options for Scenarios

Case	Condition	Valid - N	Sum of – Ranks	Mean – Rank
A	*Teacher/student ratio: 1/5*	111	23021,5	207,401
B	*No resources, no students*	111	22725,0	204,730
C	*Prosperity*	111	28889,5	260,266
D	*Sustainability is a must*	111	24154,0	217,604

The Mann–Whitney *U* test has shown that when the options for Scenario C are compared with the options for Scenario A, Scenario B or Scenario C, the null hypothesis is rejected (p < 0.01), the differences between the values of mean ranks are statsitically semnificative. However, when the comparisons are between the options for any two of the Scenario A, Scenario B, Scenario D, the null hypothesis is accepted (p>0,05), the differences between the values of mean ranks are not statsitically semnificative. The data regarding the Mann–Whitney *U* test are presented in Annex 2. The options for Scenario C (illustrated by the values of sum of ranks and mean rank) are dominant in raport with the options for Scenario A, scenario B or Scenario D. The proportion of options for Scenario C is statistically semnificative, the values for the non-parametric Kruskal-Wallis test (for global comparison) and Mann-Whitney U test (for comparison of options for Scenario C and any of other Scenario) being statistically semnificative (p<0.01).

The most selected university scenario was scenario B (*Knowledge Constellation*), followed shortly by scenario C (*Atheneum*) (Table 3). Both scenarios forecast a future in which university regains an important position in shaping the society.

Table 3. Frequency of selected university scenarios

Scenario	Count	Cumulative – Count	Percent	Cumulative – Percent
A	20	20	18.018	18.018
B	35	55	31.532	49.550
C	34	89	30.631	80.180
D	22	111	19.820	100.000

5. Conclusion

Scenario C (*Prosperity*) was selected by 51,35 % of tested students, this result being statistically significant (confirmed by the Kruskal-Wallis test and the Mann–Whitney *U* test, p < 0.01). This fact could make us speculate that the students did not internalise the perils of living in 21st century and that they are not aware of the consequences in time of migration and consumerism. However, a pertinent conclusion could be taken only after a more comprehensive study, to identify the predictors for students' selection of scenarios. Nevertheless, taking in consideration that the most optimistic scenarios were selected from both sets of scenarios (university scenarios and Chemistry teacher training and practice in 2030), it would be interesting to verify if optimism and personality traits could predict students' selection of scenarios (among other possible predictors).

References

Aikenhead, 1994 – *Aikenhead, G. S.* (1994). What is STS teaching? In J. Solomon & G. Aikenhead (Eds.), STS education: International perspectives on reform (pp. 47 – 59). New York: Teachers College Press.

Amer et al., 2013 – *Amer, M., Daim, T. U., Jetter, A.* (2013). A review of scenario planning. *Futures*, *46*, 23-40.

Anastas et al., 1998 – *Anastas P. T., Warner J. C.* (1998). Green Chemistry Theory and Practice. New York: Oxford University.

Andreescu, L. et al., 2012 – *Andreescu, L., Gheorghiu, R., Zulean, M., Curaj, A.* (2012). Systemic Foresight for Romanian Higher Education. In Curaj, A., Scott, P., Vlasceanu, L. and Wilson, L. (eds.) European higher education at the crossroads: Between the Bologna Process and national reforms. Dordrecht: Springer, pp. 995-1017.

Andreescu, L. et al., 2013 – *Andreescu, L., Gheorghiu, R., Zulean, M., Curaj, A.* (2013). Understanding normative foresight outcomes: Scenario development and the 'Veil of Ignorance' Effect. T*echnological Forecasting and Social* Change, *80*(4), 711–722.

Bencze, 2013 – *Bencze, J.L.* (2013). Science & Technology Education for Global Wellbeing. *Les dossiers des sciences de l'éducation*, *29*, 109-123.

Burmeister et al., 2012 – *Burmeister, M., Rauch, F., Eilks, I.* (2012). Education for Sustainable Development (ESD) and chemistry education. *Chem. Educ. Res. Pract.*, *13*, 59-68.

Dannenberg et al., 2016 – *Dannenberg, S., Grapentin, S.* (2016). Education for Sustainable Development-Learning for Transformation. The Example of Germany. *Journal of Futures Studies*, *20* (3), 7-20.

