

<https://doi.org/10.52326/csd2023.01>

## IMPROVING THE QUALITY OF HIGHER EDUCATION IN THE REPUBLIC OF MOLDOVA BY DEVELOPING STEAM SKILLS

Aurelia Litvin<sup>1</sup>, PhD. hab., Rina Țurcan<sup>2</sup>, PhD., Iuliu Țurcan<sup>3</sup>, PhD.

<sup>1,2,3</sup> *Technical University of Moldova, 168 Stefan cel Mare and Sfânt Boulevard, Chisinau, Republic of Moldova*

**Abstract.** The discussions within the programs on higher education have highlighted the challenges facing the higher education systems in the Republic of Moldova, namely: an inconsistency between the competences that the Republic of Moldova needs and the competences available. The labor market of the Republic of Moldova often faces deficits in certain high-qualified professions, both in terms of qualifications and in terms of the quality of associated skills. At the same time, too many students graduate with basic skills and without having the range of transverse skills (problem solving, communication, etc.) that they need to cope with a changing world.

In the Republic of Moldova there is a request not covered by graduates in the fields of science, technology, engineering, (arts) and mathematics (STEAM) and in education. [1]

It is important that all students in higher education, regardless of discipline, have to acquire advanced transverse skills and key skills that will allow them to develop. High level digital skills, mathematical skills, critical thinking and problem-solving ability are increasingly important attributes.

The teachers, as a facilitator of learning, play an important role in the good performance of the educational act based on the STEAM concept. They are the ones who have to concentrate learning between the curricular content and the involvement of students in steam activities, they are the ones who have to model the process of forming knowledge in such a way that not only includes the interdisciplinarity elements, but to focus on the importance of the problem studied for the student and relevance to the topics addressed.

The research in question is dedicated to the analysis of the impact of implementing Steam skills on the quality of higher education.

**Keywords:** *Education, Higher education, Skills, STEAM, Learning process, Sustainable development.*

**JEL code:** *I21, I23, I25*

STEAM education focuses on the learning process as much as on results. STEAM education has incorporated **design thinking and the design process** to provide a solution based on the problem-solving approach. It provides opportunities for experiential learning and gives students the opportunity to think critically and educate themselves. Students are simply challenged to pick up a problem and solve it. Through **critical thinking** they have to ask themselves questions and find answers. They are encouraged to listen to the opinions of others and share knowledge. Mistakes are to be appreciated in this process, because they represent the fact that something has gone wrong and we will have to see "what?", but also find the right solution. From this we understand that this type of education encourages **perseverance**. [1]

Teachers who teach this type of education are guided by 6 steps.

**1. Focus.** In this step, the teacher selects an essential question or problem that the students convey to i. They focus that the question or problem is well focused, clear and with reference on both the STEM side and the arts.

**2. Detail.** It is the step of the process in which the answer is sought or solving the problem. Also in this phase there are correlations between several areas and implicitly a lot of information, skills or key processes that students already have to address.

**3. Discovery.** It is the stage at which the teacher can analyze the gaps that students have and in their own abilities and processes. It is the phase that relates to active research and intentional teaching.

**4. Application.** The most fun part is the application. Once students have all the information and analyzed the current solutions, they can begin to create their own solutions and processes to solve the problem. Here they use their own skills, processes and knowledge that were accumulated in the previous stages.

**5. Presentation.** This phase of the process emphasizes sharing with others. Everyone expresses their opinion, expresses feedback and receives one. It is the time when they learn to give and receive contributions.

**6. The link.** It refers to the loop that closes the activity. It is meant to give students the opportunity to reflect on their process and the feedback received. Based on this reflection students will be able to self-correct and improve their own skills and knowledge.

