

Bridging the skills gap: How the education system develops the 21st-century skills needed for employability in STEM fields

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Abstract

The research analyses the importance of 21st-century skills for STEM graduates and the level of their development in Latvian educational institutions, to identify possible mismatches between labour market expectations and the skills developed in the educational process. The empirical study included Latvian high school students (n=493) and students in STEM higher education programs (n=502). Respondents assessed 18 skill dimensions, determining (1) the importance of skills for STEM graduates in the labour market and (2) the extent to which skills are developed in the educational process. The survey shows ratings of 21st-century skills, including the involvement of various educational institutions in skills development. These findings indicate the necessity of purposefully integrating the development of 21st-century skills into the content of teaching and learning, and of strengthening the link between educational institutions (especially higher education) and industry and labour market requirements.

Keywords: 21st century skills; student; employability; development.

1. Introduction

The impact of 21st-century skills on employability and work performance has become particularly relevant in recent years (Orona et al., 2023; Poláková et al., 2023). These skills are increasingly emphasised as essential for individuals to be competitive in the labour market. (Habets et al., 2020; Das & Reddy, 2024). According to the World Economic Forum (World Economic Forum, 2025), forecasts indicate that by 2030, approximately 59% or more than one billion of the global workforce will need to retrain and acquire new knowledge and skills. This issue gained visibility during and after the COVID-19 pandemic as a significant gap persists between the 21st-century skills of higher education graduates and those required in the labour market (Orona et al., 2023; Crosta et al., 2023). This gap is reinforced by a mismatch between the content of higher education study programs and labour market needs, resulting in graduates

who are less competitive (Campbell & Kresyman, 2015; Daka et al., 2023). This mismatch manifests as lower job satisfaction, reduced productivity, difficulties finding work, and increased unemployment among recent graduates (Opoku et al., 2024). To solve this problem, it is necessary to understand the skills mismatch. To address this problem, it is necessary to understand skills development as a whole and the interaction between educational institutions and the labour market (Goueli, 2024; McGunagle & Zizka, 2020). Therefore, the aim of this paper is to assess the importance of 21st-century skills for STEM graduates and to analyse the level of development of these skills in Latvian educational institutions, with a view to identifying potential mismatches between labour market demands and the skills developed during the educational process. The article is structured as follows: Chapter 2 examines the role of 21st-century skills in the labour market; Chapter 3 presents the methodology and results of the empirical study; and Chapter 4 summarises the main conclusions.

2. 21st-century skills in the context of the labour market

The impact of 21st-century skills on employment and work performance has become particularly significant in recent years (Orona et al., 2023; Poláková et al., 2023). These skills are increasingly emphasised as essential for individuals to be competitive in the labour market (Habets et al., 2020). The interaction between skills and the labour market is significant in reports by international organisations that analyse macro-level forecasts for employment, structural changes, and skills demand. For example, the World Economic Forum (2025) forecasts that between 2025 and 2030, there will be a significant reduction in jobs and a need for employers to invest in developing their employees' necessary skills (McKinsey & Company, 2021) emphasises the link between 21st-century skills and employment, salary levels, and overall employee job satisfaction, while OECD data supplements this view with skill-mismatch indicators across countries (see Table 1).

Table 1. The importance of skills in employability

Relevance	Description	Sources
Changes in the labour market structure by 2030	Technological advances, demographic changes, the geopolitical situation, and economic pressures are the main drivers of change, which will cause a 22% shift in jobs, resulting in the loss of 92 million jobs but the creation of 170 million new jobs	World Economic Forum, 2025; McKinsey & Company, 2025
Future skills	Skills (with a particular focus on transverse skills) that all employees need to develop to be competitive, ensuring higher incomes and job satisfaction	McKinsey & Company, 2021
Need for skills change	Approximately 40% of job requirements are changing, and 63% of employers point to the mismatch between employee skills and job requirements as the main obstacle to business	Joshna, D, 2024; World Economic Forum, 2025,

	development. 85% of employers plan to retrain their employees, while 70% plan to hire new employees with the necessary skills, a trend facilitated by the introduction of artificial intelligence into everyday life and work.	McKinsey & Company, 2025
Skills mismatch among European residents	80 million European workers lack skills that match their jobs, underscoring the need to acquire new skills and qualifications. Skills mismatches are less common in Latvia than in other OECD countries overall; 26% of workers are employed in jobs that do not match their level of education (compared to 35% in OECD countries)	World Economic Forum, 2025; Getting Skills Right: Skills for Jobs Indicators, 2017; OECD, 2024

