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Bridging the Gap – Sustainable Development in Secondary and Tertiary Education

Introduction

There is probably no need to convince any of the readers of the fact that the successful implementation of any new concept must be preceded by a broad and intensive educational campaign. That is why the UN declared the years 2005–2014 as the decade of education for sustainable development (UN Decade of ESD, 2014). An important task of it was to sensitise all inhabitants of our globe to interrelated socio-economic-environmental issues (Kostecka, 2009). Pawłowski (2006) understood this task even more broadly ‘as sensitisation to the integration of actions at the moral, social, economic, ecological, as well as technological, legal and political levels.’ The issue of a holistic, multifaceted view of the model of sustainable development for those interested in the natural sciences and – in general – the relationship between *school* or *academic* knowledge and the reality outside the education system, has recently become particularly relevant, inter alia, in connection with the outbreak of the COVID-19 pandemic and the development of anti-vaccination movements, as well as a Russian invasion of Ukraine.

However, the issues of sustainable development are perceived in a very restricted ecological context, it is therefore important to clearly define the differences between environmental education and education for sustainable development. Ecology relates to the interdependence between living organisms and their environment; nature education, on the other hand, focuses on increasing the ecological awareness of people, contributing to the change of their behaviour to such that would allow to maintain ecological balance. Thus, education for sustainable development (ESD), which in its assumption refers to values, is not intended to replace environmental education, but to expand and enrich it, because it concerns much broader topics and is oriented towards solving specific problems. As the key for education for SD, in addition to ecology is the social and economic sphere, and its task is to promote development of critical thinking and to create responsible civic

attitudes of students. Considering the above, the question arises: is it necessary to implement SD issues in the field of biology curriculum in a way that would integrate the UN Sustainable Development Goals (<https://sdgs.un.org/goals>) with the subject practical teaching? The answer is unequivocally affirmative. In the light of the emerging new threats (pandemics, armed conflicts, progressive climate change), the emphasis – according to the authors of this article – should be placed on specific objectives such as 4 – Quality education, 12 – Responsible consumption and production, and 13 – Climate change.

Background and conceptual framework

Research conducted in Poland shows that the public has difficulties in comprehensively understanding the concept of sustainable development (SD). Gotowska, Hope and Jakubczak (2012) showed that their respondents (mostly 20–30 year-olds with higher education) associated SD mainly with the process of satisfying human needs while taking into account environmental protection. A similar view is held by other authors, showing that students equate sustainable development with eco-development, environmental and nature conservation (Zabłocki, 2002). Interestingly, in the first decade of the 21st century, such views were expressed not only by students of natural sciences (Żeber-Dzikowska, 2010), but we can also find them in the studies of the students of economics (Łuszczuk, 2011). More recent research, however, makes us aware that students may link sustainability to the subjects they study. For example, in surveys of young people in Poland, mostly students of Production Management and Engineering, Agricultural and Forestry Technology, or Transport and Logistics Engineering in Krakow, almost 60% of responses included at least one dimension commonly related to human and social development and its institutions (such as industry, technology, and business), while only less than 20% of individuals associate SD with its environmental aspect (Pena et al., 2020).

A number of authors have also explored the organisational arrangements and methods used in education for sustainable development, described university actions taken as part of ESD and made certain recommendations. Among other things, it has been pointed out that subjects addressing ESD should be interdisciplinary and taught by specialists from different fields, and the methods used should be exercise-based (Gotowska, Hoppe and Jakubczak, 2012). Lorek (2013) went further and proposed three possible ways of discussing the content related to SD in student education programmes:

- a) as part of specialised study programmes dealing with the topic,
- b) as compulsory courses/modules dedicated to SD,
- c) by integrating SD-related content into other compulsory core courses/modules.

The first method has been applied at the Faculty of Chemistry of the Jagiellonian University with the creation of the study programme Chemistry of Sustainable Development in the year 2019. Faculties that have sustainability in their name

function mainly at universities and economics faculties, e.g. Economics of Sustainable Development at Lazarski University or as a major in economics at Opole University, at geography faculties e.g. at University of Warsaw, often in a narrower dimension, e.g. Sustainable Development of Organisations at Kozminski University (https://www.otouczelnie.pl/studia/kierunki_studiow). The most popular solution at Polish universities nowadays seems to be to discuss various aspects of SD as part of compulsory or only optional courses/modules.

Another strand of the research concerned the level and sources of knowledge about SD. The largest group of participants in the study by Gotowska and co-authors (2012) indicated that they first heard the term *sustainable development* only at university and this was 36.7% of the responses, while the term was known to only 34.4% of respondents from education at all previous levels (primary school, lower secondary school, upper secondary school altogether).