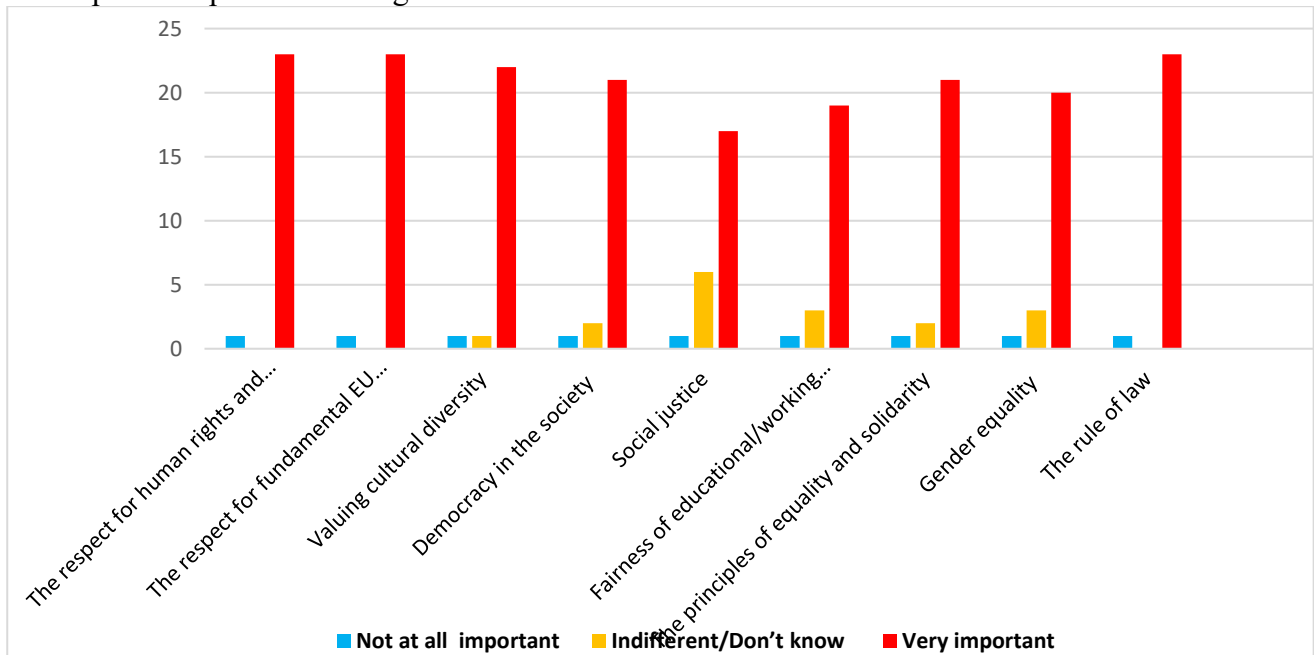
Among the multitude of benefits of STEAM education, we can also mention the **development of entrepreneurial skills in students.** [1]

The **basic purpose** of the given study is to analyze, through the questionnaire, the degree of knowledge and application of STEAM skills, in the educational process within TUM. For this purpose, students were interviewed.

The research was conducted on a sample of **24** students of the bachelor programme in Business & Administration from **Technical University of Moldova, Republic of Moldova.** The demographic analysis of the sample shows the following distribution: [2]

- **79,2 %** female and **20,8 %** male students;
- students of the bachelor programme in Business & Administration: **13,3%** are enrolled in the 1st study year, **62,5%** are enrolled in the 2nd study year, **24,2%** are enrolled in the 3rd study year.

To begin with, we wanted to find out the students' opinion about attitude, perception & knowledge of Sustainable Development. The analysis of student's values related to sustainable development is presented in figure 1.



