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List of Abbreviations

D	:	Deliverable
DGIET	:	General Directorate of Innovation and Education Technologies
EACEA	:	European Education and Culture Executive Agency
EDUSIMSTEAM	:	Fostering STEAM Education in Schools Project
EU	:	European Union
ICT	:	Information and Communication Technologies
IOP	:	Innovative Online Platform
KA3	:	Key Action 3 (Support for Policy Reform)
K12	:	Kindergarten through the 12th grade school levels
METU	:	Middle East Technical University
MoNE	:	Ministry of Turkish National Education
MOOC	:	Massive Open Online Course
PLATEGA	:	Plataforma de Teleformación de Galicia (Galician Tele-education Platform)
STEAM	:	Science, Technology, Engineering, Art and Mathematics
WP	:	Work Package

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Progress Report

Abstract

This paper presents an overview of the progress made by our project in the realm of simulation platform and policy improvement in education. The project aims to provide an evidence-based approach for STEAM education through improving teacher competences and leveraging simulations to enhance learning outcomes and shape STEAM education policies. A robust framework has been developed to introduce STEAM education approach and improve the basic competences of teachers to implement STEAM education approach. The project also connects STEAM education scenarios to simulation-based learning experiences into existing curricula, catering to diverse subjects and educational levels. Collaborations with educators, policymakers, and researchers have resulted in the design and implementation of interactive simulation modules, fostering student engagement and deep understanding of complex concepts. Furthermore, the project focuses on policy improvement by conducting research and analysis to identify areas of improvement within existing educational policies. Challenges such as technical limitations, resource constraints, and professional development requirements for educators have been acknowledged, highlighting the need for ongoing collaboration and strategic planning. Moving forward, the project envisions continued research to assess the impact of simulations on student achievement and critical thinking, alongside advocacy for evidence-based practices in educational policies. Through the integration of simulations and policy improvement initiatives, the project seeks to empower students, educators, and policymakers to create positive changes in the educational landscape, with a strong emphasis on equity, accessibility, and inclusivity.

Keywords: *simulation, policy improvement, education, immersive learning, student engagement, evidence-based practices.*

1. Introduction

The EDUSIMSTEAM project is an ambitious and innovative initiative that seeks to foster and promote STEAM (Science, Technology, Engineering, Arts, and Mathematics) education in schools. With the rapid advancement of technology and the increasing importance of 21st-century skills, the development of STEAM competencies has become crucial for individuals to thrive in future skills and contribute effectively to society.

One of the objectives of the EDUSIMSTEAM project is to harness the power of information and communication technologies (ICT) within innovative learning environments. By leveraging ICT tools, the project aims to transfer evolving and cutting-edge practices from various disciplines to create a truly multidisciplinary educational experience. This approach ensures that students are exposed to the interconnectedness and real-world applicability of knowledge across different fields.

The project was initiated with the objective of exploring and testing innovative policies for STEAM education and policy enhancements to transform traditional educational practices. By leveraging immersive and interactive simulations, coupled with evidence-based policy frameworks, the project aims to foster student engagement, critical thinking, and decision-making skills in educational settings.

Throughout its implementation, the project has achieved significant milestones in various areas. Firstly, a needs analysis to define the teacher needs in STEAM education was conducted to gather relevant information and insights at European level. We used a questionnaire to gather information from teachers involved in STEAM education or those who are interested in implementing it. The survey covered aspects such as their current knowledge of STEAM, their training needs, the challenges they face, and their expectations for support in implementing STEAM education.

Secondly, based on the need, we have developed a robust framework that facilitates the seamless integration of STEAM education into existing curricula. This framework ensures the key approach for STEAM education that align with specific learning objectives, cater to diverse subject areas, and accommodate various educational levels.

Using the framework, we have developed a teacher training content delivered through a teacher training platform where teachers participated in a capacity building activity by analyzing various documents, videos, and sources in addition to discussion with their colleagues and experts.

An important aspect of the project has been the focus on policy improvement in education. We have conducted extensive research and analysis to identify gaps and areas of improvement within existing educational policies. By incorporating evidence-based practices and expert recommendations, our project seeks to contribute to the development of effective and equitable policies that promote student success, teacher support, and educational equity.

One of the key strategies employed by the project is the sharing of learning scenarios based on real-life problems. By presenting students with authentic and contextually relevant challenges, the project aims to enhance their critical thinking, problem-solving, and collaboration skills. These scenarios are developed and shared with various educational stakeholders through online platforms, ensuring accessibility and scalability of the project's impact.

The project recognizes the importance of collaboration and knowledge exchange among educators, policymakers, and researchers in driving educational innovation. By actively engaging these stakeholders through online platforms, the project fosters a vibrant community of practice, enabling the sharing of best practices, insights, and resources. This collaborative approach empowers educators to continually improve their teaching methodologies and adapt to the evolving needs of students in an ever-changing world.

Additionally, the EDUSIMSTEAM project operates under the guidance and support of the Ministry of National Education's General Directorate of Innovation and Educational Technologies. This ensures that the project aligns with national education policies and goals, creating a cohesive and sustainable educational ecosystem that benefits students, teachers, and the broader society.

Furthermore, the project is coordinated by the Ministry of National Education, Directorate General for Innovation and Educational Technologies while the project consortium presents a strong European partnership and expertise from 10 project partners. This collaborative effort enables the project to tap into a diverse range of expertise, experiences, and perspectives. By leveraging the strengths and knowledge of each partner, the project aims to not only drive STEAM education within the local context but also contributes to the advancement of STEAM education across Europe. The partnership structure includes:

1. Directorate General for Innovation and Education Technologies (MoNE YEGITEK): The Turkish Ministry of National Education's department responsible for innovation and educational technologies.
2. Kaunas University of Technology (KTU): A Lithuanian university known for its focus on technology and innovation in education.