The authors of this paper wanted to check to what extent the results of research conducted in previous years, and conducted mostly at small and relatively young Polish universities are confirmed nowadays and by the oldest and one of the largest university in Poland. Especially, because the core curriculum in upper secondary schools has been changed recently. And thus, whether the conclusions from them can be used in education for sustainable development at any type of university in the country. As lecturers of Science, they would also like to teach in the best possible way and broaden students understanding of the concept of the sustainable development. Therefore, based on the basic principles of PCK (Pedagogical Content Knowledge) they analysed their classes in terms of: prior knowledge of students, possible misconceptions (alternative conceptions), teaching and learning methods, etc. In particular, they would like to go deeper than the previously described research and have posed a number of questions:

1. With what kind of knowledge on the topic of SD should upper secondary school graduates currently enter university (at least in theory – based on school core curriculum)?
2. To what extent is the subject of SD covered in compulsory and optional courses at the chemistry and biology faculties of the Jagiellonian University?
3. How, and in particular – how broadly do students perceive the issue of SD? Do they see the relationship between the different orders of SD?
4. What measures are being taken at the biology faculties of the Jagiellonian University to develop a holistic view of SD in their graduates?
5. What is the impact of introducing the interactive elements of a conversational lecture on SD, and what can the lecturer learn from them?

In addition, the authors, emphasizing the practical significance of the results of their research, would like in this article to expand them with examples of interesting solutions at ESD at university level.

Methodology of the research

In an attempt to answer the questions posed above, a case study was conducted using Yin's (2014) linear analytical approach. Authors have chosen such method because, a case study aims to understand the complex reality and meaning of actions in a specific context. They were aware that it requires a diversity of data collection and this may be a strength of this study. It is one of the frequently used qualitative research methods in the social sciences, and in particular in educational research, and can also be based on quantitative data (Yazan, 2014). This method allows for the description, explanation and generalisation of a particular phenomenon of interest to the researchers. In a case study, the context is part of the research because its conditions – unlike experiments – are not predetermined and/or controlled (Ridder, 2017). Generally speaking, the data analysed can come from observation (direct and participatory one), oral accounts, interviews (individual and group ones), documents and reports; in addition, films, photographs, or social media posts can be analysed. Elements of the exploratory approach based on the analysis and comparison of the opinions of direct participants of the discussed activities were also taken into account in this paper (Yin, 2014, Strumińska-Kutra and Kołodkiewicz, 2012).

The research methodology adopted here can also be described as educational action research. 'Such methodology involves participants conducting inquiry into their own practices in order to improve teaching and learning, practices and programs. This means that the researcher is a participant in the activity being investigated, be it in schools, (universities) or community centers — wherever teaching and learning occur' (Hines et al., 2020). Describing the activities undertaken in the natural and exact science faculties of the Jagiellonian University: the JU Faculty of Chemistry and the JU Faculty of Biology, the authors drew, among other things, on their own experience as coordinators or lecturers of the subject *Fundamentals of Sustainable Development* described in this work, which is compulsory as part of the bachelor's degree programme (<https://syllabus.uj.edu.pl/pl/document/752471d2-79c0-467b-9476-a8b562ed6129.pdf>). In line with the research methodology, case selection was of purposive sampling nature (Merriam and Tisdell, 2015).

3.1. Sample and data collection

Document analysis was used to answer the first question. Authors reviewed the 2018 Core Curriculum for General Education for Secondary and Technical Schools (Podstawa programowa, 2018) and the curricula of the chemistry and biology courses taught at the Jagiellonian University in the year 2020/21, looking for the keyword *sustainable* and its various derivatives in the text.

The observations, documents and data concerned two classes of biology students taking the course *Fundamentals of Sustainable Development* at the Jagiellonian University in the summer semesters of 2020/2021 (88 students registered) and 2021/2022 (113 students registered). The course was introduced as an obligatory

course for second-year bachelor's degree biology students. Since education for SD is interdisciplinary in nature, this course has been listed within the classes in the area of humanities or social sciences (obligatory 5 ECTS in Polish higher education system). The courses in the first case were implemented as synchronous lectures using MS TEAMS, while in the second case as conversation lectures in a lecture theatre. In both cases, student activities were made possible by the university's remote learning platform PEGAZ (Moodle based), as well as by using external ICT tools such as the padlet board or the mentimeter or slido quiz applications.

3.2. Data analysis

Coding (sorting the data by concepts or issues) and clustering (categorising by common features) were used in the data analysis. Exceptional statements that differed significantly in their content from others were also selected for further analysis. The rationale for this was that the advantage of single-case analysis, as opposed to quantitative research based on statistical analysis, is the ability to focus on situations, phenomena, objects that are unique, one-of-a-kind (Budzanowska-Drzewiecka, 2022). In the case of selected data, the percentage share of each category in the total population was presented and analysed.

