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Impact Assessment

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EDUSIMSTEAM | Erasmus+ KA3 Forward Looking Cooperation Project

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IMPACT ASSESSMENT

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Abstract

This impact analysis report focuses on evaluating the impact of the STEAM learning model on teachers and students, specifically measuring their appreciation of science before and after engaging with project activities. The analysis examines the project's outcomes in relation to the achievements of teachers and students in STEAM activities. The primary objective is to assess the impact of the Teacher Training and IOP experiences based on the following aspects:

1. **Level of Skills:** The analysis measures the level of skills acquired by teachers and students through the project's activities. It evaluates the improvement in their proficiency in STEAM-related skills.
2. **Improvement of Results:** The report assesses the improvement in students' academic performance in STEAM subjects as a result of their engagement with the project's activities. It also examines the enhancement of students' interest and motivation in STEAM disciplines.
3. **Student Satisfaction:** The analysis examines the impact of the STEAM learning model on student satisfaction levels with respect to STEAM disciplines. It measures the extent to which students find the learning experiences engaging and rewarding.
4. **Dissemination:** The report explores the dissemination of project outcomes to other educational institutions and non-school settings that were not directly involved in the project. It assesses the reach and influence of the project beyond its immediate participants.
5. **Impact on Education System:** The analysis investigates the impact of the project on the education system, particularly in terms of training courses for teachers focused on STEAM education. It examines the influence of the project on shaping educational practices and policies related to STEAM.

These were presented in the themes of general, short-term, and long-term impact. By conducting this comprehensive impact assessment, we aim to gain insights into the effectiveness and significance of the STEAM learning model in promoting positive outcomes for teachers and students. The findings will provide valuable feedback for further improvement and refinement of STEAM education approaches.

Keywords: Interdisciplinary, Policy improvement, Professional development, Real-world applications, Research and innovation ecosystem, STEAM learning model, Teacher training, Teachers, Technological advancements, Well-rounded citizens, Workforce development.

1. Introduction

This impact report presents an in-depth account of the significant progress achieved by our pioneering project in the realm of simulation and policy improvement in education. Our overarching goal has been to establish an evidence-based approach for STEAM education by harnessing the power of simulations, thereby elevating learning outcomes and shaping policies in the field.

Our endeavor has culminated in the development of a robust framework, seamlessly integrating simulation-based learning experiences into existing curricula across a wide range of subjects and educational levels. This integration has been made possible through fruitful collaborations with educators, policymakers, and researchers, resulting in the design and implementation of interactive simulation modules. These modules have proven instrumental in fostering student engagement and facilitating a profound comprehension of intricate concepts.

In addition to its focus on STEAM education in simulation-based learning, our project places great emphasis on policy improvement. Through extensive research and analysis, we have identified areas of enhancement within current educational policies. While undertaking this task, we have acknowledged and addressed various challenges, such as technical limitations, resource constraints, and the professional development needs of educators. It is essential to underscore that these challenges have underscored the importance of ongoing collaboration and strategic planning in order to drive meaningful change.

Looking ahead, our project envisions sustained research efforts to assess the impact of STEAM education on student achievement and critical thinking. We believe it is imperative to advocate for evidence-based practices in educational policies, ensuring that decisions are grounded in empirical data and best practices. By seamlessly integrating simulations into the educational landscape and fostering policy improvement initiatives, our project aims to empower students, educators, and policymakers to effect positive transformations. Furthermore, we are deeply committed to the principles of equity, accessibility, and inclusivity, ensuring that our initiatives benefit all learners and stakeholders.

In conclusion, this impact report highlights the remarkable achievements of our project in the domains of simulation and policy improvement in education. By leveraging simulations and fostering collaborative endeavors, we have successfully contributed to the advancement of STEAM education. Moving forward, we remain dedicated to our mission of creating a positive and transformative educational landscape, and we are resolute in our commitment to equity, accessibility, and inclusivity.

2. General Impact

The project strengthened the implementation of STEAM policy in partner countries. This proposal informed those engaged in curriculum development to design more integrated learning units and associated assessment tasks that were more appropriate to real-world situations.

The project served to link teachers and educators across all sectors (Primary, Post-Primary, and higher) and formed connections that enhanced teaching and learning, both at local and national levels. It complemented the great work already being done in schools on STEAM and enhanced and developed the provision already there. It helped create new pathways to develop and enrich learning and teaching.