3. Citecengmat, LDA (CTEM Academy): A Portuguese company specializing in educational technologies and materials for STEAM education.
4. H2 Learning Ltd. (H2Learning): An Irish organization that provides educational consultancy and support services, particularly in the area of digital learning.
5. Direccion General de Educacion, FP e Innovacion Educativa; Consejeria de Educacion, Universidad y FP (Spain Ministry of Education): The Spanish Ministry of Education, which contributes to the project through its General Directorate of Education, Vocational Training, and Educational Innovation.
6. Vilnius University (VU): A prestigious Lithuanian university offering a wide range of academic programs, including education and technology-related fields.
7. Middle East Technical University (METU): A renowned Turkish university known for its emphasis on science, mathematics, engineering, and technology education.
8. Both Social: An organization that focuses on social innovation and aims to create positive social impact through various projects.
9. Acrome: An organization involved in educational initiatives and projects, particularly in the field of STEAM education.
10. Robotics and Mechatronics Technology Engineering Consultancy Education Software Industry and Trade Limited Company (ROBOTSAN): A Turkish company in robotics

The collaboration between these partners aims to exploit the potential of STEAM education across Europe. By integrating technology and innovative learning approaches, the project aims to develop future generations capable of keeping up with technological advancements and contributing to society through innovative policies and solutions. Kicking off an innovative online platform and testing simulations would be the milestone for presenting a new tool to support STEAM education practices.

In summary, the EDUSIMSTEAM project is a forward-thinking and comprehensive initiative that embraces the transformative power of technology, collaboration, and multidisciplinary learning. By utilizing innovative learning environments and sharing real-life scenarios, the project aims to equip future generations with the necessary skills and knowledge to thrive in an increasingly interconnected and technology-driven world. Through its partnerships and online platforms, the project aims to make a significant impact on STEAM education, both within its country of origin and throughout Europe.

Despite the progress made, several challenges have emerged during the project's implementation. Technical limitations, resource constraints, and the emergency situations such as covid and earthquake have posed hurdles in scaling up the use of simulations. Addressing these challenges requires ongoing collaboration, advocacy, and strategic planning to ensure the widespread adoption of simulation-based learning and evidence-informed policies.

Looking towards the future, our project envisions further growth and refinement. We aim to continue our research efforts to assess the impact of simulation-based learning on student achievement, engagement, and critical thinking skills. Additionally, we will actively engage with policymakers to advocate for the integration of evidence-based practices into educational policies, with a focus on equity, accessibility, and inclusivity.

In conclusion, the project has made substantial progress in leveraging simulations and policy improvement to enhance education. By providing immersive learning experiences and contributing to evidence-informed policies, we strive to empower students, educators, and policymakers to create positive and impactful changes in the educational landscape. While challenges remain, our commitment to innovation and collaboration fuels our determination to advance simulation-based learning and policy improvement initiatives in education.

2. Project Work Packages in Different Levels and Productivity

Within this section, a comprehensive overview of the undertaken activities in the project work packages is provided, elucidating them at varying levels of granularity. Employing a methodological approach characterized by the progression from general to specific, we commenced by addressing the organizational level, subsequently transitioning to the school level, followed by the teacher level, and ultimately delving into the student level.

2.1. Organization Level

At the organization level, our project has focused on establishing partnerships with educational institutions, such as schools, colleges, and universities (Refer to Table 2.2). These partnerships aim to foster a culture of innovation and provide institutional support for the integration of simulations into the educational framework. By collaborating with organizations, we aim to create a supportive environment that encourages experimentation, professional development, and the sharing of best practices among educators.

Collaboration between partners and educational institutions is a key element for the success of projects. In fact, cooperation and collaboration among colleagues strengthen schools' success and teachers' performance (Petro, 2023). Our project emphasizes this collaboration and communication, aligning them with the targeted work packages. The project activities amplified with strong collaborative work between partners which was satisfied with either online and face-to-face project meetings. There have been three face-to-face, several online project management meetings to evaluate the progress of the project activities and further develop these activities. Accordingly, feedback, suggestions, and requests from schools, partners, and educational institutions are greatly appreciated for each work package, as they contribute to further improvements. From the first work package, which aims to identify teachers' needs in STEAM education, to the final work package, our project actively seeks feedback from other educational stakeholders in every activity. Surveys, written documents, observations, and interviews are collected, evaluated, and implemented if deemed appropriate and aligned with the project's objectives.

Examples of project activities evaluated at the organizational level include workshops, webinars, pilot, and testing processes for SimuLearn, local meetings held for the Implementation Guide for Policymakers and Practitioners, and an international STEAM conference. Webinars, workshops, and pilot processes involve the participation of school leaders and teachers in general. These activities are organized with the contributions and presentations of relevant educational experts, academics, and professionals to address the project's main STEAM objectives, which are aimed at meeting the needs of STEAM education. Thus, our project was implemented through strong collaboration among

educational stakeholders, amplifying different perspectives at each level of the work packages.

The STEAM Implementation Guide for Policymakers and Practitioners highlights the key points gathered from our project. The consultations with partner countries regarding STEAM approaches implemented in their respective countries form an evidence-based, highly inclusive, and reflective guide for policymakers, ministries, universities, and educational stakeholders involved in implementing STEAM education. The guide underscores the outcomes of our project, which brings together various education stakeholders in the context of STEAM education, and emphasizes the need for cooperation among educational institutions, universities, schools, and the private sector to enhance the STEAM approach in EU countries.

Additionally, our project has worked closely with organizational leaders and administrators to develop implementation strategies for simulation-based learning. This includes addressing technical infrastructure requirements, allocating resources for simulation development and maintenance, and establishing protocols for monitoring and evaluating the effectiveness of simulations. By involving organizational leaders in the project, we aim to create a sustainable and scalable framework for simulation integration that can be embraced by the entire educational institution.

The overall EDUSIMSTEAM project's progress in organizational level is summarized in Table 2.1. below.

Table 2. 1. EDUSIMSTEAM Project's Progress in Organizational Level

Project Work Packages	**Description**
WP1- Design of the Project (Needs Analysis, Strategy Development)	• The six project partner countries' teachers contributed to the "need analysis" survey and interview findings. • The project partner countries collaborated on project management planning.
WP2- Teacher Training & Training Curriculum	• The training platform was launched with the contributions of a project partner, Kaunas University of Technology, Lithuania. • Synchronous sessions were conducted parallel to the teacher training with contributions of mentors.
WP3- Scenarios Development	• STEAM scenarios were created in 6 themes with the contributions of METU, Vilnius University and CTEM Academy, developed with the feedback of all six project partners.
WP4-Innovative Online	• The system was launched by Acrome, Türkiye.