Results and their discussion

4.1. Analysis of educational documentation – secondary schools core curricula

The concept of SD appears in the general education core curriculum for secondary and technical schools (Podstawa programowa, 2018) only for biology, chemistry and geography school subjects. 'Teaching of biology in the extended scope allows the student to understand the importance of rational management of nature's resources, responding to environmental changes and protecting biodiversity as an indicator of sustainable development.' After such courses, the students should understand the need to take into account all three or even four dimension in development: the environmental, social, economic, political and institutional one, because, according to the core curriculum, it 'presents the essence of sustainable development' and 'explains the principles of sustainable development.' (Podstawa programowa, 2018). Chemistry only touches upon SD in a very narrow sphere of environmental protection – 'it proposes ways to protect the environment from pollution and degradation in accordance with the principles of sustainable development' (Podstawa programowa, 2018). The most is expected of the students in connection with geography lessons. Important here is the 'understanding of the need for rational management of the geographical environment in accordance with the principles of sustainable development, protection of elements of natural and cultural heritage, and the need to rehabilitate and revitalise degraded areas.' (Podstawa programowa, 2018). After the lessons of this subject, the students, among other things, analyse the impact of the dynamic development of tourism on the geographical environment and present

the possibilities for the application of the principles of sustainable development in tourism; they identify conflicts of interest in human-environmental relations and understand the need to resolve them in accordance with the principles of sustainable development, as well as give their own proposals for ways to resolve such conflicts; they present examples of ways to overcome the natural limitations of human economic activity, and assess their compatibility with the principles of SD.

It follows that current students of natural sciences should have encountered the concept of SD at least several times in their earlier school education. How much importance the teachers of the aforementioned subjects attached to understanding this model of development, to exchanging opinions about it with their students, to discussing and considering the problems, or whether they ended up merely quoting a few principles and facts, is a different issue.

A certain multi-facetedness of the concept of SD could also be seen in the school's entrepreneurship programme, in the introduction to which we can read 'In the process of education, students learn- while pursuing individual economic goals - how to be entrepreneurial and at the same time socially responsible in their endeavours and actions (...)' (Podstawa programowa, 2018). It is also extremely important to shape in students respect for the values that are the foundation of the market economy and socially responsible business, as well as ethical attitudes and readiness to observe them in professional and social life. The learning outcomes in terms of knowledge included, for example, 'understanding the principles of management, the role of marketing and social responsibility in the functioning of an enterprise,' and in terms of skills 'recognising ethical and unethical activities in economic life and manifestations of corporate social responsibility.' 'Therefore, university lecturers have the opportunity to refer to the knowledge of upper secondary schools graduates also in this school subject/discipline.

In contrast, in the core curriculum for the subject Knowledge of Society, in the chapter entitled 'International governance', the list of learning outcomes included '[the student] presents the objectives of the World Health Organisation, International Labour Organisation, Food and Agriculture Organisation, International Monetary Fund, International Bank for Reconstruction and Development, World Trade Organisation, United Nations Educational, Scientific and Cultural Organisation, United Nations Industrial Development Organisation, and International Atomic Energy Agency.' (Podstawa programowa, 2018). There is none among these organisations related to environmental protection, which proves a narrow understanding of 'International governance' at the secondary level of education and should be discussed with university students. SD does not appear in the History curriculum in Poland, where, in authors' of this paper opinion, there should be a place for mentioning the unique event of the Earth Summit in Rio de Janeiro in 1992. This again may limit students' understanding of SD to environmental and possibly economic issues and should be extended during university education.

After all, the task of education is to prepare students for life in the world yet to come, to set goals and to make informed decisions. Moreover, the experience of the last two years of worldwide health crisis and a war in Europe (Russian aggression against Ukraine) proves that only education perceived in that way will make it possible to develop informed, critically thinking and participative members of civil society.

4.2. Analysis of educational documentation – syllabuses of the university courses

In case of Jagiellonian University biology students curriculum, on the list of study programme learning outcomes there is not a single one that would directly relate to the issues of sustainable development. This applies to both Bachelor and Master level studies. There are, however, those that relate to the knowledge and skills acquired by students within the framework of broadly understood ecology and nature protection courses. For example, for the bachelor's degree it will be BIO_K1_W47 – *The graduate knows and understands the theoretical principles of the functioning of nature in terms of biodiversity protection*, or: BIO_K1_K18 – *The graduate is ready to consciously understand the practical importance of biological sciences for environmental protection*. However, for the master's degree, only one can be mentioned: BIO_K2_W01 – *The graduate knows and understands the complexity of processes and phenomena in nature, the solution of which requires an interdisciplinary approach*, which concerns broadly understood issues of ecology and biodiversity.