By recognising the importance of skills in employment and their impact on the labour market, it is possible to identify existing mismatches between the skills offered and those in demand, and to develop policies to reduce them. This approach not only helps to reduce the risks posed by technology and automation but also promotes employment growth and the development and transformation of the labour market. 21st-century skills are considered important for ensuring an individual's competitiveness in the labour market. At the same time, studies show that the integration of skills development and study programs has a positive impact. However, there is still a gap between employers' expectations and the actual abilities of graduates, i.e., there is a mismatch between the skills acquired in educational institutions and the needs of the labour market, which is often associated with outdated study programs or inappropriate teaching methods. At the same time, studies have shown that, in addition to providing academic knowledge, educational institutions should also include training programs that develop soft skills to reduce the gap between the qualifications acquired and the labour market's actual requirements. Digital tools, vocational training programs, and lifelong learning are becoming increasingly important parts of graduate preparation today, as digital technologies and automation influence the labour market. There is a gap between graduates' skills and employers' expectations, especially in soft skills, which are important in professional activities.

3. Survey on the development of 21st-century skills in educational institutions in Latvia

The European Skills Panorama (Līce et al., 2023) presents results from an employer survey on the assessment of 21st-century skills conducted with 300 across Europe. The research summarised employers' assessments of the skills required by STEM graduates in the labour market. The research identified skills (professional skills or skills specific to fields or professions were not included). In this article, data from an employer survey is used as a benchmark to determine which 21st-century skills are considered important for STEM graduates in the labour market. The 18 skill dimensions analysed in the study are as follows: self-

management, critical thinking, communication and teamwork, adaptability, creativity, well-being, emotional intelligence, leadership, sustainability competence, growth mindset and learning, responsibility and fairness, global thinking, information and data literacy, scientific, economic, and technological literacy, advanced data analysis and mathematical skills, computer programming, statistical programming, and other advanced technical skills. Employers' assessments of the importance of skills are summarised in Table 2.

Table 2. Employers' assessment of the importance of key employability skills of STEM graduates as needed in the 21st-century labour market (Līce et al., 2023)

Skills	Rating, %	Skills	Rating, %
Self-management, purposefulness, perseverance	99	Emotional intelligence and empathy	86
Critical thinking, problem-solving and systems thinking	99	Vision, leadership, mobilising and managing others	81
Communication, collaboration, teamwork	99	Global mindset, social and cultural awareness	79
Growth mindset and learning	97	Sustainability competence	78
Responsibility and fairness	96	Other advanced technical skills	77
Adaptability, resilience and stress resistance	95	Basic, scientific, economic, and technological literacies	74
Information and data literacy, information interpretation	94	Advanced data analysis and mathematical skills	74
Creativity, curiosity, open mindset, spotting opportunities	94	Computer programming	60
Wellbeing, positive attitudes, mindfulness	90	Statistical programming	60

Based on the list of 21st-century skills identified in the employer survey, a survey of high school students (who plan to study a STEM field) and STEM students was conducted in the 2024/2025 academic year to gauge their views on the importance of these skills for STEM graduates and on how educational institutions develop them in the teaching and learning process. Respondents were asked to rate 18 characteristics in two aspects: (1) the importance of the characteristic for STEM graduates and (2) the performance of educational institutions in developing the respective skill. The assessment was conducted on a Likert scale from 1 to 6, where 1 indicates "completely unimportant" and 6 indicates "extremely important". A 6-point scale was used with "7" corresponding to the option "I do not know" and excluded from the calculations; it was analysed separately. Descriptive statistics were used to characterise the data, including the mean, standard deviation, and median. This approach allows us to describe the central tendency of respondents' ratings and the dispersion of the data for each skill analysed. To determine the relationship between two ordinal indicators, Kendall's tau correlation coefficient was used. Its

values range from -1 to +1, where the sign of the coefficient indicates the direction of the relationship and the absolute value indicates its strength. The relationship was considered statistically significant if the p-value was less than 0.05.

3.1. Analysis of high school student survey data

In the 2024/2025 academic year, a survey of high school students was conducted, with 493 respondents. Respondents were divided into three age groups: 54.16% of respondents were aged 16-18, 36.51% were aged 19-20, and 9.13% were aged 21 and above. 60.45% of respondents were female, 37.55% were male, and 2% did not wish to indicate their gender. Data analysis shows that 55.58% of students reported not planning to study STEM, and this indicator is not associated with the region where the secondary education institution is located. Therefore, the analysis of the skills required of STEM graduates was conducted on a sub-sample of students (n=139) who indicated they wanted to study STEM subjects. It should be noted that the proportion of this sub-sample is reasonable when compared with external data after secondary education, as, according to Statistics on Higher Education (n.d.), 23.95% of all Latvian students studied STEM subjects in 2024. For an assessment of which characteristics are most important for STEM graduates, see Table 3. High school students rated critical thinking, problem-solving, and systematic thinking highest, and these characteristics also received the highest ratings in the assessment of the contribution of educational institutions (skills development).