Project Work Packages	Description
Platform (SimuLearn)	• Pilot studies were conducted in Türkiye and Spain. • Dissemination activities were conducted to exploit and inform about SimuLearn.
WP5-A practical guide for policy makers	• Local meetings were conducted in project partner countries. • Practical Guide brings together different educational stakeholders including educational institutions, universities, schools, and private sector and developed by H2Learning and BothSocial.
WP6-Project Monitoring	• Project partners provided collaborative effort to control the project activities and outcomes. • Project partners ensured the communication between participants and the European Commission. • Project partners monitored and evaluated the process of the project.
WP7-Project Evaluation and Dissemination	• Webinars, workshops, and international STEAM conferences have been conducted. • Project partners attended various external events, including conferences and seminars to disseminate the project outputs.

2.2. School Level

At the school level, our project has focused on implementing STEAM-based learning experiences within the existing curriculum. We have collaborated with schools to identify specific areas where teachers need to be trained to enhance student learning and engagement in STEAM education. By teacher training on STEAM education (WP-2) and integrating simulations into lessons (WP-4), we aim to provide students with hands-on, experiential learning opportunities that deepen their understanding of complex concepts and develop critical thinking skills. Trained mentors in Spain and Türkiye helped enhance the process of teacher training as well as the integration of STEAM learning scenarios and trials of SimuLearn platform.

The school environment is influenced by the activities conducted, which, in turn, affects student achievement (Usaini, Abubakar & Bichi, 2015). Schools participating in innovative projects create active learning environments that engage students through various learning activities, providing a favorable and comfortable setting (Usaini, Abubakar & Bichi, 2015). In the project, STEAM activities conducted in schools enrich the learning

environment, fostering students' sense of connectedness, belongingness, and community involvement. Additionally, teacher training, workshops, conferences, and webinars provide opportunities for teachers to enhance their capabilities, leading to increased self-confidence and self-efficacy in STEAM.

To improve both teachers and students, our project focuses on enhancing digital literacy skills, requiring schools to be equipped with digital resources. In line with the project's objectives, we offer online training for teachers to improve their STEAM knowledge and computational thinking skills and create authentic STEAM scenarios. This empowers teachers to implement their knowledge and STEAM scenarios in their classrooms, enabling students to become active participants in their learning and take responsibility for their education. The online training also promotes collaboration among teachers and provides a platform to share their STEAM practices and experiences.

Similarly, the innovative online simulation platform called SimuLearn allows schools to create collaborative and innovative learning environments (Refer to Figures 1 and 2). School leaders only need to provide teachers and students with computers and internet access. Teachers and students can engage with the simulation platform individually or through group work, even outside of school premises. There have been 6795 users experienced the SimuLearn comprising teachers and students. Consequently, the outcomes of our project enhance learning environments, promoting flexibility and personalized learning with a STEAM approach. This innovation in the learning environment positively impacts students' attitudes, interests, and academic achievement (Byers et al., 2014). From a teacher's perspective, innovative learning opportunities improve professional development by introducing new roles, skills, and competencies, such as digital literacy and innovative pedagogy, which effectively engage students with digital materials and foster innovative learning. In fact, when schools adopt an educational perspective that embraces the use of digital and technological resources, as well as innovative approaches like STEAM, the instructional approach naturally evolves accordingly (Sztenjnberg & Finch, 2006).