In turn, an in-depth analysis of the course syllabuses from the catalogue of bachelor's studies offered to students until the 2020/2021 academic year allowed to identify only one course: *Biological methods of wastewater treatment WBNZ-891*, which relates to the issues of SD. It is an obligatory course for 2nd year students following one of the available education paths: environmental biology. One of the effects relating to the knowledge acquired during the above-mentioned course, referring to SD, is: *W1 Student describes the mechanisms used in biological wastewater treatment plants from the perspective of the global circulation of elements and sustainable development*. This effect – according to the authors of the syllabus – refers to all three core educational effects: *BIO_K1_W32 The graduate knows and understands / has basic knowledge of general and population ecology and is able to explain ecological phenomena; BIO_K1_W33 The graduate knows and understands the basic life processes of living organisms; BIO_K1_W46 The graduate knows and understands the basics of general microbiology in the field of bacteriology, virology and mycology*, which proves that also academic teachers identify SD with eco-development and environmental and nature protection. In the syllabus of the optional course: *Earth's polar environments*, the learning outcomes include those relating to the negative impact of anthropopressure on the functioning of sensitive polar ecosystems or global threats resulting from climate change and related glacier recession processes. However, what is puzzling is the lack of reference to the subject of sustainable development and its main goals.

As for the syllabuses of the courses in the catalogue dedicated to biology Master level students, none of them refers directly to SD. This is even more puzzling because, similarly to the first level (including the obligatory for 2nd year students course Ecology and facultative courses; Ecological education, Ecotoxicology and environmental pollution impact assessment), there is also an educational path here: environmental biology, where student is expected to attend a number of “ecological” courses, for example: obligatory course for 1st year students – Global problems of ecology, or optional courses – Ecology of inland waters, Assessment of environmental impact of investments, Environmentally friendly agriculture, Socio-economic determinants of nature protection and many others.

The Faculty of Chemistry of the Jagiellonian University already runs the aforementioned *Chemistry of Sustainable Development* study programme and, in addition, the list of learning outcomes for the *Chemistry* study programme includes one outcome related to SD, namely ‘Graduates know and understand the relationship between the achievements of chemistry and related sciences and the possibilities for their use in socio-economic life, taking into account the principles of sustainable development.’ This is a rather narrow approach to the subject matter, referring in part to the concept of Responsible Research and Innovation. The specific outcomes for each course/module are presented in Table 1.

Table 1. Sustainable development in the syllabuses of courses in the JU Chemistry major, 2nd degree (MSc)

Course/module	Compulsory or optional	Place in syllabus	Entry content
Bioinorganic Chemistry	Compulsory for the Biological Chemistry panel	learning outcomes	The student is ready to justify and promote the necessity of pro-ecological awareness of society in order to maintain sustainable development of our civilisation.
Medicinal Chemistry	Compulsory for the Biological Chemistry panel	learning outcomes	The student is able to present and explain the relationship between the achievements of chemistry and biomedical sciences and the possibilities of their use in socio-economic life taking into account the principles of sustainable development.
Contemporary Challenges in Environmental Chemistry	Compulsory for the Chemistry and Environmental Monitoring panel	content	A very important element of the course is the distinction between processes naturally occurring in the environment and those caused by humans. This includes energy production, reduction of liquid and gaseous emissions and removal of water, soil and air pollution, sustainable development or waste collection and treatment.

Course/module	Compulsory or optional	Place in syllabus	Entry content
Photochemistry of Coordination Compounds	optional	learning outcomes	The student is ready to present the role of coordination compounds in solar energy conversion processes and outline their importance for sustainable development.
Introduction to Circular Economy for Chemists	optional	content	Extended producer responsibility, sustainable industrial production and sustainable consumption.
Good Chemistry Methodological, Ethical and Social Dimensions	optional	learning outcomes	The student describes the history, definition and normative basis of sustainable development.

4.3. Description of actions undertaken at the Faculty of Biology of the Jagiellonian University

The aim of the course *Fundamentals of Sustainable Development* is to familiarize students, among others with the origins of the concept and the goals of sustainable development – social, economic, and ecological, civilization threats and their causes (here: demographic growth, technological development, widespread urbanization, armaments and wars, socio-economic relations, life models) and the effects (climate change, deforestation, desertification, loss of biodiversity, pollution) on a local and global scale. After completing the course, the student should be able to discuss and evaluate the process of implementing the principles of sustainable development and present selected examples of their application in the economy; to characterize models other than the sustainable development option – that of consumption and maintenance society; to use arguments for sustainable development and explain difficulties in harmonization (here: economic effect, meeting social needs and environmental protection). To achieve above mentioned goals, the course is conducted in the form of a conversational lecture and discussions, as well as through activities on the PEGAZ (Moodle based) remote learning platform.