The project produced tools that could be easily maintained and implemented in the future. The tools could also be used by organizations and structures that were not directly involved in the project. The platform IOP was implemented with more courses and could be enjoyed by other entities. The contents, translated into all the languages of the project, could be translated into other languages to truly "massively" expand attendance.

In the long term, the action coordinated and leveraged Member States' activities with respect to the proposed innovative approach to STEAM education based on our STEAM Framework. A further expected impact was the definition of a new educational integrated curriculum in the field of science, both vertically (between school levels) and horizontally (between disciplines). This occurred within a rethinking of the school system with the inclusion of methodological approaches for teaching STEAM. In summary, the proposal seemed to be able to effectively contribute (in the long term) to achieving the Europe 2020 education target by improving STEM skills among young students, with fewer than 15% of pupils underperforming by 2020. It aimed to increase the range of innovative results that reflect societal needs and improve teacher skills for the next digital natives in the coming decades.

We followed all impact assessments with quantitative and qualitative methods to see whether they met the intended indicators above and impacts below. They first addressed seeing these indicators:

- The number of teachers and students engaged in project activities: 44.000
- The number of registered users on the online platform: 6894 users
- The number of teachers participating in online trainings: 7259
- The perceptions of teachers written in the strategy development for the project:
- The curriculum studies done with universities and teachers in the pilot schools: 132
- The prevalence of STEAM use in class documented after teacher trainings according to teacher reports and curriculum studies:
- The number of scenarios developed for the pilot schools: 132
- The use of scenarios by teachers for their school lessons as documented by them:
- The proportion of teachers completing the trainings and demos online:

- The proportion of teachers using scenarios in pilot schools against non-users:
- The number and type of materials produced and disseminated: 8
- The scenarios uploaded to the online system by teachers from different regions: 340
- The number of teacher trainings conducted in partner countries: 3000
- The amount of time dedicated to quality assurance, risk planning, and monitoring strategy, documented in project progress reports: 360 month
- Quality of STEAM application in pilot schools as rated by their school management:715
- The satisfaction students and teachers attained from the online platform in the project, depending on mini satisfaction surveys after each course: %97
- The amount of e-contents uploaded to the platform: 31
- The production of A Practical Guide for Policy Makers
- The online and physical distribution of the policy guide to all interested parties:
- The number of meetings with policy makers in the partner regions: 50
- The impact assessment results of the project:
- The parties, teachers, and families reached under project dissemination activities like conferences, ads, etc: 254
- The schools' or teachers' participation in EU sites like eTwinning for project dissemination activities or knowledge sharing about this project: scientix, FCL, eTwinning
- The number of meetings with stakeholders: 150
- The number of dissemination activities: 254
- The number of project outputs (scientific papers, learning resources): 215

The improvements were assessed through online surveys on the platform and paper surveys/ interviews conducted by the partners. We also ran on-site surveys with teachers and students. The results showed the following impacts of the project.

3. Short-term Impact

The project aimed to contribute to the achievement of the Europe 2020 strategy by stimulating STEAM methodology in the partner countries. As stated before, this project was based on the call priorities and outcomes below:

1) "Teacher Training & Curriculum for STEM and Scenarios" for continuous teacher training in innovative pedagogies with cross-disciplinary approaches that included exposure to STEM fields.
2) STEAM-based Innovative Online Platform for reforming curricula for STEM with a STEAM approach, including real-world applications, inquiry-based and ICT-enriched learning, collaborative practices, with a transdisciplinary focus, and the use of extra-curricular activities in order to deliver a wider range of skills that drive innovation and creativity and nurture forward-looking skills.
3) Developing frameworks and/or recommendations through A Practical Guide for Policy Maker for developing and aligning local and regional initiatives to national strategies and objectives,

with a special focus on developing strategies for producing a well-qualified and diverse workforce in the future.

These three main outputs, in line with priorities, had a great impact on the partner countries with the STEAM activities implemented. To make STEM education more attractive, this project proposed an innovative methodology based on the criteria of interdisciplinary, problem-solving, and peer education. The project model predicted that the transfer of knowledge occurred with tools such as IOP (which we called Teacher Training Platform & SimuLearn) and scenarios that connected courses with the realities of the countries.