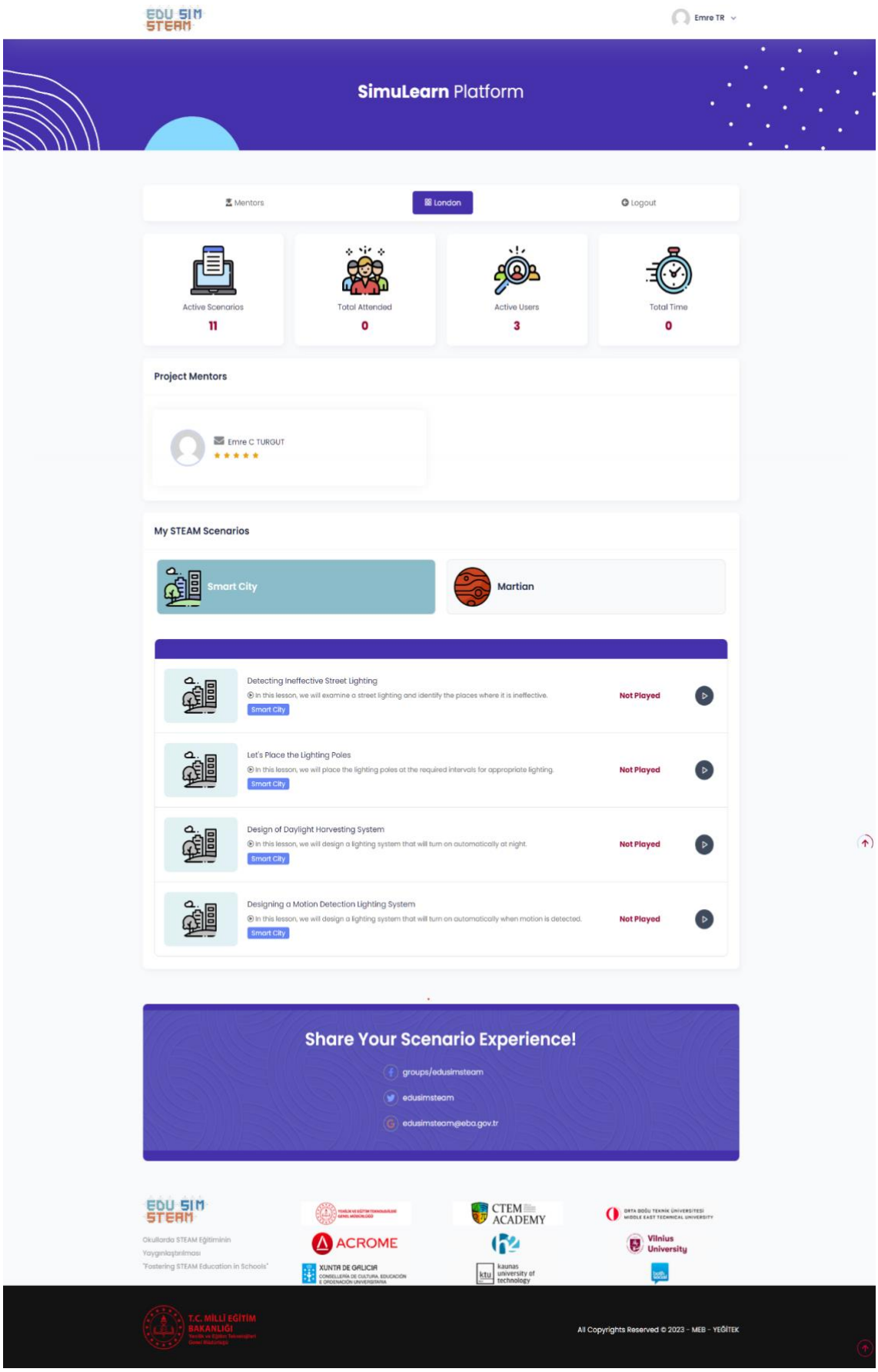

Figure 1. A Scene from a learning scenario on SimuLearn – 1

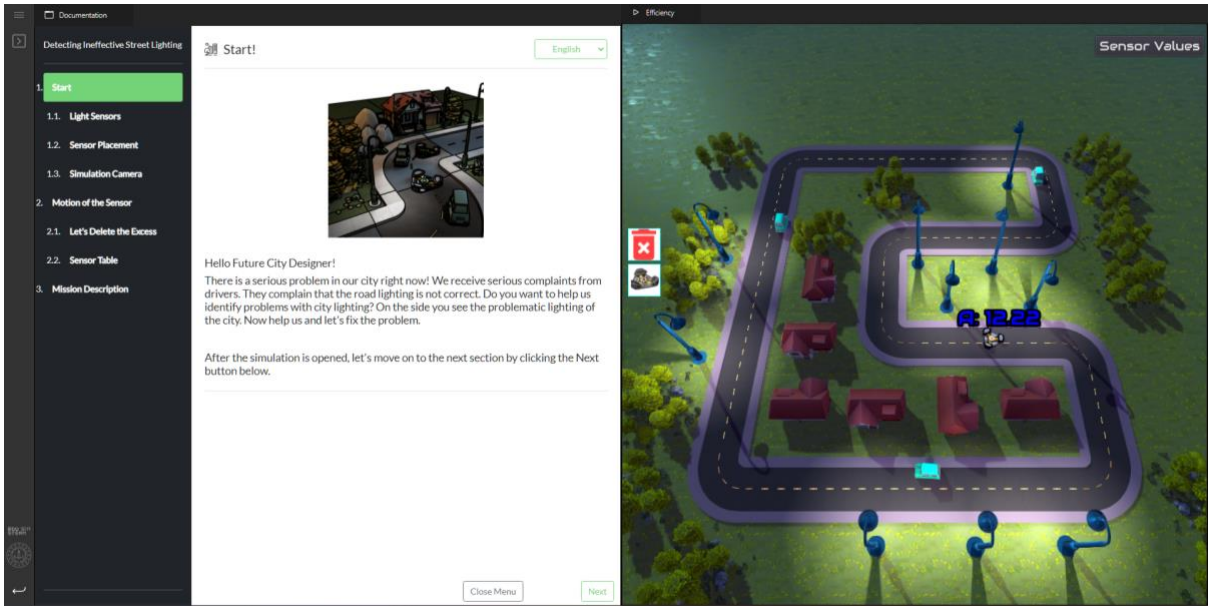

Figure 2. A scene from a learning scenario on SimuLearn - II

Moreover, our project has supported schools in creating a supportive infrastructure for simulation-based learning. This includes providing access to necessary technological resources, training teachers on simulation implementation, and establishing assessment strategies to measure the impact of simulations on student outcomes. Additionally, we have encouraged schools to create collaborative learning environments where students can work together, solve problems, and apply their knowledge gained through simulations in real-world contexts.

The overall EDUSIMSTEAM project's progress in school level is summarized in Table 2.2. below.

Table 2.2. EDUSIMSTEAM Project's Progress in School Level

Project Work Packages	**Description**
WP1- Design of the Project (Needs Analysis, Strategy Development)	Need analysis of the project highlights the teachers' needs in STEAM and computational thinking that provide to develop related project activities that contribute to meet teachers' needs.
WP2- Teacher Training & Training Curriculum	The online training platform with the content of STEAM and computational thinking contribute to teachers' STEAM knowledge and computational thinking skills and provide creating STEAM scenarios to amplify the school environment with STEAM education.
WP4- Innovative Online	The simulation platform targeted to implement STEAM

Project Work Packages	Description
Platform (SimuLearn)	scenarios provide schools to change to a learning environment with an innovative and digital educational platform.
WP7- Project Evaluation and Dissemination	Teachers are supported with webinars, workshops related to STEAM and computational thinking to support students with STEAM education.

2.3. Teacher Level

At the teacher level, our project has focused on equipping educators with the necessary knowledge, skills, and resources to effectively integrate simulation-based learning into their teaching practices. We have developed comprehensive training programs and professional development opportunities specifically tailored to teachers. In fact, in the project activities, the teachers from Türkiye and Spain enrolled in pilot and test programs to improve the training and platforms accordingly. These initiatives aim to enhance their understanding of simulations, their pedagogical benefits, and how to effectively incorporate them into their lessons. By providing teachers with the necessary support and training, we aim to empower them to facilitate engaging and immersive learning experiences for their students.

The implementation of STEAM in classrooms is a robust process that requires the integration of various disciplines through collaboration. Our project aims to enhance teachers' STEAM knowledge and computational thinking skills through online teacher training, which includes comprehensive academic and practical resources. This training enables teachers to create STEAM learning scenarios and engage in computational thinking-related experiences. To further enhance the impact of online STEAM teacher training and facilitate the sharing of experiences among teachers, synchronous online sessions were conducted to cover the content of each module.