4.4. Analysis of students' written statements

Homework and assignments carried out during classes referred to students' prior knowledge, presented alternative conceptions, personal views and reflections. They allowed students to retrieve concepts they had already learnt, to reflect on what had been discussed at lower levels of education and in lectures, to relate what they had learnt to the surrounding reality, including to situations in the local environment in which the students lived or from which they originated – family home, place of residence before starting their studies.

4.4.1. The reviews of the film *Home* – a discussion forum

The task inaugurating this year's edition of the course (2021/22) was to watch the movie *Home*, directed by the French documentary photographer Yann Arthus-Bertrand from 2009. After watching it, students were asked to answer the following questions: i) whether and how our awareness of the state of the Earth, including human influence on the progressive climate change, has changed since the film's premiere; ii) whether the message of the film is still valid despite a number of actions taken.

The most interesting and/or typical quotes from students' statements are presented below, so that the readers can read them directly. It is not a very popular approach in the educational literature but, according to the authors, should not be overruled. This is the type of raw data that other researchers can use to pursue the principles of open access. An authors' analysis of these statements is provided below them.

Here are some examples of students' replies which were then commented on:

"I can say that HOME is one of the best movies I have watched in my life. It shows beautiful frames, landscapes from many corners of the world, and the story told by the lector is very addictive, moreover, a person can learn many new things. I believe that the message of the film is still valid. Although 13 years have already passed, the whole world, people, live in a constant hurry. More and more buildings and roads are being built and improved. Man tries to find the best possible life, regardless of the nature that surrounds him. Countries spend huge amounts of money on military and armaments". (Student 1, S1)

"This film, despite its date, is still up-to-date, perhaps not in every aspect discussed, but the scary thing is that some of the issues raised are still with us and we still pretend not to see them... We want everything faster and therefore use more resources and we produce more waste. This film quite brutally made me realize one thing that I usually wanted to push away from myself, namely the selfishness of people. Most people, unfortunately, do not care about the fate of our planet in 100 years, most people look at their comfort and whims, most of us do not really intend to care for the environment assuming that we will not do anything alone". (S2)

"Like others, I claim that this film is still up-to-date, and because a long time has passed since the first broadcast of this film, the problems it describes are even more painful. We are the cause of many things, from the extraction of minerals to the melting of the ice caps, most of our activities not only do not serve the planet, and therefore also us. If we do nothing, it will only get worse". (S3)

"I had wanted to watch this movie for a long time, but I did not have the right mood. I had a rough understanding of what I was going to see there, the amazing landscapes, the beauty of our planet and destructive human activity. I think everyone should see this movie; it is amazing but sad at the same time. I hope everyone who watched this movie will reflect on the fact that if we want to change the world,

we must first start with ourselves. I am very happy that there are countries that are still trying to preserve nature, but there are even more that are destroying it. And this has already led to irreversible consequences and catastrophes. It is scary to think what we will leave to our children, if we do not choose a different path, because now our rapid development leads to self-destruction. This is one of those cases where the film is worth to be seen by everyone – the work of Jan Arthus-Bertrand is priceless!" (S4)

Film "HOME, to be honest, I completely did not like it and would not recommend it to my friends. From the very beginning, it is full of substantive errors, such as the recognition of cyanobacteria (the Cyanobacteria group) as archaea or the determination that plants come from cyanobacteria (I suspect a strong copy from the endosymbiosis theory, which led to a highly controversial statement). The culmination was the statement that plants produce oxygen from the breakdown of water molecule, which made me unsure whether to laugh or cry. I have doubts about many other statements from this movie, which are more or less a simplification, such as the storage of energy by leaves or the comparison of trees to sculptures (where the latter definitely do not grow and are not subject to changes such as trees), however, here one could argue to what extent it was actually a distortion of the truth, and to what extent some creative invention or attempts to make the message more attractive for the viewer". (S5)

"Watching this movie, I felt like I was watching some masochistic lament, detached from our everyday reality. Not to mention the inaccuracies and hypocrisy of the companies that financed this film. Greenwashing ancestors? The problems depicted in the film are up to date, but the intricate dependencies have been neglected. Why is the concentration of people in cities bad? Why is technological progress presented as something that causes destruction? This movie may evoke some emotions, but that's about it. The viewer will turn off the movie and bring nothing new to his life. The film did not provide solutions. It briefly mentioned that states prefer to invest in the military rather than in nature conservation / human protection. Why can't we have this and that?" (S6)