**Figure 1. The distribution of student's values related to sustainable development**

Source: elaborated by the authors based on the questionnaire

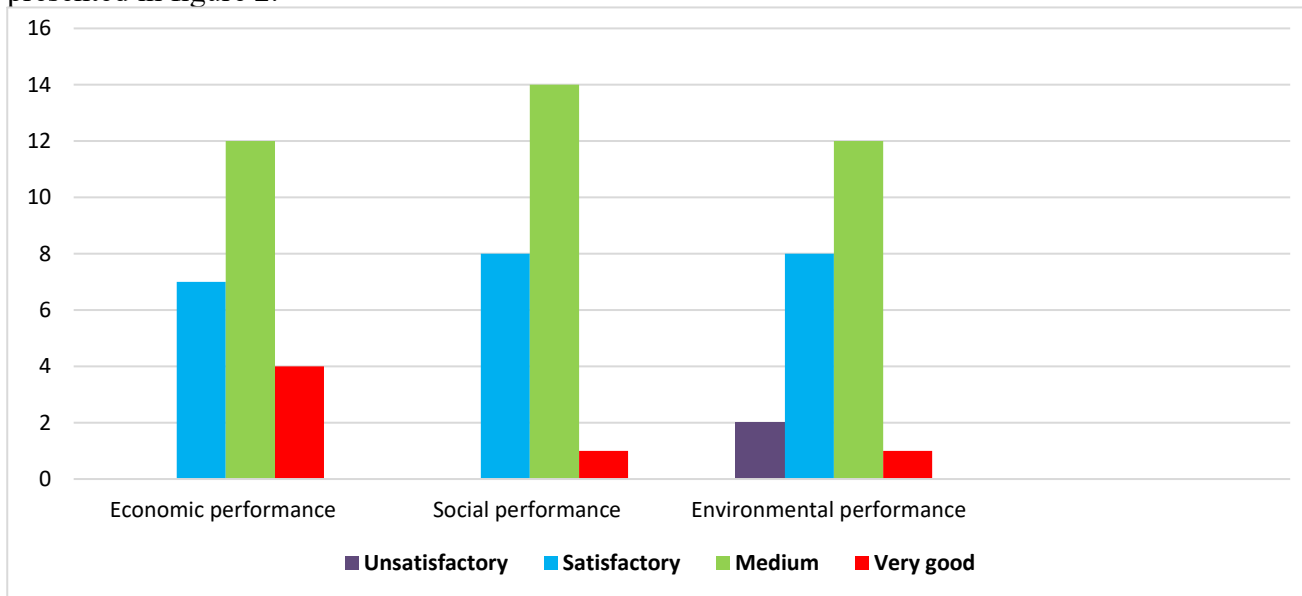
For most students, all the values related to sustainable development are very significant. In particular, for the absolute majority of respondents (23 students), the following aspects are very important: the respect for human rights and freedoms (i.e. dignity, equality, solidarity, justice,

citizen's rights, etc.), the respect for fundamental EU freedoms (i.e. free movement of goods, capital, services, and labor) and the rule of law.

At the same time, there was a small number of indifferent respondents to such values as social justice (6 students), fairness of educational/working systems (3 students), gender equality (3 students) and the principles of equality and solidarity (2 students). [2]

However, it is obvious that students are aware of the importance and necessity of developing the values of a modern inclusive society for their own sustainable development.

The analysis of students of knowledge on Economic, Social, Environmental performance is presented in figure 2.



**Figure 2. The level of understanding with regard to Sustainable Development concepts acquired during your study period**

Source: elaborated by the authors based on the questionnaire

The Business & Administration programme involves the formation of an integral system of knowledge, skills and abilities in interdisciplinary areas. The Sustainable Development concept requires a holistic and cross-sectorial approach of 3 performance areas: Economic performance, Environmental performance and Social performance.

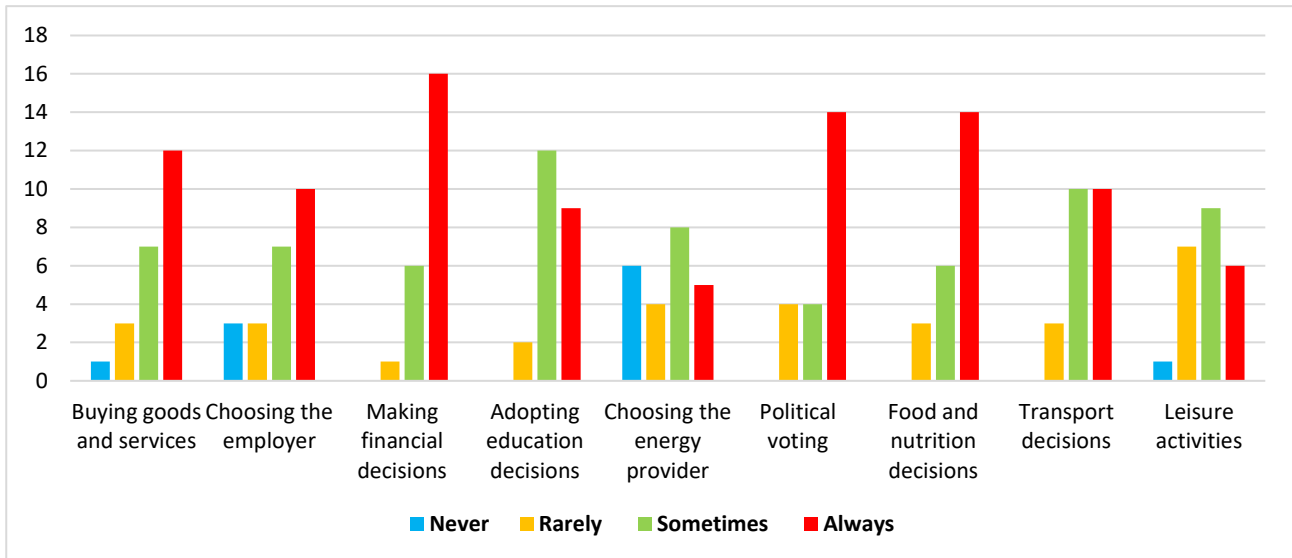
According to the results of the survey, students received fairly good knowledge of these three aspects during the period of study. 12 respondents noted a medium level of Economic knowledge with respect to Sustainable Development. The highest rating (very good) for this criterion was indicated by 4 respondents. At the same time, it should be noted that a rather large number of students (about 30% of the respondents) indicated a satisfactory level of knowledge in the economic aspect.