By developing innovations like SimuLearn, scenarios for STEAM, policy-making and strategy frameworks, the project empowered the existing educational landscape in the partner countries. For example, in Spain, although there were several initiatives to foster STEAM education, science teaching was traditional and lacked an artistic dimension. The main didactical resource used was the textbook, from elementary school to college. If experimental activities were used, they were usually like recipes, illustrating theory rather than promoting knowledge construction. Due to time constraints imposed by a large curriculum, teachers did not employ problem-solving strategies, and students had a general perception that science was not related to the real world, boring, and difficult. The same applied to Türkiye, with the only difference being the existence of teachers who had developed themselves by taking continuous online courses after graduating from university.

With the implementation of the IOP in this project, the teachers in partner countries had the opportunity to follow a unique system in their own language, which included how to employ STEAM-based classes accompanied by sample learning scenarios. The IOP also included teacher training on STEAM with theoretical and practical backgrounds.

This fostered direct impacts in a short time:
1. First level: teachers and students were directly involved in the construction of the IOP. At least 4,000 teachers were trained on the online platform, and more than 5,000 schools were informed to enable their students to use the IOP.

The project also delivered impacts in the short term regarding frameworks and/or recommendations through A Practical Guide for Policy Maker, as two ministries informed all other related ministries through EU networks and employed eTwinning national contact points to spread the information on all teachers' platforms. It was estimated that the strategy framework was downloaded 10,000 times upon its production.

The project activities impacted four main groups:

- Schools
- Students
- Teachers
- Families and society

1. **Schools:**
   - Increased participation of schools in STEAM fields.
   - Improved connectivity.
   - Increased availability of digital content.
   - Specific in-service training within the school premises.

2. **Students:**
   - Students benefited from trained teachers and online content.
   - Engaged in individual tasks within the IOP.
   - Had access to elective STEM subjects and a specific module on STEAM.

3. **Teachers:**
   - Teachers benefited from the IOP, support, teacher training plans, learning scenarios, special courses, and reinstatements.
   - Had a space for creativity, encouraging teacher participation in the creation of digitized content.

4. **Families and society:**
   - Families, with the support of registered schools or teachers, integrated experiences in the digital society.
   - Received guidance and support from parents' associations to enhance their familiarity with digital learning tools.

In summary, the project outcomes had a significant impact on the target groups and strengthened the educational landscape by developing innovations that met the needs of the Education and Training field related to the selected priority areas. The project empowered teachers, students, schools, and families, resulting in increased participation in STEAM fields, improved digital connectivity, enhanced access to educational resources, and the development of forward-looking skills.

4. Long-Term Impact

The European Union (EU) is actively promoting education to adapt to evolving socio-economic changes, such as the increasing demand for highly skilled workers and the rise of automation in office and service jobs. The growing influence of artificial intelligence, big data, analytics, and machine learning further emphasizes the need for advanced and efficient STEAM education, where experimentation and data-driven hypotheses gain momentum.

The participants aimed to maintain and develop the project results (mainly IOP, Scenarios, Policy Doc) even after the end of the project. The results remained available online to be used and implemented not only by partners but also in all European countries if needed. The Exploitation Plan detailed the procedures and roles for these later developments. The project directly involved students, teachers, and policy stakeholders, with a large number of young people, teachers, and decision-makers participating.

The long-term impact of the Edusimsteam Project is multifaceted, with implications for students, teachers, the education system, and society as a whole. The following subsections outline the key areas of long-term impact and their associated contents:

Workforce Development and Employability

The Edusimsteam Project aims to equip students with the skills and competencies needed for the workforce of the future by guiding their teachers to help them. By promoting critical thinking, problem-solving, creativity, and collaboration, STEAM education prepares students to adapt to rapidly evolving technological advancements and changing job market demands. It cultivates a well-qualified and diverse workforce, nurturing individuals capable of driving innovation, entrepreneurship, and sustainable economic growth.

Innovation and Technological Advancements

STEAM education fosters a culture of innovation by encouraging students to explore, experiment, and apply their knowledge to real-world problems. This focus on innovation cultivates a generation of individuals who can contribute to technological advancements, scientific discoveries, and creative solutions. The long-term impact of STEAM education through Edusimsteam Project extends to technological progress, societal advancements, and addressing complex global challenges.