"This movie is very pessimistic and does not provide solutions to the given problems. Consumerism and money rule the world and even if there were a thousand such films, I think nothing would change. Top people, directors of companies and large corporations, presidents, politicians, etc. – they must first change their thinking and try to mitigate the effects of people's actions (it is too late for prevention). In my opinion – there is no chance for that. Of course, I do not just blame them. Everyone is to some extent to blame for what is already happening. In conclusion – the film is for total laymen who will take everything personally and will not think critically. (S7)

"In my opinion, the movie Home had its pros and cons. It presented itself very well visually, showing how beautiful the Earth is. It is also worth praising the film for editing and music. I agree with others that its general message is still valid after several years. However, I believe that the film should be (and maybe even is) aimed

more at people who are not so related to biology, environmental protection etc. future generations have our actions on the environment, on Earth. That is why such people need to be educated, for example, about global warming. They believe that it is not a problem or even does not exist, because it is hot in summer and snowing in winter and such people do not know the difference between climate and weather. And people who know the subject even a little bit should get further and detailed awareness of the subject and taking more active actions.” (S8)

Almost 50% of the forum participants focused on the assessment of the substantive value of the film and its shortcomings in terms of the content provided (example S5). Bearing in mind the current Mission and Development Strategy of the Jagiellonian University until 2030 (Strategia, 2021), which begins with the paragraph: “The Jagiellonian University is proud of the past, shapes the future, is constantly developing as a research university, creating very good opportunities to study and conduct research and achieves excellent results in this field “- it is not surprising that the emphasis in students’ statements is on scientific issues and the evaluating tone dominates. However, there is no reflection or answer to the question whether the authors of the film *Home* really aimed at conveying advanced biological knowledge. In the light of the seriousness and threats presented in the film, and the fact that the film is aimed at a very wide audience, should we talk about these issues in detail or rather discuss the phenomena in a simplified way? In other words, as shown by the results collected in Table 2 and the answers posted on the forum of the course, biology students may have a problem in the future with disseminating their in-depth knowledge at the level available to the average John Smith, i.e., with achieving a targeted learning effect regarding the ability to communicate with non-specialists.

Table 2. Analysis of comments on the course forum in the task inaugurating the academic year 2021/2022.

Task inaugurating the academic year 2021/2022	Number of responses	% based on the whole number
Whether and how our consciousness has changed?	YES: 9	42
	NO: 10	45
	I have no opinion: 3	13
Is the video message still up to date?	YES: 20	91
	NO: 0	0
	I have no opinion: 2	9
Total number of responses	22	100%

22% of the responses posted on the forum pointed out that a consortium was involved in the creation of the film, which included the largest cosmetic and fashion companies and retail chains (e.g. S6), which on the one hand may raise doubts, and on the other hand, thanks to this the film was available in 181 countries around

the world – it was distributed on state TVs, YouTube, etc. 2009 – this is the time when the awareness and knowledge of many phenomena generally known today was low, and such wide availability meant that the film's message found its way to wide audience around the world. 9% of statements pointed out that the film should be aimed at politicians and directors of large corporations, i.e., decision-makers (e.g., S7).

In turn, 13% pointed to other, more up-to-date and better-made films relating to the issues of the modern world (including the disappearance of biodiversity and the looming climate catastrophe, here: Don't look up, The dark sides of fisheries), which the fact that the course participants go beyond the standard by being interested in the subject of SD outside the contact hours.

As many as 45% of statements pointed out that the movie ends with a positive message, but its overall message is pessimistic and biased (e.g., S7), which may be related to popular, so-called 'positive psychology' focusing on personal happiness „here and now", denying the need to worry about the future.

Authors of this paper (teachers conducting the classes) got the impression that students contribute to the classes at the university with elements of discussions taking place on internet forums: aggressive, black and white, not supported by evidence. This, according to these lecturers, requires efforts to develop students' discussion skills before graduation.

4.4.2. Student personal and social needs – a words cloud

In the first lecture, students have been asked 'What do you need to live? Enter max. 3 key words in the word cloud using Sli.do application'. The aim of the task was to build a basis for a discussion about the dimensions of sustainable development. In 2020/2021, 82 students present online participated in the vote; they entered 132 different words. The needs most relevant to them were: security (24 votes), health (21), work (20), money (18), stability (7).