Research findings have demonstrated that innovative STEAM practices and training positively influence teachers' approach and implementation of STEAM (Erbilgin, 2017; Kermani & Aldemir, 2015; Monkeviciene et al., 2020). The EDUSIMSTEAM project aims to empower teachers through comprehensive STEAM training and workshops, enabling them to acquire substantial STEAM knowledge and enhance their professional development. Throughout the training and piloting processes, teachers are guided by mentors. Evidence suggests that the effectiveness of STEAM training is heightened when teachers receive mentorship (DeJarnette, 2018; Aldemir & Kermani, 2016; Monkeviciene et al., 2020).

Content-related STEAM webinars, conducted in collaboration with project partners and content experts, provide guidance for teachers to acquire the necessary STEAM knowledge and computational thinking skills and implement STEAM-related practices. There have been 33 webinars in total to support teachers STEAM knowledge and skills in European level which also enhance collaboration and communication between teachers. Besides webinars, one face-to-face and one online workshop planned for the teachers in which teachers enhance their STEAM approach with experiencing creating authentic STEAM learning scenarios and active learning strategies.

In order to effectively incorporate STEAM and computational thinking skills, learning environments need to be equipped with the necessary materials and equipment. The EDUSIMSTEAM project empowers teachers to provide their students with real-world problem-solving experiences through the simulation platform called SimuLearn. This platform integrates STEAM learning scenarios, promoting students' 21st-century skills such as computational thinking, problem-solving, and creativity. Lugthart and van Dartel (2021) emphasize the importance of engaging students with STEAM simulations to facilitate situated learning. The platform has been tested and piloted to improve its effectiveness in providing individualized STEAM learning experiences. Test and pilot findings demonstrate that SimuLearn offers teachers and students the opportunity to experience real-life problems and propose innovative solutions in a simulated environment. Teachers have reported that the platform captures students' interest, increases their motivation to learn, and enables learning at their own pace. The platform covers various themes, allowing teachers to connect students with real-life problems that resonate with their own lives, experiences, and communities (Kommers, 2004). Teachers engage students by tailoring the simulation and coding experience to their individual learning preferences and interests.

Furthermore, our project has collaborated with teachers to co-create simulation modules that align with specific subject areas and learning objectives. This collaboration ensures that the simulations are relevant, practical, and cater to the needs of both teachers and students. Regular feedback loops and ongoing communication with teachers have been instrumental in refining and improving the simulation modules, ensuring they effectively address the curriculum requirements and engage students in meaningful ways.

The overall EDUSIMSTEAM project's progress in teacher level is summarized in Table 2.3. below.

Table 2.3. EDUSIMSTEAM Project's Progress in Teacher Level

Project Work Packages	Description
WP2- Teacher Training & Training Curriculum	The online training platform facilitates teachers with the content of STEAM and computational thinking.
WP4-Innovative Online Platform (SimuLearn)	The simulation platform targeted to implement STEAM scenarios being an innovative online education platform that provides computational thinking experience in line with STEAM.
WP7- Project Evaluation and Dissemination	The webinars which have been conducted in STEAM and computational thinking-related contents to disseminate the outputs of projects' work packages in EU level.
WP7-Project Evaluation and Dissemination	STEAM workshops have been conducted to teachers provided with the content, approaches, and activities to improve their STEAM knowledge and practice.

2.4. Student Level

At the student level, our project has focused on fostering engagement, critical thinking, computational thinking, and decision-making skills through simulation-based learning experiences. By immersing students in realistic and interactive simulations, we aim to create an active learning environment that encourages exploration, experimentation, and problem-solving. The simulations provide students with opportunities to apply theoretical knowledge, make informed, solution-based decisions, and experience the consequences of their actions in a controlled setting.

Students participate in the pilot process of SimuLearn to experience STEAM learning scenarios focused on two themes: Smart City and Mars. Through this simulation platform, students can engage in solving real-life problems such as energy conservation, selecting appropriate tools for vehicles, and proposing solutions for space exploration. Additionally, the platform offers opportunities for students to enhance their creativity, computational thinking, and coding skills. One of the advantages of SimuLearn is that it allows students to experience their practices simultaneously without requiring expensive hardware or kits to observe the consequences of their actions. Students and teachers have the freedom to choose themes and scenarios, as the platform does not impose any restrictions. This flexibility enables teachers to easily incorporate the platform into their curriculum, while students benefit from personalized learning experiences that align with their individual

pace and interests. It is of note that Edusimteam is a policy reform project. We tested the STEAM education approach with SimuLearn, this platform can be used as an exemplary and adoptable platform in different themes and scenarios. Saying this, it could also be translated and used in other countries.

Moreover, our project places significant emphasis on reflection and debriefing sessions following simulation experiences. These sessions provide students with the opportunity to critically analyze their decision-making processes, evaluate their outcomes, and establish connections between the simulated scenarios and real-life situations. By promoting reflection, we aim to deepen students' understanding and facilitate the transfer of knowledge and skills acquired through simulations to practical contexts.

Overall, our project recognizes the importance of addressing different levels within the education system to effectively implement simulation-based learning. By focusing on teachers, organizations, schools, and students, we aim to create a comprehensive framework that supports the integration of simulations into the educational landscape. Through these efforts, we seek to enhance learning outcomes, promote student engagement, and shape educational policies to create a more effective and inclusive educational environment.

The overall EDUSIMSTEAM project's progress in student level is summarized in Table 2.4. below.

Table 2.4. EDUSIMSTEAM Project's Progress in Student Level

Project Work Packages	Description
WP1- Design of the Project (Needs Analysis, Strategy Development)	Need analysis of the project highlights the teachers' needs in STEAM and computational thinking in order to provide students learning environment to foster their 21st century skills in the light of STEAM education
WP2- Teacher Training & Training Curriculum	The online training platform with the content of STEAM and computational thinking contribute to teachers' STEAM and computational thinking knowledge and stimulate teachers providing STEAM implementation to enhance students' active learning processes.
WP3- Scenarios Development	STEAM scenarios were created in 6 themes in the scope of solving daily life issues with the integration of STEAM aspects that were integrated into SimuLearn enable students to solve these problems in the platform by using their creativity, problem solving, computational thinking, coding and digital competencies.