This confirms the need to pay special attention to the quality of studying economic issues which is especially important for students of the bachelor programme in Business & Administration.

With regard to Social performance, students indicated good understanding with respect to SD concept: 14 respondents confirmed the medium level of knowledge and 8 respondents – a satisfactory level. In modern conditions of creating a progressive society, this area of knowledge is very important and essential.

Slightly lower is the level of training of students in the Environmental performance aspect. 2 respondents indicated an unsatisfactory level of knowledge in this area and 8 respondents – a satisfactory level. Environmental issues are currently very relevant. As different environmental problems were identified, usually because the adverse effects – it became apparent that more attention was needed to address each new problem. Accordingly, it is extremely important to increase knowledge and understanding in this direction. The environment is an interrelated whole, and society's environmental protection efforts should be integrated as well.

The analysis of adopted measures for leaving more sustainable is presented in figure 3.



**Figure 3. The frequency of adopted sustainable measures**

Source: elaborated by the authors based on the questionnaire

The survey confirms that the majority of respondents always think about sustainability issues when making strategic decisions, such as:

- Financial decisions (16 students);
- Political voting (14 students);
- Food and nutrition decisions (14 students).

It seems unreasonable that 12 respondents only sometimes think about sustainability concerns when they adopt education decisions.

There is a lack of a strategic approach in such aspects as:

- Choosing the employer: 6 respondents never or rarely think about sustainability concerns. This is irrational, since choosing an employer should be a responsible and reasonable step;
- Choosing the energy provider: this is explained by the limited choice of consumers and natural monopolies of energy providers;
- Leisure activities: only 9 respondents sometimes and 6 respondents always analyze this aspect from the point of view of sustainable development. For young people, this aspect is a significant and important part of life, therefore, special attention should be paid to more responsible leisure planning.

In general, it should be noted the need for a more responsible and thoughtful attitude of students to the issues of making important decisions. To form and maintain sustainability, each decision should be analyzed from the perspective of its strategic result.

The next chapter of our questionnaire referred to the analysis of Learning needs & expectations for STEAM skills development. About the **subjects of Sustainable Development to be taught (Q12)** – the distribution of responses is presented in Table 1. [2]

