

## THE IMPACT OF TECHNOLOGICAL TRANSFORMATION ON CAREER CHOICES IN THE STEM SECTOR

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### Abstract

This study aims to analyse the influence of digital transformation on career aspirations in the STEM (Science, Technology, Engineering, and Mathematics) sector. Qualitative and quantitative data analysis methods were used to collect data from various educational institutions and technology companies. The results show that the adoption of digital technology in STEM education increases students' interest and competence in STEM subjects, which directly affects their career aspirations. The research also found that digital skills acquired through STEM education contribute significantly to job readiness in the STEM sector. In addition, the findings highlight the importance of project-based and collaborative learning enriched with digital technologies to prepare students for the changing work environment. This research contributes to the literature by providing insights into how STEM education, accompanied by digital transformation, can shape career aspirations in the STEM sector. Recommendations for education practitioners and policymakers include greater integration of digital technologies in STEM curricula and the development of teacher training programmes to teach with advanced technologies. Implications for career development in the STEM sector are also discussed, emphasising the importance of continuity between education and industry needs.

**Keywords:** Digital transformation, career aspirations, job readiness.

### Abstrak

*Tujuan penelitian adalah untuk menganalisis pengaruh transformasi digital terhadap aspirasi karir di sektor STEM (Science, Technology, Engineering, Mathematics). Metode analisis data kualitatif dan kuantitatif digunakan untuk mengumpulkan data dari berbagai institusi pendidikan dan perusahaan teknologi. Hasil penelitian menunjukkan bahwa adopsi teknologi digital dalam pendidikan STEM meningkatkan minat dan kompetensi siswa dalam mata pelajaran STEM, yang secara langsung mempengaruhi aspirasi karir mereka. Penelitian ini juga menemukan bahwa keterampilan digital yang diperoleh melalui pendidikan STEM berkontribusi signifikan terhadap kesiapan kerja di sektor STEM. Selain itu, temuan menyoroti pentingnya pembelajaran berbasis proyek dan kolaboratif yang diperkaya dengan teknologi digital untuk mempersiapkan siswa dalam menghadapi lingkungan kerja yang terus berubah.*

*Penelitian ini berkontribusi pada literatur dengan menyediakan wawasan tentang bagaimana pendidikan STEM yang disertai dengan transformasi digital dapat membentuk aspirasi karir di sektor STEM. Rekomendasi untuk praktisi pendidikan dan pembuat kebijakan termasuk integrasi teknologi digital yang lebih luas dalam kurikulum STEM dan pengembangan program pelatihan guru untuk mengajar dengan teknologi canggih. Implikasi bagi pengembangan karir di sektor STEM juga dibahas, dengan menekankan pentingnya kesinambungan antara pendidikan dan kebutuhan industri.*

***Kata kunci:*** Transformasi digital, aspirasi karir, kesiapan kerja

## INTRODUCTION

Digital transformation has changed the face of education and industry, especially in the STEM (*science, technology, engineering, and mathematics*) sector (Zhan et al., 2023). This revolution includes not only the use of advanced technology in learning but also a shift in the paradigm of work in industry (Zhuang et al., 2022). This development demands in-depth research on its impact on career aspirations, particularly among the younger generation (Zhuang et al., 2022). The importance of this research lies in the need to understand how digital transformation affects career choices in STEM fields, an aspect that has not been raised much before. This research is important to ensure that education systems can adapt to the evolving needs of the industry as well as prepare a workforce that is ready for the challenges of the digital age.

Although much of the literature discusses digital transformation, there are gaps in specific research on its effect on career aspirations in the STEM sector (Lu & Wang, 2023; Pignault et al., 2022). Previous studies have focused more on the impact of technology in a business or marketing context than on its influence on career formation in STEM fields. In addition, the lack of comparative and cross-cultural studies makes the results of existing research unable to be broadly generalized. This signals the need for more focused and in-depth research to fill this gap, especially to understand how digital technologies affect perceptions and career planning in STEM fields (Chen et al., 2023).