Education System Transformation

The implementation of the STEAM education has the potential to transform the broader education system. By integrating interdisciplinary, inquiry-based learning approaches and leveraging technology, STEAM education challenges traditional teaching methods and fosters a learner-centered environment. This transformation extends beyond individual classrooms and schools, influencing educational policies, curricula, and teaching practices at regional, national, and international levels.

Societal Impact and Well-Rounded Citizens

STEAM education not only prepares students for future careers but also cultivates well-rounded individuals who actively contribute to society. By fostering creativity, critical thinking, and social awareness, STEAM education nurtures responsible citizens who can engage in informed decision-making, ethical practices, and sustainable development. The long-term impact of STEAM education extends to creating a society that values and leverages science, technology, engineering, arts, and mathematics to address societal challenges effectively.

Equity, Diversity, and Inclusion

An essential aspect of the long-term impact of the STEAM learning model is its potential to promote equity, diversity, and inclusion in education. By providing accessible and inclusive learning experiences, STEAM education can bridge gaps in educational opportunities and

promote equal access for students from diverse backgrounds. This impact extends to empowering underrepresented groups, including girls and individuals from marginalized communities, to actively participate and succeed in STEAM fields.

Research and Innovation Ecosystem

The long-term impact of the STEAM learning model extends to the development of a vibrant research and innovation ecosystem. By nurturing students' curiosity, critical thinking, and problem-solving skills, STEAM education contributes to a culture of research and innovation. This ecosystem involves collaborations between educational institutions, research organizations, industry partners, and policymakers to address emerging challenges, develop cutting-edge technologies, and drive sustainable growth.

By considering and actively working towards these long-term impacts, stakeholders in STEAM education can contribute to the creation of a future-ready society, characterized by innovation, inclusivity, and sustainable development. Continuous research, collaboration, and investment in STEAM education are essential to ensure its long-term effectiveness and relevance in preparing students for the opportunities and challenges of the rapidly changing world.

In summary, with numbers, the long-term indirect impacts were as follows:

First Level

- Stakeholders involved in the project and interested in the project results used from
    - Different ministries.
    - Students and classrooms from at least 1,000 schools in 6 countries.
    - Students and classrooms from other countries.
    - Universities.
    - Public administrations.
    - Scientific journals.

Second level:

- Potential users of the project (the IOP was an open platform) in the widest sense, which reached up to hundreds of thousands of users.

Third Level:

- The policy documentation concerning the STEAM methodology was published and largely promoted to ensure the widest dissemination and use, from eTwinning to the largest Education networks.
- In this way, 150,000 students and 25,000 teachers made use of IOP and related content.

5. Conclusion

In conclusion, this impact analysis report has provided a comprehensive assessment of the STEAM learning model's impact on teachers and students. Through the evaluation of various aspects such as skills acquisition, improvement of academic results, student satisfaction,

dissemination, and impact on the education system, we have gained valuable insights into the effectiveness and significance of the STEAM education approach.

The findings of this report have demonstrated the positive outcomes and transformative potential of the project. In the short term, the project successfully strengthened the implementation of STEAM policies in partner countries, fostering collaboration among teachers and educators across different sectors. The development of tools and platforms, such as the Innovative Online Platform (IOP) and learning scenarios, has facilitated the integration of STEAM into existing curricula, promoting real-world applications, inquiry-based learning, and collaborative practices.

Furthermore, the project's impact has extended beyond its immediate participants through dissemination activities and the availability of project outputs to educational institutions and non-school settings. The reach and influence of the project have been significant, with the IOP attracting a substantial number of registered users, and the project's policy guide being downloaded and utilized extensively.

In the long term, the project has aimed to contribute to the achievement of Europe 2020 education targets by improving STEM skills among young students. By fostering innovative approaches to STEAM education, the project has facilitated the development of a well-qualified and diverse workforce for the future. The project's emphasis on interdisciplinary, problem-solving, and peer education methodologies has transformed traditional science teaching approaches, making STEM education more attractive, relevant, and engaging for students.

To sum up, the project has made a profound impact on the education system, empowering teachers, students, schools, and families. It has led to increased participation in STEAM fields, improved digital connectivity, enhanced access to educational resources, and the cultivation of forward-looking skills. By leveraging simulations, promoting policy improvement, and advocating for evidence-based practices, the project has paved the way for positive transformations in education.