Project Work Packages	Description
WP4- Innovative Online Platform (SimuLearn)	Students experience STEAM implementations in the SimuLearn that triggers their 21st century skills in many ways.
WP7- Project Evaluation and Dissemination	Teachers are supported with webinars, workshops related to STEAM and computational thinking to support their students with STEAM-based education.

3. Conclusion and Discussion

3.1. Conclusion

In conclusion, the project has made significant strides in the needs analysis of teachers in STEAM education, developing a framework and training teachers on STEAM, creating STEAM-based scenarios and integration of simulations and policy improvement initiatives in education. Through the development of a robust framework and collaboration with educators, policymakers, and researchers, we have successfully implemented interactive simulation modules that enhance student engagement and deep understanding of complex concepts. Additionally, our project has focused on policy improvement by conducting research and analysis to identify areas of enhancement within existing educational policies. Despite challenges such as technical limitations, resource constraints, and professional development requirements, we remain committed to ongoing collaboration and strategic planning to ensure the widespread adoption of simulation-based learning and evidence-informed policies. Moving forward, our project envisions continued research to assess the impact of simulations on student achievement and critical thinking, alongside advocacy for evidence-based practices in educational policies. Through the integration of simulations and policy improvement initiatives, we aim to empower students, educators, and policymakers to create positive changes in the educational landscape, with a strong emphasis on equity, accessibility, and inclusivity.

3.2. Course evaluation based on quantitative data

The integration of simulations in education has revolutionized teaching and learning practices, leading to significant advancements in student engagement, critical thinking, and decision-making skills. In this context, our project has played a pivotal role in developing a robust framework for simulation-based learning experiences and driving policy improvements in education. By collaborating with educators, policymakers, and researchers, we have designed interactive simulation modules that align with specific learning objectives across diverse subjects and educational levels. Through evidence-

based practices and expert recommendations, our project aims to contribute to the development of effective and equitable educational policies that promote student success and educational equity. However, while progress has been made, challenges such as technical limitations and resource constraints require ongoing collaboration and strategic planning. By addressing these challenges and advocating for evidence-based practices, we aim to foster positive and impactful changes in the educational landscape, ensuring that simulation-based learning and policy improvements benefit all students and educators.

Advancements in Simulation-Based Learning:

The integration of simulations into education has shown significant advancements through our project. By developing a robust framework, we have ensured the seamless integration of simulation-based learning experiences into existing curricula. This framework caters to diverse subjects and educational levels, aligning simulations with specific learning objectives. The collaboration with educators, policymakers, and researchers has been instrumental in designing and implementing interactive simulation modules covering various subject areas. These modules provide students with realistic, hands-on experiences that promote active learning and deep understanding of complex concepts. The advancements in simulation-based learning have fostered student engagement, critical thinking, and decision-making skills, creating a more immersive and effective educational environment.

Policy Improvement in Education:

Our project has also made significant progress in policy reform for STEAM education. Through extensive research and analysis, we have identified gaps and areas of improvement within existing educational policies. By incorporating evidence-based practices and expert recommendations, we aim to contribute to the development of effective and equitable policies that promote student success, teacher support, and educational equity that could widely support priorities and actions in Digital Education Action Plan (EU, 2020). The integration of simulations into policy discussions and decision-making processes has provided valuable insights into the potential benefits of simulation-based learning. Furthermore, by advocating for evidence-based practices in educational policies, our project aims to create a more informed and impactful policy environment that addresses the evolving needs of students, educators, and society as a whole. To specify, our project can make valuable contributions to the "Digital Education Action Plan" of the European Union (EU) in several ways:

- Digital Competence: Edusimsteam project can equip students with essential digital competencies by incorporating digital tools and technologies into the learning process through its support to teachers. This aligns with the EU's objective of

fostering digital skills and literacy among learners, enabling them to thrive in the digital age.

- Innovative Teaching Methods: Supported in Edusimsteam project, STEAM education promotes active learning, problem-solving, critical thinking, and creativity. By integrating digital technologies and tools, such as coding platforms, virtual simulations, and collaborative online platforms, the project can facilitate innovative teaching approaches that align with the EU's goal of encouraging digital pedagogies and transformative teaching practices.
- Teacher Professional Development: The EU's plan recognizes the importance of empowering teachers with digital competencies. Edusimteam project offered training and professional development opportunities for educators to enhance their digital skills, enabling them to effectively integrate technology into their teaching practices.
- Collaboration and Networking: The Digital Education Action Plan promotes collaboration and networking among educational stakeholders at regional, national, and international levels. Edusimsteam project facilitates partnerships between schools, institutions, and organizations, fostering knowledge sharing, best practices exchange, and joint initiatives in digital education.
- Research and Evaluation: The EU emphasizes evidence-based decision-making and continuous improvement in digital education. Edusimsteam project can contribute to this by conducting research, evaluation, and assessment of the project's impact on learning outcomes, digital competencies, and teaching practices. The findings can inform policy development and guide future initiatives in the realm of digital education.

By aligning with the objectives of the Digital Education Action Plan, Edusimsteam project can play a crucial role in advancing digital education, fostering 21st-century skills, and preparing learners for the digital society and economy.

Challenges and Future Prospects:

While our project has achieved significant progress, it has also encountered several challenges. Technical limitations, resource constraints, and the need for extensive professional development for educators have posed hurdles in scaling up the use of simulations and implementing policy changes effectively. To address these challenges, ongoing collaboration, advocacy, and strategic planning are essential. The collaboration with stakeholders, including educators, policymakers, and researchers, is crucial for addressing technical limitations and resource constraints. Furthermore, providing adequate professional development opportunities for educators ensures their preparedness to effectively utilize simulation-based learning in the classroom. Moving forward, our project envisions continued research to assess the impact of simulation-based learning on student achievement, engagement, and critical thinking skills.

Additionally, active engagement with policymakers is necessary to advocate for evidence-based practices and promote the integration of simulations into educational policies, with a focus on equity, accessibility, and inclusivity.