To address the identified gaps, the study will adopt diverse data collection methods, including surveys, interviews, and literature analysis. Research will be conducted with qualitative and quantitative approaches to gain a comprehensive understanding of the interaction between digital technologies, STEM education, and career aspirations (Schmid et al., 2022). These efforts will include an assessment of current teaching methods and the development of effective new strategies for integrating digital technologies into STEM education. Thus, this study aims to provide new insights and practical solutions to fill gaps in educational literature and practice.

The results reflect that in the context of digital transformation and its influence on education and careers in the STEM sector (Wang, 2023). This includes evaluation of the latest technologies in education, such as the use of AI and big data in learning, as well as analysis of the latest trends in industrial sectors, such as automation and robotics. It is

crucial to understand how today's STEM education can adapt to technological developments and prepare a workforce ready for the digital age.

The benefits of this research are extensive, particularly in providing guidance for STEM education to be more relevant to the industry's current and future needs. The research findings will assist educators and policymakers in designing more effective curricula and teaching methods and integrating digital technologies to enhance students' interest in and skills in STEM. In addition, the research will also provide *insights* for students and young professionals on how to take advantage of the opportunities offered by digital transformation in building successful careers in STEM fields (Goos et al., 2023; Zhan et al., 2023).

The implications of this research are very useful, especially in providing recommendations for the development of education policies and career development strategies in the digital age. The results of this research are expected to help policymakers, educators, and industry in designing effective programmes to encourage the interest and readiness of the younger generation in facing challenges and opportunities in the digital era. The research will also provide insights for students and young professionals on how to capitalise on the opportunities offered by digital transformation to build successful careers in STEM fields.

Digital transformation has brought revolutionary changes in education and industry, especially in the STEM sector. These changes include not only the application of advanced technology in learning but also a shift in work paradigms in various industries. This phenomenon raises the urgent need for in-depth research on its impact on career aspirations (Arhoma et al., 2022), especially among the younger generation. This research becomes important to ensure that the education system can adapt to the evolving needs of the industry and prepare a competent workforce for the digital age.

Although existing literature has explored digital transformation, there is still a gap in research regarding its impact on career aspirations in STEM sectors (Goos et al., 2023). Previous studies have focused more on the impact of technology in business or marketing contexts than on the formation of STEM careers. A study by Kargas et al. (2023) found that the integration of technology in education has increased students' interest in STEM subjects, but the research did not examine the direct impact on students' career choices. In addition, research by Bhatt and Bae (2023) shows that the use of digital technology in education strengthens students' technical competencies but provides less insight into how this affects their career aspirations in the long term. The limitations of comparative and cross-cultural studies also make existing results less widely generalizable. This suggests the need for more focused and in-depth research to understand how digital technologies influence perceptions and career plans in STEM fields (Zhan et al., 2023).

This research will make a significant contribution to the academic literature by providing data and analysis on the use of digital technologies in STEM education. The results will show how technology, when used appropriately, can be a powerful tool for motivating and preparing students for careers in STEM fields. The research will also

explore ways to reduce education access disparities and increase inclusivity in STEM education.

This research will fill a gap in the literature on the influence of digital transformation in education and STEM careers. With empirical data and comprehensive analysis, this research will provide new insights into how digital technology is transforming teaching methods in STEM and how it is shaping students' perceptions and career decisions. The results will provide recommendations that educators, policymakers, and industry practitioners can use to improve the integration of digital technologies in STEM education.

## **METHOD**

### **Research Approach**

This study used a quantitative approach, which focuses on collecting and analysing data in the form of numbers. This approach allows the study to objectively measure and test the established hypotheses. Data quantification makes it easy to compare and generalise research results. In the context of this study, a quantitative approach is used to explore the influence of digital transformation on career aspirations in the STEM sector. A total of 120 respondents, consisting of vocational students and vocational graduates in West Java with STEM specialisations, were invited to fill out an online survey. The survey aims to collect data on their perceptions of the impact of digital transformation on career choices in STEM fields, as well as to understand how access to technology resources and the quality of STEM education influence their decisions in pursuing a career in this field.