Moving forward, it is essential to sustain research efforts and ongoing collaboration to continually assess and refine the impact of STEAM education. The project's outcomes, including the IOP, learning scenarios, and policy frameworks, should be further developed and widely implemented to benefit students, educators, and policymakers across Europe and beyond. By prioritizing equity, accessibility, and inclusivity, the project will continue to drive meaningful change and create a positive and transformative educational landscape.

6. Discussion

The impact analysis report presented here has provided a comprehensive evaluation of the STEAM learning model's impact on teachers and students. The findings and outcomes

discussed in the previous sections highlight several key points that warrant further discussion and reflection.

Firstly, the analysis revealed a positive impact on the level of skills acquired by both teachers and students through project activities. The implementation of the STEAM learning model, supported by the Innovative Online Platform (IOP) and learning scenarios, has enabled teachers to enhance their proficiency in STEAM-related skills. This, in turn, has translated into improved teaching practices and the ability to deliver engaging and effective STEAM education to students. The acquisition of these skills has also positively influenced students, as evidenced by their improved academic performance in STEAM subjects. It is worth noting that the project's emphasis on real-world applications and inquiry-based learning has played a crucial role in fostering students' interest and motivation in STEAM disciplines.

Secondly, the analysis highlighted the impact of the STEAM education on student satisfaction levels. By integrating interactive and engaging learning experiences into the curriculum, the project has successfully created a more rewarding and enjoyable learning environment for students. The utilization of simulations, collaborative practices, and transdisciplinary approaches has made STEAM subjects more accessible, relatable, and interesting to students. The high levels of student satisfaction reported throughout the project demonstrate the effectiveness of the STEAM learning model in engaging students and fostering their enthusiasm for STEAM disciplines.

The impact analysis also shed light on the dissemination of project outcomes to other educational institutions and non-school settings. The project's reach and influence extended beyond its immediate participants, with the IOP and project outputs being made available to a wider audience. This dissemination has contributed to the broader adoption of the STEAM learning model, enabling more students and educators to benefit from the innovative approaches and resources developed within the project. The dissemination activities, such as conferences and advertisements, have played a crucial role in raising awareness and generating interest in the project's outcomes, leading to increased engagement and collaboration from stakeholders in the education community.

Moreover, the analysis explored the impact of the project on the education system, particularly in terms of training courses for teachers focused on STEAM education. By providing comprehensive teacher training and professional development opportunities, the project has played a significant role in shaping educational practices and policies related to STEAM. The project's emphasis on continuous learning, collaboration, and the integration of STEAM into existing curricula has influenced educational institutions and policymakers to prioritize STEAM education and consider innovative approaches. The project's impact on the education system has the potential for long-term sustainability and systemic change, contributing to the advancement of STEM skills among students and the development of a future-ready workforce.

It is important to acknowledge that the impact analysis presented in this report is based on a specific timeframe and set of indicators. While the findings demonstrate significant progress and

positive outcomes, it is essential to continue monitoring and evaluating the long-term impact of the STEAM learning model. Further research and assessments are needed to assess the sustained effectiveness of the model, its scalability, and its ability to address the evolving needs of students and society in an ever-changing technological landscape.

In conclusion, the Edusimsteam Project has provided valuable insights into the effectiveness and significance of the STEAM learning model on teachers, students, and the education system. The project's outcomes have demonstrated the transformative potential of integrating simulations, fostering collaborative endeavors, and improving policy frameworks in STEAM education. By prioritizing equity, accessibility, and inclusivity, the project has successfully empowered teachers, students, and stakeholders to effect positive changes and create a more engaging and relevant educational landscape. Moving forward, continuous research, collaboration, and refinement of the STEAM learning model will be crucial to sustain its impact and ensure its continued success in preparing students for the challenges of the future.

7. Implications

The impact analysis report of Edusimsteam Project has significant implications for various stakeholders in the field of education. The findings and outcomes discussed in the previous sections carry important implications for educators, policymakers, researchers, and educational institutions. This section explores some of these implications and their potential influence on future practices and policies.

1. Educators and Teachers

The report of the Edusimsteam Project highlights the importance of professional development and continuous training for teachers in implementing effective STEAM education. The findings indicate that providing teachers with the necessary skills and resources, such as the Innovative Online Platform (IOP) and learning scenarios, can significantly enhance their teaching practices and improve student outcomes. As such, educational institutions should prioritize investing in professional development programs that equip teachers with the knowledge and tools needed to effectively integrate STEAM into their classrooms. Ongoing support and collaboration among educators can further enhance their ability to deliver engaging and innovative STEAM instruction.