**Table 1. Students’ expectations for subjects to be taught**

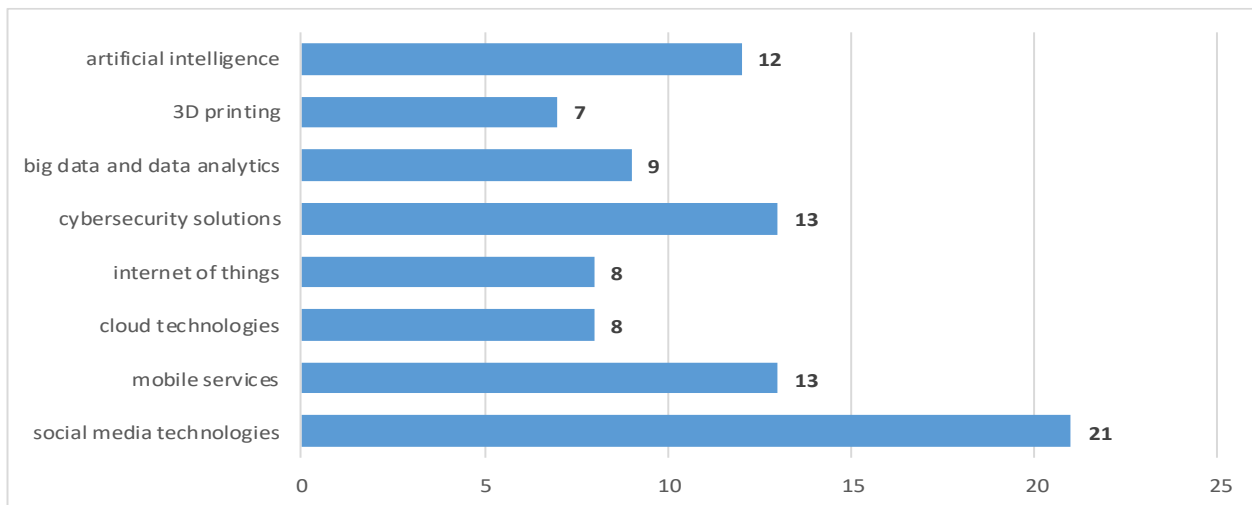
	Not useful	Useful	Very useful
<b>ECONOMIC subjects</b>			
Sustainable Procurement practices	9,1%	72,7%	18,2%
Competition, fair-trade regulations and practices	4,3%	47,8%	47,8%
<b>Green business, green finance and investments</b>	<b>4,3%</b>	<b>34,8%</b>	<b>60,9%</b>
Resources efficiency through sharing economy: co-working space, crowd-funding, freelancers, etc.;	4,5%	54,5%	40,9%
<b>Sustainable consumption and production: circular economy and EU action plan for circular economy;</b>	<b>4,3%</b>	<b>39,1%</b>	<b>56,5%</b>

<b>Innovation &amp; product responsibility</b>	<b>4,3%</b>	<b>39,1%</b>	<b>56,5%</b>
Corporate social responsibility	8,7%	56,5%	34,8%
<b>Social entrepreneurship</b>	<b>4,3%</b>	<b>43,5%</b>	<b>52,2%</b>
<b>ENVIRONMENTAL subjects</b>			
Environmental compliance	8,7%	56,5%	34,8%
Supplier environmental assessment	4,3%	60,9%	34,8%
<b>Circular economy – green productions and consumption, waste to resources – secondary raw materials and water reuse, etc.</b>	<b>4,3%</b>	<b>52,2%</b>	<b>43,5%</b>
<b>SOCIAL subjects</b>			
<b>Green jobs and local community engagement.</b>	<b>4,3%</b>	<b>34,8%</b>	<b>60,9%</b>
Sustainable employments	8,7%	52,2%	39,1%
Social and labour protection	4,3%	47,8%	47,8%
Occupational health and safety	4,5%	40,9%	54,5%
Diversity and equal opportunities, and human rights	4,5%	40,9%	54,5%
<b>Sustainable lifestyle and education</b>	<b>4,5%</b>	<b>31,8%</b>	<b>63,6%</b>

Source: elaborated by the authors based on the questionnaire

After analysing the data we can draw the following conclusions. All the topics mentioned in the survey exceed a cumulative frequency of over 90%. Respondents consider that absolutely all Economic, Environmental and Social subjects would be useful to understand the directions of Sustainable Development.

The opinion about the **Digital technologies to be used in case studies and exercises (Q13)** are presented in Figure 4.