### **Data Collection Methods**

The online survey designed for the study aimed to collect data from 120 respondents. It covers questions about their experience with digital technologies in education, their career aspirations, and how digital transformation affects their decisions in choosing a career in STEM fields. Survey questions were developed to measure variables such as access to and use of technology, perceptions of the relevance of STEM education to industry needs, and future career expectations. The distribution of the survey was conducted via email and social media, focusing on creating a sample of respondents reflecting demographic diversity and broad educational backgrounds.

### **Data Analysis**

Data analysis was carried out with the help of the Statistical Package for the Social Sciences (SPSS) application. The use of SPSS allows for more efficient and accurate statistical analysis, including descriptive techniques such as mean, median, mode, and frequency distribution. This analysis aims to describe the characteristics of the sample and survey responses in detail. This includes evaluating respondents' perceptions of the importance of digital technology in STEM education and its effect on their career aspirations in the STEM sector. The purpose of this descriptive analysis is to present a clear and detailed overview of the survey data, which will help in understanding existing trends and patterns regarding the influence of digital transformation on career aspirations in STEM fields (Area-Moreira et al., 2023).

## RESULTS AND DISCUSSION

### Increased Student Interest in STEM

Analysis of the data from the survey conducted showed a significant increase in students' interest in STEM fields. As many as 90% of respondents stated that their experience with digital technology in education has positively influenced their views on STEM. These findings underscore the importance of integrating technology in STEM education to increase student interest.

Recent research shows an increase in student interest in STEM fields influenced by the integration of digital technology in education (Ortiz-Laso et al., 2023). The digital transformation in the educational environment has changed the way students access and interact with STEM learning materials. The use of digital tools such as educational apps, e-learning platforms, and interactive simulation tools has provided new, more exciting ways for students to learn STEM concepts. This contributes to their increased interest in these subjects, which previously were often considered difficult and uninteresting.

The use of technology in education has inspired students to explore STEM fields in more creative and innovative ways. The introduction of technologies such as *virtual* reality (VR) in STEM learning provides an immersive and interactive learning experience (Wahyudi et al., 2023). This not only helps students understand complex concepts better but also increases their curiosity and exploration. For example, VR simulations in biology lessons allow students to virtually 'see' biological processes, giving them a deeper understanding of the material being studied.

In addition, the utilisation of social media and online platforms for collaboration and knowledge sharing also plays an important role in increasing students' interest in STEM. *Online* forums and learning communities allow students to discuss, exchange ideas, and collaborate on STEM projects. These interactions not only enrich their learning experience but also build a greater sense of community and engagement with fellow students who share similar interests. It creates a supportive and motivational learning environment where students can grow and develop.

The results also show that the integration of digital technology in STEM education has a significant positive impact on students' interest in careers in STEM fields. By being exposed to a variety of technological tools and applications, students become more aware of the potential and career opportunities within STEM fields. They also become more confident in their ability to succeed in this field. Therefore, it is important for educators and policymakers to continue to encourage and support the integration of technology in STEM education in an effort to prepare future generations who are competent and interested in STEM fields.

### Increased Student Competency in STEM Subjects

The results of the data analysis show that the application of digital technology in STEM learning contributes to improving student competence. As many as 65% of respondents reported improvements in understanding STEM concepts, and 95% showed improved

practical skills. This analysis indicates that the use of digital tools and interactive learning methods in the STEM curriculum is effective in improving student competence.