2. Policymakers

The impact analysis report of the Edusimsteam Project underscores the need for policymakers to recognize and support the implementation of STEAM education initiatives. The positive outcomes observed in the project demonstrate the potential of STEAM to improve student engagement, academic performance, and critical thinking skills. Policymakers should consider integrating STEAM into national curricula and educational policies, ensuring its inclusion at all educational levels. Additionally, policymakers should promote the development of resources,

platforms, and initiatives that facilitate the implementation of STEAM education, fostering collaboration between educational institutions, policymakers, and industry partners. By prioritizing STEAM education in policies, policymakers can contribute to the development of a future-ready workforce and drive innovation in various sectors.

3. Researchers

The findings of the impact analysis report of the Edusimsteam Project provide valuable insights for researchers in the field of STEAM education. The report highlights the impact of specific strategies, such as inquiry-based learning, real-world applications, and collaboration, on student outcomes and teacher practices. Researchers can build upon these findings to further investigate the effectiveness of different pedagogical approaches and instructional techniques within the STEAM framework. Moreover, the report emphasizes the importance of ongoing research and evaluation to monitor the long-term impact and sustainability of the STEAM learning model. Researchers should continue to explore new methodologies, technologies, and assessment tools that can enhance the effectiveness of STEAM education and address emerging challenges and opportunities.

4. Educational Institutions

The Edusimsteam Project provides educational institutions with evidence-based insights on the benefits and impact of implementing the STEAM learning model. Institutions should consider integrating STEAM education into their curricula and providing the necessary resources and support for teachers to effectively implement STEAM practices. Collaboration among schools, universities, and industry partners can foster the development of innovative STEAM programs, facilitate the sharing of best practices, and enhance the availability of resources and learning materials. By embracing the STEAM learning model, educational institutions can prepare their students for the demands of the 21st century, equipping them with critical thinking, problem-solving, and creativity skills.

In conclusion, the implications of the Edusimsteam Project extend to educators, policymakers, researchers, and educational institutions. The findings highlight the importance of continuous professional development for teachers, the need for policy support and integration of STEAM in curricula, the role of research in furthering the understanding of effective STEAM practices, and the responsibility of educational institutions in embracing the STEAM learning model. By considering these implications, stakeholders can work together to advance STEAM education, foster innovation, and prepare students for the challenges and opportunities of a rapidly evolving world.

8. Limitations

While the impact analysis report highlights significant achievements and positive outcomes of the STEAM learning model, it is essential to acknowledge certain limitations that may have influenced the project's implementation and findings.

1. COVID-19 Pandemic
The COVID-19 pandemic has had a profound impact on education worldwide, causing disruptions in traditional teaching practices, classroom interactions, and access to educational resources. During the project implementation period, the pandemic necessitated a shift to remote and online learning, which posed challenges to teachers and students alike. The sudden transition to virtual learning environments may have affected the optimal delivery of STEAM education, particularly in regions with limited access to technology or internet connectivity. Despite these challenges, the project team adapted swiftly to the changing circumstances, offering support and resources to ensure continuity in STEAM education.

2. Earthquake in Türkiye
In addition to the COVID-19 pandemic, the project faced the unexpected challenge of an earthquake in Türkiye, which caused significant disruptions and hardships for the local community. The earthquake had repercussions on educational institutions, teachers, and students, making it even more challenging to implement the STEAM learning model effectively. However, despite these adversities, the project persisted, and the first-level impact plans were achieved, indicating the resilience and commitment of all stakeholders involved.

3. Limitations in Data Collection
The impact analysis report relies on data collected during a specific timeframe, which may limit the comprehensiveness of the findings. External factors such as school schedules, participant availability, and unforeseen events may have affected data collection efforts. Additionally, certain data points may have been subject to self-reporting bias, influencing the accuracy of certain measurements.

4. Scope and Generalizability
The impact analysis report primarily focuses on the project's outcomes within the selected partner countries and specific contexts. As such, the generalizability of the findings to other educational settings may be limited. Different educational systems, cultural contexts, and socio-economic conditions could influence the impact and effectiveness of the STEAM learning model in varying ways.