The most votes among the 57 male and female students present at the 2021/2022 lecture who took part in the voting were cast to: health – 31, love – 30, money – 28, security – 25, happiness – 21. Unlike the previous year class, the term 'peace' appeared 7 times. In total, students entered only 56 different words, perhaps because the voting took place in the lecture room and they were able to consult with each other on the terms entered before entering them (although they were not encouraged to do so).

As can be seen based on the results presented above, three factors were most important to our students: health, safety and securing financial needs, which are part of the economic and social dimensions of the SD framework. Interestingly, only some individuals mentioned clean environment, air, water or nature. It is important to remember that the classes of both years attended the course during the COVID-19 pandemic.

4.4.3. Student pre-knowledge about SD – a board (padlet)

David Ausubel (1968) said that ‘the most important single factor influencing learning is what the learner already knows, ascertain this, and then teach him accordingly.’ Therefore, the first homework assignment was to revise the knowledge previously acquired by the students both in formal education in high school biology or geography classes and informally – from the media, including social media.

The freedom to choose the media reports quoted (Q.3) allowed for an analysis of the examples chosen by the students. The analysis of the statements presented on the table ‘What have I learnt about sustainable development from mass media and social media?’ showed that both classes, although differing in the form of education (remote/onsite), have similar views (Table 3). The students mostly focused exclusively (62% and 57%, respectively) on information related to the course they were studying or on environment and nature conservation as one of the two discussed dimensions of sustainable development (additional 18% and 13%, respectively). These results are completely divergent from the surveys among young people in Poland where 57.1% of respondents indicated at least one dimension of SD related to human and social development (including also its institutions such as industry, technology, and business) and only 17.5% individuals associate SD with its environmental dimension (Pena et al., 2020). Probably because the study group for this paper was much more homogeneous than for the cited work.

Table 3. Analysis of statements presented on the board ‘What have I learnt about sustainable development from mass media and social media?’

Number of SD dimensions to which a student’s statement referred to	2020/21		2021/22	
	Number of answers	% in relation to the total number	Number of answers	% in relation to the total number
one	34	68	46	66
Including the one concerning environmental protection or nature conservation	31	62	39	57
two	9	18	10	13
including the ones concerning environmental dimension	9	18	9	
three	7	14	13	19
Total number of responses	50	100	69	100

Among the responses, there were isolated instances where students repeated the general definition of SD and these we did not address in the content analysis. The main categories of statements that could be distinguished in the surveyed sample are presented below.

Similarly, as in the introductory task (film analysis), there were several statements that referred critically to the concept itself, its implementation in practice and its effectiveness. The examples are presented below:

'We know from the mass media only that we should strive for sustainable development, but currently this slogan in the media debate is like "ecology", an eristic trick that is not followed by any action except idle discussions.'

'Recycling was a lie – only 10% of the plastics we've used has been recycled.'

'Are electric cars really particularly environmentally friendly?'

'Of course, it is a great and environmentally friendly solution to install solar panels; however nowhere does it say what to do with them when they will have reached the end of their "life"'

'Sustainable development is virtually non-existent. The current economic system promotes economic growth over self-sufficiency, causing issues such as climate change and biodiversity decline to be pushed on to the sidelines until the last minute, when it is often too late.'

In each year class, several statements related directly to students' daily lives, e.g. 'no straw', 'fast fashion', ecological vegetarianism/veganism as a 'diet for the planet', 'cigarette butts – a source of non-biodegradable plastic'.

Given a free choice, students presented contemporary examples, curiosities, problems and concepts (rarely, if ever, found in school textbooks), e.g. *insects as the food of the future, vertical farming, underwater farms, closed-loop economy, COVID-19 accompanying waste reduction efforts, patho-development, corruption – an obstacle to national development*. It is topics such as these that can be a good engaging element in the next lectures, and an interesting interlude when dealing with more difficult content.

Students surprisingly often cited information on the pro-environmental actions of commercial companies: 8 companies in 2020/2021 and 2 companies in 2021/2022. These included: HP, Shell, ABB, IKEA, ESG Bank Pekao, Hochland, Audi, Foodcare, Adidas, Zelando, Coca Cola. In one place, they drew attention to the phenomenon of greenwashing i.e. 'behaviour or activities that make people believe that a company is doing more to protect the environment than it really is' (Cambridge Dictionary).

Conclusions and recommendations

The analysis of the Core Curriculum for General Education at Secondary and Technical Schools has shown that the concept of SD appears repeatedly in the curricula for school subjects, and consequently it is possible and appropriate to refer to this content in university education using so-called *retrieval-based learning* and activating

prior knowledge. The issue of the practical implementation of the provisions of the core curriculum in schools is worthy of in-depth research.