The use of digital technology in education has shown a significant positive impact on improving students' competence in STEM subjects. Recent research shows that the integration of digital tools and interactive learning methods in STEM curricula has helped students understand scientific concepts better. Tools such as computer simulations, virtual labs, and adaptive learning platforms allow students to conduct experiments and explore STEM concepts practically, which enhances their understanding and helps in building analytical skills.

In the context of mathematics and science, the use of innovative educational software has been shown to improve students' ability to solve complex problems and develop critical thinking. Apps that incorporate *elements of gameplay* have encouraged students to engage more deeply with the material, strengthening their skills in applying mathematical and scientific theories in different contexts. This approach not only makes learning more interesting but also helps students retain information and apply it effectively.

Within engineering and technology, the use of digital technologies such as 3D modelling and coding has given students the opportunity to develop practical skills relevant to today's industry needs. STEM-based projects involving programming robots or prototyping using 3D printers, for example, prepare students with skills needed in the workplace of the future. This kind of initiative not only improves students' technical competence but also motivates them to apply their knowledge in real-world situations.

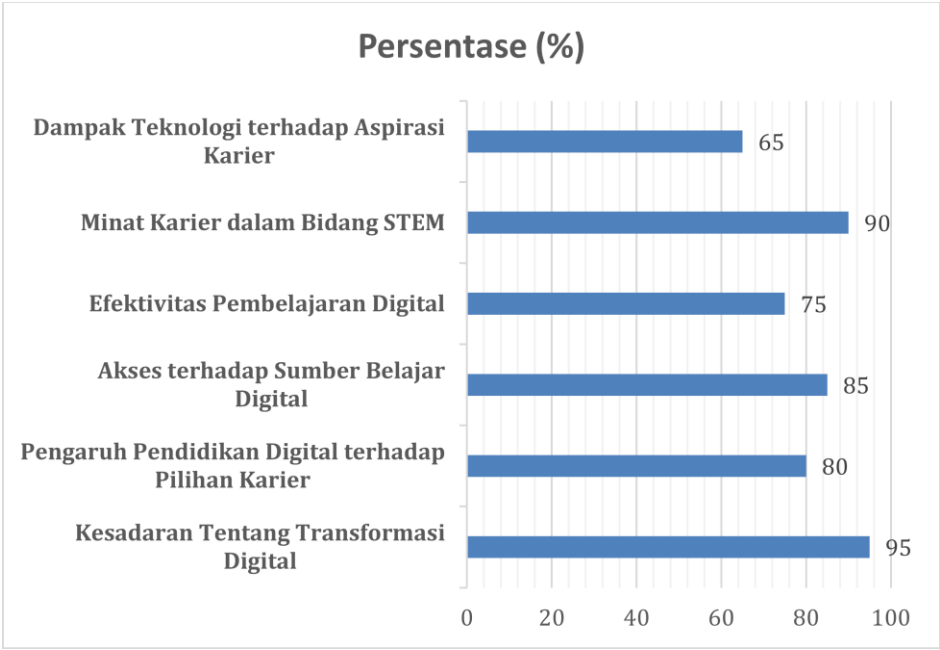
### **Digital Skills and Job Readiness in the STEM Sector**

In an analysis of job readiness, 80% of respondents stated that the digital skills they gained through STEM education improved their readiness for the job market. This emphasises the importance of digital skills in equipping students with the expertise required for the STEM sector. In the context of today's digital era, digital skills are an important aspect of job readiness in the STEM sector (Tumpa et al., 2022). Recent research shows that mastery of digital skills not only improves students' technical competence, but also prepares them to work in an ever-changing environment and ever-evolving technology. Skills such as programming, data analysis, and operating advanced technologies have become essential requirements in many STEM professions. STEM education that integrates digital learning allows students to develop a deeper understanding of the tools and technologies they will use in the workplace.