5. Long-Term Impact Assessment
While the report presents valuable insights into the short-term impact of the STEAM learning model, a more extensive and prolonged assessment of the long-term impact is necessary to gauge the sustainability and lasting effects of the project. As with any educational initiative, measuring the long-term impact requires continued monitoring and evaluation beyond the project's duration.

Despite these limitations, the project has demonstrated resilience and adaptability, overcoming challenges posed by the COVID-19 pandemic and the earthquake in Türkiye. The commitment of all stakeholders to achieving the first-level impact plans, as well as the ongoing dissemination activities, highlights the dedication to advancing STEAM education. These experiences and learnings can inform future projects and initiatives, ensuring continuous improvement and refinement of STEAM education approaches. As the project moves forward, continued collaboration, research, and evaluation will be crucial in maximizing the positive impact of the STEAM learning model on students, teachers, and the broader education community.

9. Recommendations

Based on the findings and implications of the Edusimsteam Project, several recommendations can be made to further enhance the effectiveness and impact of the STEAM learning model. These recommendations target various stakeholders involved in STEAM education, including educators, policymakers, researchers, and educational institutions. Implementing these recommendations can contribute to the continuous improvement and advancement of STEAM education practices.

1. Educators and Teachers

a. Continuous Professional Development: Educators should actively engage in continuous professional development opportunities focused on STEAM education. This can include workshops, training programs, conferences, and online courses that provide them with the necessary skills and knowledge to effectively implement STEAM practices in their classrooms. Educational institutions should allocate resources to support and encourage educators' professional growth in STEAM education.

b. Collaborative Practices: Educators should foster collaboration among their peers to share best practices, resources, and strategies related to STEAM education. Collaborative networks, both online and offline, can serve as platforms for teachers to exchange ideas, collaborate on projects, and collectively address challenges in implementing STEAM practices. Educational institutions should provide support and opportunities for teachers to engage in collaborative practices.

2. Policymakers

a. Policy Integration: Policymakers should prioritize the integration of STEAM education into national curricula and educational policies. This can be achieved by developing guidelines, frameworks, and standards that emphasize the importance of STEAM education and its integration across subject areas. Policymakers should also consider allocating resources to support the implementation of STEAM education initiatives at all educational levels.

b. Partnerships and Funding: Policymakers should foster partnerships between educational institutions, industry partners, and research organizations to promote collaboration, resource sharing, and innovation in STEAM education. Adequate funding should be allocated to support

the development of STEAM programs, the provision of necessary resources, and the training of teachers in STEAM practices.

3. Researchers

a. Continued Research: Researchers should continue to conduct rigorous research on the impact and effectiveness of different pedagogical approaches, instructional strategies, and technologies within the STEAM learning model. This research should focus on identifying best practices, evaluating outcomes, and exploring innovative methodologies to enhance STEAM education. The findings should be disseminated widely to inform educators, policymakers, and other stakeholders in the field.

b. Longitudinal Studies: Researchers should conduct longitudinal studies to assess the long-term impact and sustainability of the STEAM learning model. This includes evaluating the effects of STEAM education on students' academic achievement, career pathways, and critical thinking skills over an extended period. Longitudinal studies can provide valuable insights into the long-term benefits and challenges associated with implementing STEAM education.

4. Educational Institutions

a. Resource Allocation: Educational institutions should allocate resources to support the implementation of STEAM education, including the provision of necessary materials, equipment, and technology. Accessible and well-equipped STEAM labs and classrooms should be established to facilitate hands-on learning experiences for students.

b. Collaboration and Partnerships: Educational institutions should actively seek partnerships with industry organizations, research institutions, and community stakeholders to enhance STEAM education. Collaborations can provide students with real-world experiences, mentorship opportunities, and access to industry expertise. Educational institutions should also establish networks and partnerships to share best practices, resources, and research outcomes related to STEAM education.

c. Evaluation and Assessment: Educational institutions should develop appropriate evaluation and assessment methods to measure the effectiveness and impact of STEAM education. This includes formative and summative assessments that assess students' subject-specific knowledge, as well as their critical thinking, problem-solving, and collaboration skills developed through STEAM education. Evaluation frameworks should also consider the holistic development of students, including their creativity, communication, and digital literacy skills.

By implementing these recommendations, stakeholders in STEAM education can collectively work towards improving and expanding the impact of the STEAM learning model. Continuous collaboration, research, and resource allocation are essential to ensure the ongoing success and relevance of STEAM education in preparing students for the future.