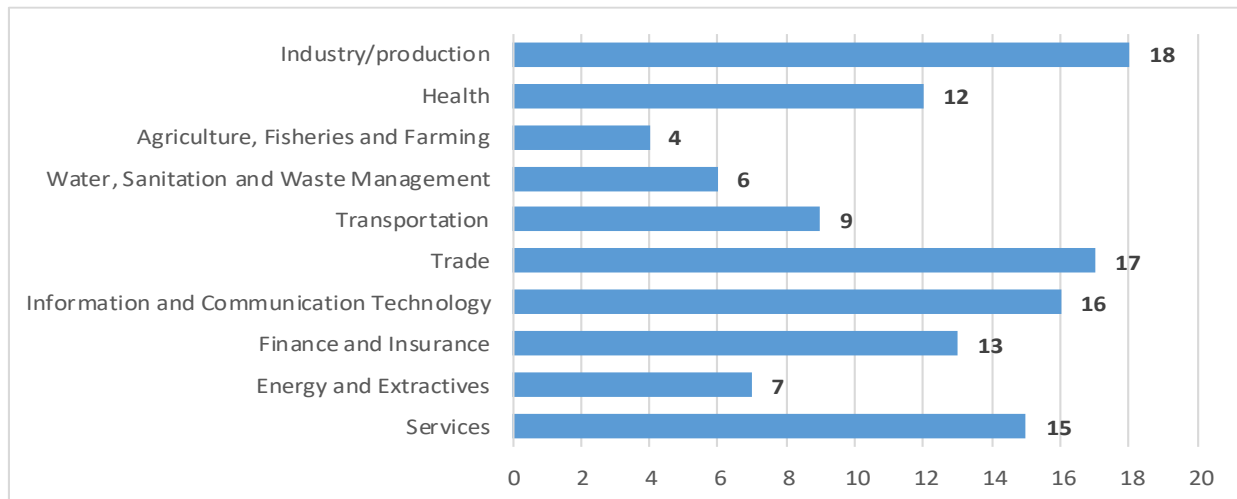


**Figure 4. Digital technologies to be used in applications**

Source: elaborated by the authors based on the questionnaire

According to the data obtained, it can be concluded that the largest number of respondents (21 students - 91.3%) believe that social media technologies should be used in applications. In second place are two positions, cybersecurity solutions and mobile services, which were chosen by 13 respondents each (56.5%). And in third place, 12 respondents (52.2%) believe that artificial intelligence can be used in apps.

About **Sustainability-related sectors to be used in case studies and exercises (Q14)** are presented in Figure 5.



**Figure 5. Sustainability-related sectors to be used in applications**

Source: elaborated by the authors based on the questionnaire

Based on the data obtained, we can draw the following conclusions. The majority of respondents consider that the following sectors related to sustainability should be used in case studies and exercises, namely: Industry/production - 18 respondents (78.3%), Trade - 17 respondents (73.9%), Information and communication technology - 16 respondents (69.6%), Services - 15 respondents (65.2%), Finance and insurance - 13 respondents (56.5%) and health - 12 respondents (52.2%). The other sectors were chosen to a lesser extent. Agriculture, fishing, forestry was chosen last by 4 respondents (17.4%).

Following the results obtained, we can highlight the following moments of students' learning expectations regarding STEAM knowledge.

The most learning expectations of students' is „To know about the need to decouple production from natural resources and wellbeing from consumption” – 87,0%.

Another learning expectations is „To know that sustainability problems must be tackled by combining different disciplines, knowledge cultures and divergent views to initiate systematic change” – 86,4%.

Among other learning expectations that exceeded the 80% threshold students highlighted:

- To know the main concepts and aspects of complex systems (synthesis, emergence, interconnectedness, feedback loops and cascade effects) and their implications for sustainability.
- To know the UN SDGs and to be aware of interconnections and possible tensions between individual goals.
- To know sustainability claims without roust evidence are often mere communication strategies (e.g. green washing).
- To know that tackling sustainability patterns requires challenging the status quo, at individual and collective level, by organizations and politics.
- To know that current or potential sustainability problems can quickly evolve and therefore need to be frequently redefined and reframed.
- To know about sustainability, including origins and further developments, main stakeholders, implications for society and the planet, environmental protection, restoration and regeneration.
- To know how political systems, including their components, should work for sustainability.
- To know that every action has an impact even if not immediate.
- To know that human shape ecosystems and that human activities can rapidly and irreversibly damage ecosystems.

- To know that there is no single solution to complex socio-economic problems, but rather different alternatives depending on time and context.