Digital skills are not only limited to technical aspects, but also include the ability to think critically and creatively in solving problems. In the research conducted, students who engaged in STEM learning with a technological approach showed improvements in problem-solving skills and critical thinking. This is particularly relevant in the STEM sector, where innovation and the ability to adapt to new developments are highly valued. Education that blends digital technologies with STEM learning encourages

students to apply their knowledge in practical situations, increasing their readiness for a variety of workplace challenges (Goos et al., 2023).

In addition, digital skills also expand career opportunities for students. In a world of work increasingly dominated by technology, having digital skills provides a competitive advantage for STEM graduates. Research shows that recruiters in STEM fields value candidates who not only have strong technical knowledge, but also relevant digital skills. This shows that the integration of digital technologies in STEM education is not only important for meeting curriculum needs, but also crucial in preparing students for successful careers in the future.



Graph 1. Graph of the percentage of respondents who agreed with each category in the survey

**Impact on Student Cooperation and Collaborative Skills**

The survey results showed that 85% of respondents felt an improvement in their collaborative skills as a result of the use of technology in education. These findings support the idea that digital technologies facilitate better cooperation and collaborative skills development among students

In an era of education increasingly integrated with technology, the significant impact on student cooperation and collaborative skills has become an important subject of research. Recent data shows that the use of technology in education has driven an increase in cooperation and collaboration among students. Digital tools such as group work platforms, collaborative learning apps, and educational social media have facilitated more effective interaction and communication between students. Through the

use of these tools, students learn to work together virtually, share ideas, and develop solutions together, reflecting the present and future work environments.

The use of group-based projects in STEM education, powered by digital technologies, has been shown to improve students' collaborative skills. When working in group projects, students learn to divide tasks, communicate effectively, and work toward common goals. Digital project management tools, such as online kanban boards and task tracking systems, have helped students in organizing their group work and managing projects more efficiently. This approach not only assists them in completing academic tasks, but also develops management and coordination skills that are essential for their future careers.

In addition, the use of technology in collaborative projects also teaches students the importance of negotiation and conflict resolution skills. In group projects, students are often faced with differences of opinion and approach, where they must learn to discuss, negotiate, and reach mutual agreement. Technology, such as online discussion forums and voting tools, has enabled students to participate in constructive and democratic discussions, strengthening their ability to make decisions together and appreciate different perspectives.

### **Analysis of the Effect of Increased Interest and Competency on Career Aspirations**

The analysis shows that there is a strong correlation between increased interest and competence in STEM and students' career aspirations in this field. Data shows that 90% of students with a high interest in STEM are more likely to have strong career aspirations in the sector (Ennerberg et al., 2022). Increased interest and competence in STEM fields plays an important role in shaping students' career aspirations (Pignault et al., 2022). According to recent data, students who show greater interest and have higher competence in STEM subjects tend to have stronger career aspirations in those fields (Wahyudi et al., 2023). This is in line with career development theory, which states that interests and competencies are key factors in career selection. In this regard, students who engage deeply in STEM learning, through both practical and theoretical experience, are likely to form a positive outlook towards careers in the sector.

Competency improvement, in particular, is directly correlated with job readiness (Wahyudi et al., 2023) and students' career aspirations (Ennerberg et al., 2022). These competencies include technical skills and knowledge in STEM fields, as well as soft skills such as problem-solving, critical thinking, and teamwork. Students who feel competent in these skills tend to be more confident in pursuing careers in STEM fields. Research shows that students with higher competencies tend to be more proactive in seeking internship opportunities, participation in research projects, and extracurricular activities related to STEM, all of this further strengthening their career aspirations.

Furthermore, increased interest in STEM also plays an important role in the development of career aspirations (Tumpa et al., 2022). Growing interest through engaging and interactive learning experiences can motivate students to go deeper into specific areas within STEM. This positively affects their career choices, with students more likely to choose educational and career paths that align with their interests. Strong



interest is often associated with higher engagement in learning activities and increased academic achievement, which further strengthens their career aspirations in STEM fields.