Table 3. Skills required of STEM graduates, high school student assessment

N°.	Feature	Average high school student rating			
		Graduates must		The school developed	
1	Self-management, perseverance, purposefulness,	5.07 ± 0.88	5.0 0	4.12 ± 1.16	4.00
2	Critical thinking, problem-solving and systems thinking	5.42 ± 0.69	5.0 0	4.22 ± 1.23	4.00
3	Communication, collaboration, teamwork	4.73 ± 0.92	5.0 0	4.32 ± 1.17	4.00
4	Adaptability, resilience and stress resistance	5.06 ± 0.86	5.0 0	3.94 ± 1.44	4.00
5	Creativity, curiosity, open mindset, spotting opportunities	4.52 ± 1.05	5.0 0	4.01 ± 1.26	4.00
6	Wellbeing, positive attitudes, mindfulness	4.50 ± 1.02	5.0 0	3.65 ± 1.39	4.00
7	Emotional intelligence and empathy	3.99 ± 1.22	4.0 0	3.53 ± 1.35	4.00
8	Vision, leadership, mobilising and managing others	4.53 ± 1.07	5.0 0	3.68 ± 1.3	4.00

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9	Sustainability competence	4.77 ± 1.05	$\frac{5.0}{0}$	3.85 ± 1.33	4.00
10	Growth mindset and learning	5.09 ± 0.92	$\frac{5.0}{0}$	4.07 ± 1.24	4.00
11	Responsibility and fairness	4.79 ± 1.09	$\frac{5.0}{0}$	4.08 ± 1.26	4.00
12	Global mindset, social and cultural awareness	4.24 ± 1.2	$\frac{4.0}{0}$	3.91 ± 1.11	4.00
13	Information and data literacy, information interpretation	5.06 ± 0.79	$\frac{5.0}{0}$	4.14 ± 1.25	4.00
14	Basic, scientific, economic and technological literacies	4.78 ± 1.01	$\frac{5.0}{0}$	4.17 ± 1.27	4.00
15	Advanced data analysis and mathematical skills	4.94 ± 0.96	$\frac{5.0}{0}$	4.20 ± 1.38	4.00
16	Computer programming	4.37 ± 1.09	$\frac{4.0}{0}$	3.65 ± 1.37	4.00
17	Statistical programming	4.50 ± 0.99	$\frac{4.0}{0}$	3.68 ± 1.46	4.00
18	Other advanced technical skills	4.58 ± 1.04	$\frac{5.0}{0}$	4.04 ± 1.43	4.00

The values are presented as the mean $\pm$ standard deviation and the median. On average, 4.56% of high school students indicated that none of these characteristics was developed at their school. The highest rate of non-development at high school level was Well-being, positive attitude, and care, with 9.35% reporting that these skills were not taught in high school, despite 87.78% of students acknowledging that these skills were important for STEM graduates. The best skill developed in high school, or the most frequently mentioned skill is excellently developed in high school, is Advanced data analysis and mathematical skills, which was rated excellent by 16.55% of high school students.

This sample was included not to assess actual higher education experiences, but rather to identify perceptions regarding which skills are important for STEM graduates and to what extent such skills are already being developed at the high school level. But the age grouping was used to characterise the heterogeneity of respondents in the transition from high school to higher education.

3.2. Analysis of STEM student survey data

In the 2024/2025 academic year, a specific student survey was also conducted to gather opinions from STEM students on their experience with 21st-century skills development in their studies. Unlike the student survey, this survey also included questions about how the university,

workplace, or internship sites contribute to skill development. A total of 648 students responded, but 44 (6.79%) started the survey but stopped after the first few questions. Another 102 students (15.74%) only completed the demographic questions and did not complete the skills assessment; as a result, $n=502$ students completed the questionnaire in full. The breakdown of respondents by gender was 66% male, in line with general trends in STEM fields. Where there is traditionally a higher proportion of male students; 32% were female; and 2% did not wish to indicate their gender. Each student assessed the importance of the characteristics for a STEM graduate and assessed the university, workplace and/or internship based on these characteristics, indicating how well young professionals are prepared. Only $n=50$ (9.96%) students who had completed an internship in their field responded to the internship question, while $n=185$ (36.85%) students with work experience in the STEM field responded to the workplace assessment question.