Iucu et al., 2013 – *Iucu, R., Stîngu, R.* (2013). Training induction metors: alternative policy scenarios of Romanian educational system, *Procedia - Social and Behavioral Sciences*, *76*, 931–934.

Jegstad et al., 2015 – *Jegstad, K. M., Sinnes, A. T.* (2015). Chemistry Teaching for the Future: A model for secondary chemistry education for sustainable development, *International Journal of Science Education*, *37* (4), 655-683.

Murray, 2014 – *Murray, J.* (2014). A new logic of consensus on the foundations of science education in Canada: results of a Delphi study of the expert community. *The Journal of Educational Thought*, *47* (3), 141-169.

Migration, n.d., 2014 – National Institute of Statistics, International migration from Romania, n.d., 2014, retrieved on 27 august 2017 from http://www.insse.ro/cms/files/publicatii/pliant%20statistice/Migratia_internationala_a_Romaniei_n.pdf

OECD, 2000 – Organisation for Economic Co-operation and Development (OECD) (2000), *OECD Annual Report 2000*, OECD Publishing, Paris. Retrieved on 27 August 2017 from http://dx.doi.org/10.1787/annrep-2000-en

OECD, Centre for Educational Research and Innovation (CERI) – University Futures, n.d. – Organisation for Economic Co-operation and Development (OECD), Centre for Educational Research and Innovation (CERI) - University Futures, n.d. Retrived on 27 August 2017 from http://www.oecd.org/edu/ceri/centreforeducationalresearchandinnovationceri-universityfutures.htm

OECD, 2008 – Organisation for Economic Co-operation and Development (OECD). (2008). Higher Education to 2030. Demography. 1. Paris, OECD.

Pedretti et al., 2006 – P*edretti, E., Bencze, L., Hewitt, J., Romkey, L., Jivraj, A.* (2006). Promoting issues based STSE perspectives in science teacher education: Problems of identity and ideology. *Science & Education*. *17*, 941–960.

Pedretti et al., 2011 – *Pedretti, E., Nazir, J.* (2011). Currents in STSE education: Mapping a complex field, 40 years on. *Sci. Ed.*, *95*, 601–626.

Salajan et al., 2017 – *Salajan, F. D., Duffield, S. K., Glava, A., Glava, A.* (2017). A comparative study of two pre-service teacher preparation programmes in the USA and Romania. *Compare: A Journal of Comparative and International Education*, 47, 483-498.

Sustainable Development Indicators in Romania (SDIR), n.d. - National Institute of Statistics in Romania, Sustainable Development Indicators in Romania (SDIR), n.d., retrieved on 27 august 2017 from http://www.insse.ro/cms/files/Web_IDD_BD_en/index.htm

Taylor et al., 2015 – *Taylor, D. M., Segal, D.* (2015). Healing Ourselves and Healing the World: Consumerism and the Culture of Addiction, *Journal of Futures Studies*, 19(3), 77-86.

Zoller et al., 2012 – *Zoller, U., Nahum, T.* (2012). F*rom teaching to KNOW to learning to THINK in science education*. In B.J. Fraser et al. (eds.), Second International Handbook of Science Education. Springer, p. 209-229.

6. Annexes

Annex 1

Teacher training and practice scenarios in Romania in 2030

Select a scenario for teacher training and practice in Romania in 2030.

Scenario A: *Teacher / student ratio: 1 / 5*

Teachers' practice in schools:

Many Romanian people have migrated to work abroad, some of them toghether with their children. The number of students is very small (*e.g.*, 5 students in a class) and some of them have parents working and living abroad. After repeated campains for rising people's awarness regarding the cautious consumption of water, energy, food, etc, these resources are sufficient. However, because of the small number of students, the teachers specialise to teach all Science subjects (Chemistry, Physics, Biology). Since the number of students in schools is very small, the finances received by schools from the Ministry of Education are less than usual. Consequently, all schools perceive taxes from students and elite schools receive additional financing from other financing sources (*e.g.* companies, NGOs, national and international grants), through partnerships.

Teacher training:

Teachers specialise to teach Chemistry, Physics, Biology, as well as Integrated Study of Science. Since a good collaboration with business medium and a good management of school finances are necessary, top professors and school directors most often have MBA (Master of Buisness Administration) studies.