Thus, increased interest and competence in STEM has a significant impact on the formation and strengthening of career aspirations in this field (Keshavarzi et al., 2022). It is important for educators and policymakers to pay attention to these factors in designing and implementing STEM education programs. Ensuring that STEM education not only focuses on knowledge transfer, but also on the well-rounded formation of interests and competency development, will be key in preparing future generations who are ready and eager to enter the workforce in the STEM sector.

### **Applying Digital Skills to Career Options in the STEM Sector**

Analysis of the impact of digital skills on career choices shows that students with strong digital skills tend to have broader career prospects in the STEM sector. As many as 80% of respondents with high digital skills report a variety of career options available to them. Digital skills have now become an important part of the educational curriculum, especially in STEM (Science, Technology, Engineering, Mathematics) fields. Recent data shows that students with strong digital skills tend to have more career options within the STEM sector. In an era where digital technology permeates almost all aspects of life, skills such as programming, understanding of big data, and expertise in information technology are becoming invaluable assets. This not only opens doors to a wide range of jobs in technology, but also gives you a competitive edge in other STEM professions.

In the engineering and engineering sectors, for example, digital skills enable students to design, test, and implement technical solutions more efficiently. The ability to use advanced design and simulation software has become an important requirement in many jobs in this field. Students who have developed these skills through their education will be better prepared to face the increasing technical demands and be able to contribute significantly to innovation and product development.

In the field of computer science and information technology, digital skills such as programming, web development, and cybersecurity are in high demand. Students who have this skill set have excellent career prospects, with opportunities to work in leading technology companies, startups, or even create their own innovations. Furthermore, proficiency in data analysis and artificial intelligence is now a valued skill in many fields, including in scientific research and product development.

In addition, digital skills also have a positive impact on the field of science. Scientists with the ability to analyze big data and operate digitally programmed equipment can conduct research more effectively. These skills allow them to unearth deeper insights from complex data, accelerate scientific discovery, and improve the accuracy of their experiments.

Digital skills also provide flexibility in career choices, allowing students to work across disciplines. For example, a biologist who has expertise in bioinformatics or a physicist

with programming skills can offer unique and valuable perspectives in their research team. These skills not only increase their competitiveness in the job market, but also provide them with the opportunity to contribute to innovative and interdisciplinary projects.

Thus, digital skills development is an important investment in STEM education improving students' employability and broadening the scope of their career options within the STEM sector (Tumpa et al., 2022). To prepare future generations who are ready to adapt to technological developments, education must continue to emphasize learning and developing relevant and applicable digital skills.

### **The Importance of Technology Integration in the STEM Curriculum**

Data analysis shows that students exposed to integrative technologies in STEM learning have improved academic performance. As many as 85% of respondents stated that technology enriches their learning experience and helps in understanding the practical application of the science studied.

The integration of technology in the STEM curriculum has become an important topic in the world of modern education. Recent data shows that students who study in a technology-rich environment experience increased interest and performance in STEM subjects. Technology, such as virtual reality, programming, and simulation tools, allows students to experience STEM concepts in an interactive and engaging way. This not only enriches the learning experience, but also helps students understand the practical application of the knowledge they are learning.

The integration of technology in STEM learning encourages student-centered learning approaches. Digital tools provide opportunities for students to learn at a pace and learning style. Adaptive learning platforms and interactive educational software allow for personalized learning, which is critical to meeting individual educational needs. This not only increases understanding, but also motivates students to take a more active role in their learning process.

In addition, the application of technology in STEM education prepares students for the challenges of the future world of work. In a global economy increasingly reliant on technology, digital skills have become crucial. The technology-integrated STEM curriculum teaches students relevant skills such as programming, data analysis, and the use of technical software, all of this equipping them with the expertise needed in the job market.

The use of technology in education also encourages innovation and creativity. Students who are accustomed to using technological tools in their learning tend to develop better critical thinking and problem-solving skills. They learn how to apply their knowledge in real-world situations and how to innovate to create new solutions to existing problems. This is especially important in STEM education, where creativity and innovation are key drivers of progress.