Following the results obtained, we can highlight the following moments of students' learning expectations regarding STEAM skills (more than 85%):

- To be able to evaluate issues and action based on sustainability values and principles
- To be able to bring personal choices and action in line with sustainability values ad principles
- To be able to look at various sources of evidence and assess their reliability to form opinions about sustainability
- To be able to consider local circumstances when dealing with sustainability issues and opportunities
- To be able to synthesize sustainability-related information and data from different disciplines
- To be able to create opportunities for joint action across communities, sectors, and regions
- To be able to assess and question personal needs to carefully manage resources in the pursuit of longer-terms goals and common interests

Between 80-85%, students' learning expectations regarding STEAM skills are: [2]

- To be able to asses own impact on nature and consider the protection of nature nan essential task for every individual
- To be able to use life cycle thinking to analyses the risks and benefits of human action
- To be able to apply personal reasoning to address criticism and arguments on sustainability matters
- To be able to apply a flexible, systemic, life cycle and adaptive approach when framing current and potential sustainability challenges
- To be able to continuously explore the problem of a sustainability issue to broaden the range of alternatives and solutions
- To be able to identify and adapt to different lifestyles and consumption patterns to use fewer natural resources
- To identify relevant social, political and economic stakeholders in the community and region to address a sustainability problem
- To apply the principle of using fewer resources, doing better with fewer resources, and reusing the same resources

The learning outcomes expected to be fulfilled are presented in Table 4 and Table 5 in decreasing order of importance.

**Table 4. Learning outcomes for STEAM knowledge – cumulative frequency**

STEAM knowledge considered useful and very useful by students	% of respondents
Exploratory thinking – K15, K16	84.5%
Promoting nature – K5, K6	84.4%
System thinking – K7, K8	82.6%
Critical thinking – K9, K10	82.6%
Problem framing – K11, K12	80,5%
Political agency– K17, K18	80.5%
Adaptability – K13, K14	80.1%
Supporting fairness – K3, K4	78,3%
Collective action– K19, K20	78.3%
Individual initiative– K21, K22	78.3%
Valuing sustainability – (K1+ K2)/2	76,8%

Source: elaborated by the authors based on the questionnaire

**Table. 5. Learning outcomes for STEAM skills – cumulative frequency**

STEAM skills considered useful and very useful by students	% of respondents
Valuing sustainability –S1, S2 idem	87.0%
Adaptability –S13, S14	84,8%
Critical thinking –S9, S10	84.8%
Exploratory thinking –S15, S16	82.7%
Collective action–S19, S20	82.7%
Problem framing –S11, S12	82.6%
Supporting fairness –S3, S4	82.4%
Political agency–S17, S18	80.5%
Promoting nature –S5, S6	80.5%
Individual initiative–S21, S22	80.0%
System thinking –S7, S8	78.3%

Source: elaborated by the authors based on the questionnaire

After analysing the data, we can draw the following conclusions.

All the topics mentioned in the survey exceed a cumulative frequency of over 90%. Respondents consider that absolutely all Economic, Environmental and Social subjects would be useful to understand the directions of Sustainable Development.

Digital technologies to be used in case studies and exercises (Q13) presented in Figure 2.19, show that the largest number of respondents (21 students - 91.3%) believe that social media technologies should be used in applications. In second place are two positions, cybersecurity solutions and mobile services, which were chosen by 13 respondents each (56.5%). And in third place, 12 respondents (52.2%) believe that artificial intelligence can be used in apps.

Sustainability-related sectors to be used in case studies and exercises (Q14) presented in Figure 2.20, show that the majority of respondents consider that the following sectors related to sustainability should be used in case studies and exercises, namely: Industry/production - 18 respondents (78.3%), Trade - 17 respondents (73.9%), Information and communication technology - 16 respondents (69.6%), Services - 15 respondents (65.2%), Finance and insurance - 13 respondents (56.5%) and health - 12 respondents (52.2%). The other sectors were chosen to a lesser extent. Agriculture, fishing, forestry was chosen last by 4 respondents (17.4%).[2]

**Acknowledgments.** The given research was developed within the project *"Developing and improving the STEAM skills of students and teachers for curriculum innovation and sustainable development of higher education institutions and local businesses/ skills4future"* reference number Project 101081787, financed by the European Commission through the ERASMUS+ program.

**References:**

1. [https://euc.ac.cy/wp-content/uploads/2022/11/MA-Ed.-Sciences\\_-Technologies-of-Learning-Communication-and-STEAM-Education\\_EN.pdf](https://euc.ac.cy/wp-content/uploads/2022/11/MA-Ed.-Sciences_-Technologies-of-Learning-Communication-and-STEAM-Education_EN.pdf)
2. <https://docs.google.com/forms/d/1hP8RSQSGCN5fInfwwHijtt8VzVxtY8ByIWD7YH6jps/edit>