Scenario B: *No resources, no students*

Teachers' practice in schools:

Many Romanians have migrated abroad and the number of students in a class is very small. Teachers specialise to teach all Science subjects, not only Chemistry, Physics or Biology. The resources are limited and no practical activities are undertaken in secondary schools and high schools. These are substituted with simulations and the utilisation of videos during class. It becomes teachers' responsibility to educate students, parents and the entire population to use the resources in a sustainable way. Curriculum includes a course in which are tackled topics reffering to the social dimensions of science and technology, as well as environmental issues (STSE Education; STSE: Science Technology Society Environment). Blood diamonds, climate change, genetically modified foods, drugs which produce tragic side effects, biodegradable plastics, nanotechnology and society (risks and opportunities) are a few examples of topics covered at this course. Activities at class include debates, simulations, and role-play. A student-centered teaching strategy is used. The focus is not to transmit information, but to form and transform students' thinking and attitude as well as their ethic and moral principles. During such course students' decision making skills and action competence could be fostered. The teacher has also the role of an activist. On request, teachers may have on-line classess with Romanian students who live abroad. Teachers keep workshops on STSE Education for students' parents and any other member of pupulation. Teachers give lectures during workshops for reduction of migration from Romania and for bringing back the Romanian labor force from abroad.

Teacher training:

Teacher training include training for teaching in Science field (Chemistry, Biology, Physics), ESD and STSE Education, as well as courses in sociology, politics, ethics, economy, which are relevant for the STSE Eucation module. Because teachers become change agents as well, their formation imply soft skills courses (negociation, public speaking, communication, etc). Hence, the traditional identity of Chemistry teacher is challenged, because is studying not only other science subjects, but social sciences subjects and soft skills as well.

Scenario C: *Prosperity*

Teachers' practice in schools:

The consumerism level decreased, there is no crisis and hence, people can use resources from local providers. The rate of migration was reduced drastically. There are 20-30 students in a class in state schools. Students are educated taking in consideration developments in technology and the requests of the job market. During every single chemsitry class practical activities are included. Students visit frequently Chemistry companies, universities and research institutes, museums. Through the Einstein exchange programs they visit for 1 month schools from Europe or US.

Teacher training:

Chemistry teachers teach only Chemsitry classes. At university the traditional courses do not take place anymore, but only blocks with practical activities, tutorials and on-line courses. The teaching activities are student-centered, not professor-centered. Student assessments include only evaluation of practical activities (laboratory work, projects, problem solving, etc). Some university modules are interdisciplinary are include also interdisciplinary laboratory work (e.g. biophysic laboratry, chemical biophysics laboratory, etc). The materials necessary for those modules are sent to the students before the module, to be read by students beforehand, in order to avoid cognitive overload during the modules. Even more, the focus is on real work. Hence, students must have:

-placements at Chemistry companies for 6 months, where they can experience different type of work at different departments within the companies;

-studentships for study and research at universities abroad, for a period of 6 months;

-teaching activities in Chemistry, from secondary school level till high school level;

-placements at other types of institutes: museums, town halls, editing houses, etc, for a period of 6 months;

Students must attend courses to form their transferable competenes (people skills, presentation skills, etc).

Scenario D: *Sustainability is a must*

Teachers' practice in schools:

The effects of consumerism were felt in all countries across the globe and there is a great lack of resourses (water, energy, food, etc). The number of jobs were reduced in all countries across the globe. Hence, migration from Romania has reduced drastically. The number of students is at least 30. The society must be trained to use the resources in a sustainable way. Chemistry teachers teach Chemistry classes, as well as courses of ESD. It is also the duty of teachers to train and inform the students' parents with regard to ESD.

Teacher training:

The training of Chemistry teachers include training to teach Chemistry and ESD. Because the resources are reduced, practical activities are replaced with simulations. If any practical activities occur, then the chemicals are recycled.

Annex 2

The Mann–Whitney *U* test regarding the options for Scenarios:

1) A and C

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of AC is the same across categories of GrAC.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

2) B and C

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of BC is the same across categories of GrBC.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

3) C and D

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of CD is the same across categories of GrCD.	Independent-Samples Mann-Whitney U Test	.008	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

4) A and B

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of AB is the same across categories of GrAB.	Independent-Samples Mann-Whitney U Test	.853	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

5) A and D

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of AD is the same across categories of GrAD.	Independent-Samples Mann-Whitney U Test	.534	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

6) B and D

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of BD is the same across categories of GrBD.	Independent-Samples Mann-Whitney U Test	.382	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.