When assessing which characteristics are most important for STEM graduates (see Table 4). Students rated critical thinking, problem-solving, and systematic thinking highest, which were also rated highest among high school students. According to students, the most developed skills at university are advanced data analysis and mathematical skills, i.e., hard skills. However, emotional intelligence and empathy received the lowest ratings for skill development. With graduates ranking them second lowest in terms of necessity.

Table 4. Skills acquired by students in higher education institutions, assessment of STEM students

N°.	Feature	Average school student rating			
		Graduates must		Higher education institutions developed	
1	Self-management, purposefulness, perseverance	4.74	5	3.81	4
2	Critical thinking, problem-solving and systems thinking	5.22	5	3.92	4
3	Communication, collaboration, teamwork	4.68	5	3.90	4
4	Adaptability, resilience and stress resistance	4.87	5	3.56	4
5	Creativity, curiosity, open mindset, spotting opportunities	4.41	4	3.62	4
6	Wellbeing, positive attitudes, mindfulness	4.45	4	3.53	4
7	Emotional intelligence and empathy	3.94	4	3.31	3
8	Vision, leadership, mobilising and managing others	4.32	4	3.37	3
9	Sustainability competence	4.59	5	3.69	4
10	Growth mindset and learning	4.95	5	3.85	4
11	Responsibility and fairness	4.88	5	4.00	4
12	Global mindset, social and cultural awareness	4.05	4	3.64	4
13	Information and data literacy, information interpretation	4.82	5	4.01	4

14	Basic, scientific, economic and technological literacies	4.35	4	3.99	4
15	Advanced data analysis and mathematical skills	4.24	4	4.09	4
16	Computer programming	4.06	4	3.45	3
17	Statistical programming	3.85	4	3.42	3
18	Other advanced technical skills	4.39	4	3.80	4

When comparing STEM students' assessments of the skills required of graduates, statistically significant differences by gender are observed in several characteristics. Depending on gender, statistically significant differences were found in three characteristics: communication. Cooperation, teamwork. Curiosity, desire to improve, and responsibility and fairness. In communication, cooperation and teamwork, female students are more likely to rate the development of these skills at higher education institutions as very good or excellent. In contrast, male students are more likely to rate it as relatively poor or rather good. However, when comparing students' assessments of the necessity of skills for graduates, depending on work experience, statistically significant differences were also found for several characteristics. Students with work experience are much more likely than those without to consider communication. cooperation. and teamwork particularly important. In contrast, students without work experience are more likely to consider these skills important. At the same time, students without work experience are more likely to consider in-depth data analysis, mathematical skills, and statistical programming particularly important. In contrast, students with work experience are more likely to rate these skills lower. In several aspects of the assessment of teaching skills at higher education institutions, statistically significant differences were found between students with work experience and/or practical experience and those without. Furthermore, in all cases, students who have not worked consider that skills are developed very well or even excellently or are unable to assess them. In contrast, students with work experience admit that a particular skill is taught rather poorly or insufficiently. These results may indicate that students who have had the opportunity to apply specific skills in practice or at work are more critical in their assessment of skill development during the study process and consider that the skills developed in the study program are insufficiently developed.

4. Conclusion

The research analysed the importance of 21st-century skills for STEM graduates' employability. It assessed how these skills are developed in Latvian educational institutions. comparing employers' skill priorities with pupils' and STEM students' assessments. Theoretical analysis confirms that the importance of skills in the labour market is growing amid technological development. automation. and structural changes. In contrast, the mismatch between the skills acquired in the education system and those required in the labour market remains a significant

challenge that can affect both individual employability and job performance and satisfaction. Survey results show that both high school and university students generally consider 21st-century skills important for STEM graduates, with particular emphasis on critical thinking, problem-solving, and systemic thinking. At the same time, there is a consistent gap between the assessment of the importance of skills and their level of development in the education process, indicating a lack of skills development. The study also reveals differences in perceptions of skills across groups, including by gender and work experience. Overall, the results justify the need to integrate 21st-century skills more purposefully into teaching and learning. Therefore, it is the task of educational institutions to develop these skills in a targeted manner so that graduates are competitive in the labour market, promoting higher incomes and job satisfaction, and overall national competitiveness. In particular, for academia members to foster students' 21st-century skills, they need professional development to introduce new teaching methods and approaches into the learning process. This would ensure the quality of the teaching process and content, as well as alignment with the demands of contemporary labour markets.

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