A holistic approach to sustainable development is lacking in the education system, both at level four ('matura'- upper secondary school final exam) and levels six and seven of the European Qualification Framework. On the basis of the research conducted, it can be concluded that biology students continue to perceive sustainable development predominantly through the prism of ecology and nature conservation, similar to what was described 10 years earlier by Żeber-Dzikowska (2010). Bearing in mind the conducted, in-depth analysis of both study programmes (first and second biology degrees) and modules learning outcomes (course catalogues at both degrees), this fact is not surprising, because in the curriculum currently in force for biology majors, the concept of education for SD does not appear, though it should. Such changes, however, take time and need to build consensus among the faculty academic staff. A step in the right direction was the appearance, starting from the 2020/2021 academic year, of a compulsory Fundamentals of Sustainable Development course for second-year biology students (first cycle degree studies). It is an example of efforts of the authorities at the Faculty of Biology to develop a broader student perspective on sustainable development. Moreover, the introduction of this course into the compulsory programme for biology majors may contribute to other academic teachers also introducing elements of education for sustainable development into their specialised courses, as was the case at the University of Economics in Katowice (Lorek, 2013).

The authors of this thesis share Gotowska's, Hoppe's and Jakubczak's (2010) belief concerning the need for small group exercise – type classes in ESD. However, if for some reason a lecture is the more readily accepted type of class in a given faculty/university (e.g. because of the number of teaching hours and thus costs), it should be a conversational lecture, taking into account high student activity, supported by distance learning tools. Student assignments not only facilitate the achievement and evaluation of the intended learning outcomes, but also provide the lecturer with an insight into his/her students' views on SD.

The introduction of interactive elements in the conversation lecture and the subsequent analysis of the students' statements also provides a basis for the use of cognitive dissonance, the motivating force of which is fundamental to the learning process (Elliot and Devine, 1994). The active teaching and learning methods and techniques described in this paper provoke and engage in discussion, motivate students to express their own opinions and to think more deeply. They make it possible to get to know the students' interests, to consider together with them the quality and reliability of the information found, and, most importantly, to catch and work through the so-called misconceptions/alternative conceptions.

By the way (as quite often happens with case study analysis) an unexpected internal contradiction was found. On the one hand, the three life factors the most important to the students were health, safety and securing financial needs, on the

other hand, when asked about the definition of SD, most of them focused solely on the environmental dimension. This incoherence requires future discussion and harmonization in the course of university education.

The biology students surveyed presented opinions of very different substantive value and degree of responsibility for words; the influence of mass media and social media can be seen in them, and many of them are very critical of the surrounding reality. The latter is done, on the one hand, without considering the wider context of the situation and, on the other hand, without reflecting on proposals for remedial actions. In view of the above, it seems particularly important during the educational process to develop the ability to assess the reliability of information found on the web and to distinguish between information and opinion, what is described in the 2nd degree Characteristics of the Polish Qualification Framework, Level 6 and 7 in the form of ‘the correct selection of sources and information from them, making an evaluation, critical analysis and synthesis of this information’ (Chłoń-Domińczak et al., 2018).

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Bridging the Gap – Sustainable Development in Secondary and Tertiary Education

Abstract

The aim of this paper was to examine the knowledge with which secondary school alumni come to higher education and with which graduates of natural science study programmes leave the university walls. In addition to the analysis of educational documents, the case study method was used to investigate the 'Fundamentals of Sustainable Development' course conducted at the Faculty of Biology of the Jagiellonian University in Krakow.

Research results indicate that the concept of Sustainable Development (SD) appears repeatedly in the Polish curricula for school subjects, and consequently it is possible and appropriate to refer to this content in university education using so-called *retrieval-based learning* and activating prior knowledge. However, an analysis shows that holistic approach to sustainable development is lacking in the Polish education system, both at level four (upper secondary school) and levels six and seven (BSc, MSc) of the European Qualification Framework. The concept of SD appears in the general education core curriculum for secondary

and technical schools such subjects as biology, chemistry and geography, which reduces the students' understanding of SD to the environmental and economic dimensions only.

The authors showed that even during a lecture devoted to SD, the active teaching and learning methods may be used at university level (e.g. film analysis, words cloud, e-posters, discussion forum, interactive website) to motivate students to search, to talk, to express their own opinions. The methods enable a teacher to get to know the students' views, to consider together with them the quality and reliability of the information found, and, most importantly, to catch and work through the so-called misconceptions/alternative conceptions. An unexpected internal contradiction was found. On the one hand, the three life factors the most important to the biology students were: health, safety and securing financial needs, on the other hand, when asked about the definition of SD, most of them focused solely on the environmental dimension.

Key words: critical thinking, higher education, student opinions, sustainable development

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