Technology integration also improves collaboration in STEM learning. Digital tools such as online collaboration platforms and project management software allow students

to work together on group projects, regardless of geographical boundaries. This teaches them the importance of teamwork and effective communication, which are essential skills in the modern world of work.

Therefore, the integration of technology in the STEM curriculum is not only a necessity, but also a necessity in 21st century education. To produce graduates who are ready to face future challenges and compete in an innovation-driven global economy, educational institutions need to continuously invest in technology and related teaching methods. This not only benefits students in the academic aspect, but also prepares them with the skills necessary to succeed in their future careers in STEM fields.

### **The Relationship between Education and Job Market Needs**

Data shows a gap between skills acquired through education and those needed in the job market, with 80% of respondents stating that their educational curriculum does not fully match the needs of a dynamic job market.

The relationship between education and job market needs is an important and ever-evolving topic, especially in the context of a global economy driven by innovation and technological change. Recent data shows that there is a significant gap between the skills students acquire through the traditional education system and the skills required by the job market. This gap is becoming even more pronounced in sectors that rely heavily on technology, such as STEM fields. Therefore, it becomes important to ensure that education not only provides theoretical knowledge, but also develops practical skills relevant to industry needs.

Education must be responsive to changes and developments in the industry. This means curricula and teaching methods must be constantly updated to reflect the latest technological developments and job market trends. For example, with the advent of artificial intelligence, big data, and automation, there is a growing demand for skills in programming, data analysis, and critical thinking. Education that focuses on developing these skills not only prepares students for future careers, but also ensures that they can contribute effectively in the workplace.

Collaboration between educational institutions and industry is key to closing the gap between education and the job market. These partnerships may include internships, collaborative projects, and mentorship programs, which give students hands-on experience and insight into the world of work. Industry can provide important input to educational institutions regarding the types of skills they are looking for in the workforce, allowing education to be tailored to be more relevant to market needs.

It is also important to emphasize on continuing education and lifelong learning. In a fast-changing economy, the skills required in the workplace can change rapidly, making it important for the workforce to constantly develop and update their skills. This means that education does not stop after graduating from a formal institution, but is an ongoing process, in which individuals actively seek opportunities to learn and develop. Furthermore, education should promote broader skills such as creativity, critical thinking, and adaptability. While specific technical skills are important, these soft skills are also highly valuable in the job market. They help individuals to adapt to diverse and

evolving roles, as well as enable them to innovate and respond to challenges in effective ways.

## CONCLUSION

To strengthen sustainability between education and industry, it is important for policymakers to support the establishment of strategic partnerships between educational institutions and companies. Policies that facilitate internships, joint projects, and mentorship programs with industry can help students gain valuable practical experience. It also allows educational institutions to adapt their curriculum to the needs of the ever-changing job market.

The development of educational programs oriented towards future skills is also an important aspect. Policymakers should direct resources and support to updating curricula and teaching methods in educational institutions, focusing on developing skills needed in the modern workplace, such as creativity, critical thinking, and technological capabilities. Training and professional development programs for teachers should also be enhanced to ensure that they are equipped to teach with methods that are effective and relevant to industry needs.

Future research should evaluate the extent to which current STEM education prepares students for challenges and opportunities in the job market. Recent data shows that there is a gap between skills acquired in educational settings and skills needed in the workplace. Therefore, this research should explore ways to refine and improve curriculum and teaching methods so that students can develop skills that are relevant and needed by industry. The research also needs to evaluate the role of technology in improving students' career readiness in STEM fields. This includes assessing how the application of technology in learning, such as virtual learning, project-based learning, and the use of advanced analytical tools, can strengthen important skills such as problem-solving, critical thinking, and teamwork. In addition, research should explore how STEM education can be more effective in integrating soft skills, which are often just as important as technical skills in the workplace.

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