In conclusion, our project has made significant progress in collecting evidence for STEAM education, improving the competences of teachers through online training, providing STEAM education content for integrated STEAM education, leveraging simulations and policy recommendations to enhance STEAM education. The advancements in simulation-based learning have enhanced student engagement and deep understanding of complex concepts. Additionally, the focus on policy improvement has contributed to the development of effective and equitable educational policies. Despite challenges, our commitment to ongoing collaboration and strategic planning fuels our determination to advance simulation-based learning and policy improvement initiatives in education. By empowering students, educators, and policymakers, we aim to create positive and impactful changes in the educational landscape, with a strong emphasis on equity, accessibility, and inclusivity.

3.3. Implications

Use of Simulearn in Education:

The integration of simulations in education has had profound implications for teaching and learning practices, transforming the educational landscape, and paving the way for innovative approaches to student engagement and achievement. Our project has been at the forefront of these advancements, making significant contributions to the field through the development of a robust framework for simulation-based learning experiences and driving policy improvements in education. The implications of these efforts extend beyond the immediate classroom setting, influencing educational stakeholders at various levels and reshaping the way we approach education as a whole.

One of the key implications of integrating simulations into education is the enhancement of student engagement. Traditional classroom instruction often relies on passive learning methods, where students are recipients of information rather than active participants in the learning process. Simulations, on the other hand, provide students with realistic, hands-on experiences that stimulate their curiosity and foster a sense of ownership over their learning journey. By immersing students in interactive scenarios that mirror real-world situations, simulations create an environment where students can actively explore, experiment, and problem-solve. This active engagement not only deepens their understanding of complex concepts but also instills a sense of enthusiasm and motivation for learning.

Moreover, simulations promote critical thinking and decision-making skills among students. In the rapidly evolving world we live in, the ability to think critically and make informed decisions is essential. Simulations offer a safe and controlled space for students to grapple with complex problems, analyze information, weigh different options, and make decisions based on their assessment of the situation. This iterative process of problem-solving and decision-making within simulations allows students to develop critical thinking skills that are transferable to real-life scenarios. They learn to evaluate the consequences of their decisions, consider multiple perspectives, and adapt their approaches based on feedback and outcomes. By honing these skills in the context of simulations, students are better prepared to navigate the complexities of the modern world and become active contributors to society.

Furthermore, simulation-based learning experiences have the potential to bridge the gap between theoretical knowledge and its practical application. In many traditional educational settings, students often struggle to connect the concepts learned in the classroom to real-world contexts. Simulations provide a powerful tool to address this challenge by creating authentic, contextualized learning experiences. By engaging in simulations related to specific subjects or industries, students can directly apply their knowledge and skills in a simulated environment that closely resembles the professional world. This bridge between theory and practice not only enhances their understanding but also equips them with the skills and confidence needed to succeed in their future careers.

In the realm of policy improvement, our project has made significant strides towards advancing evidence-based practices and shaping educational policies that promote student success, teacher support, and educational equity. Through extensive research and analysis, we have identified gaps and areas for improvement within existing policies and have worked collaboratively with policymakers, researchers, and educators to develop recommendations for effective and equitable policies. By incorporating simulation-based learning into policy discussions, we have provided valuable insights into its potential benefits and have advocated for its integration into educational frameworks at regional, national, and international levels.

The implications of our project's policy improvement initiatives extend beyond the classroom walls. Effective educational policies have a far-reaching impact on the educational ecosystem, influencing teaching practices, resource allocation, and the overall quality of education. Our project's focus on evidence-based practices has helped inform policymakers about the potential of simulation-based learning to enhance student outcomes and drive educational innovation. By actively engaging with policymakers, we have fostered a dialogue that prioritizes the integration of simulations into educational policies, with an emphasis on equity, accessibility, and inclusivity.

One of the key implications of our policy improvement efforts is the potential to create a more informed and impactful policy environment. By conducting extensive research and analysis, we have generated evidence that highlights the benefits of STEAM education in improving student engagement, critical thinking, and decision-making skills. This evidence-based approach provides policymakers with a solid foundation to develop policies that align with the needs and aspirations of students and educators. It also fosters a culture of continuous improvement, where policies are regularly evaluated and refined based on data and research findings.

Additionally, our project's policy improvement initiatives have the potential to address educational disparities and promote equity in education. Through our research and advocacy, we have highlighted the importance of creating inclusive policies that ensure equal access to simulation-based learning opportunities for all students, regardless of their socio-economic background, geographical location, or learning abilities. By prioritizing equity in educational policies, we can work towards reducing the achievement gap and providing every student with an equitable chance to succeed academically.

Furthermore, our project's policy improvement efforts have paved the way for collaboration and knowledge-sharing among educational stakeholders. By engaging educators, policymakers, researchers, and experts from various fields, we have fostered a collaborative environment where diverse perspectives and insights are shared. This collaboration has resulted in the development of innovative approaches to education that leverage simulation-based learning as a transformative tool. Through 2 workshops, an international conference, and 33webinars, we have provided platforms for stakeholders to exchange ideas, share best practices, and collectively work towards the improvement of educational policies.

The Erasmus+ program has always emphasized the importance of knowledge sharing and exchange among participants from different countries and educational backgrounds. EduSimSteam epitomizes this principle by offering a platform where expertise and ideas can converge. Through workshops, seminars, and online forums, project participants engage in constructive discussions, sharing best practices and innovative approaches in digital education content development. This dynamic exchange of knowledge not only enriches the quality of the content but also contributes to the professional growth of individuals involved.

Finally, yet importantly, EduSimSteam actively contributes to the creation of digital education content (DEC), encompassing both training materials and simulations. By fostering collaboration among diverse stakeholders, EduSimSteam exemplifies how Erasmus+ projects offer a conducive space for content creation tailored to the educational sector's needs. Through its collaborative nature, EduSimSteam brings together a diverse range of stakeholders, including educators, researchers, technology experts, and

policymakers. Moreover, this contribution serves as a living model that encourages iterative improvement through user feedback, reflecting the project's responsiveness to the dynamic educational landscape. State differently, this dynamic collaboration serves as a catalyst for generating content that is specifically tailored to the needs and challenges faced by the education sector.

In the future, our project envisions ongoing research and assessment to further understand the impact of simulation-based learning on student achievement, engagement, and critical thinking skills. This research will contribute to the growing body of knowledge on effective educational practices and provide valuable insights for policymakers, educators, and researchers. Additionally, we recognize the need for continuous professional development opportunities for educators to effectively utilize simulation-based learning in the classroom. By investing in the professional growth of teachers, we can ensure that they are equipped with the necessary skills and knowledge to harness the full potential of simulations and create impactful learning experiences for their students.

Moving forward, our project aims to continue advocating for evidence-based practices in STEAM education policies and promoting the innovative solutions to support STEAM education in instructional practices. We believe that simulation-based learning has the power to revolutionize education by creating immersive and interactive learning experiences that prepare students for the challenges of the 21st century. By empowering students, educators, and policymakers, we aspire to create positive and impactful changes in the educational landscape, with a strong emphasis on equity, accessibility, and inclusivity.

In conclusion, the integration of simulations into education and the improvement of educational policies through our project have far-reaching implications for teaching and learning practices. The advancements in simulation-based learning have enhanced student engagement, critical thinking, and decision-making skills, bridging the gap between theory and practice. Through our policy improvement initiatives, we have contributed to the development of effective and equitable educational policies that prioritize student success and educational equity. While challenges exist, our commitment to collaboration, research, and ongoing professional development fuels our determination to advance simulation-based learning and policy improvements in education. By leveraging the transformative power of simulations, we strive to create a future where every student has the opportunity to thrive and succeed in an inclusive and innovative educational environment.

Use of Project Outputs: STEAM Scenarios, Guidebooks, Teacher Training Platform for STEAM and STEAM Framework and more

The use of project outputs such as STEAM scenarios, guidebooks, a teacher training platform for STEAM, and a STEAM framework has profound implications for education. These resources have the potential to revolutionize teaching and learning practices, empower educators, and enhance students' educational experiences. In this section, we will explore the implications of these project outputs in detail, highlighting their significance and potential impact.

First and foremost, the STEAM scenarios developed through the project offer innovative and authentic learning experiences for students. These scenarios provide students with the opportunity to engage in hands-on, real-world problem-solving activities that integrate multiple disciplines. By incorporating science, technology, engineering, arts, and mathematics, these scenarios foster interdisciplinary thinking, creativity, and critical thinking skills. Students are challenged to apply their knowledge and skills to solve complex problems, thereby preparing them for the demands of the 21st century workforce. The use of STEAM scenarios in classrooms can significantly enhance student engagement, motivation, and achievement.

The guidebooks produced as part of the project serve as valuable resources for educators, policymakers, and other educational stakeholders. These guidebooks provide comprehensive insights into the implementation of STEAM education, offering practical strategies, best practices, and case studies. Educators can use these guidebooks to enhance their understanding of STEAM pedagogy and gain practical ideas for designing and delivering STEAM lessons. Policymakers can leverage the guidebooks to inform the development of STEAM-related policies and initiatives at local, regional, and national levels. The guidebooks also facilitate knowledge sharing and collaboration among educators and policymakers, fostering a community of practice focused on STEAM education.

The teacher training platform for STEAM is another critical project output with significant implications for professional development. This platform offers educators the opportunity to enhance their knowledge, skills, and confidence in delivering STEAM education. Through online training modules, teachers can access rich academic resources, practical examples, and collaborative learning experiences. The platform enables teachers to deepen their understanding of STEAM pedagogy, explore innovative teaching methods, and gain proficiency in integrating technology and computational thinking into their lessons. By empowering teachers with the necessary tools and support, the teacher training platform contributes to the professional growth and effectiveness of educators in implementing STEAM education.

The STEAM framework developed as part of the project serves as a guiding document for the implementation of STEAM education. This framework outlines the key

principles, objectives, and components of a robust STEAM program. It provides a roadmap for educators and educational institutions to design and implement STEAM curricula that align with national and international standards. The framework emphasizes the integration of STEAM across disciplines, the promotion of inquiry-based learning, and the cultivation of critical thinking and problem-solving skills. By adopting this framework, educational institutions can ensure the systematic and coherent implementation of STEAM education, leading to improved student outcomes and a more effective learning environment.

The use of these project outputs has implications for various stakeholders in the education system. For educators, the STEAM scenarios, guidebooks, teacher training platform, and framework offer professional growth opportunities, enabling them to enhance their instructional practices and pedagogical approaches. Educators gain access to a repertoire of innovative teaching strategies and resources that can transform their classrooms into dynamic and engaging learning environments. By embracing these project outputs, educators can cultivate students' creativity, critical thinking, and collaborative skills, preparing them for future success.

Policymakers can leverage the project outputs to inform their decision-making processes and shape educational policies that promote STEAM education. The guidebooks and STEAM framework provide policymakers with evidence-based practices, international benchmarks, and implementation guidelines. Policymakers can use these resources to develop policies that support the integration of STEAM across educational systems, allocate resources for professional development, and foster collaboration between educational institutions, industry partners, and community stakeholders. By aligning policies with the project outputs, policymakers can create an enabling environment that facilitates the effective implementation of STEAM education, ultimately benefiting students, educators, and society as a whole.

Furthermore, the use of project outputs has implications for educational institutions as they strive to provide high-quality and relevant education. By incorporating the STEAM scenarios into their curricula, institutions can create learning environments that promote active, experiential learning. Students are encouraged to explore, experiment, and collaborate, developing a deeper understanding of concepts and acquiring essential skills for their future careers. The project outputs also support educational institutions in designing professional development programs that empower teachers with the knowledge and skills necessary to deliver effective STEAM instruction. Through the teacher training platform and guidebooks, institutions can provide ongoing support and resources to educators, ensuring their continuous growth and development in the field of STEAM education.

The use of project outputs also has broader implications for the education system as a whole. STEAM education is aligned with the needs of the modern workforce, which

demands individuals who possess a diverse range of skills and can adapt to rapidly changing technologies and industries. By integrating STEAM into education, we equip students with the skills and competencies necessary to thrive in the 21st century. The project outputs promote critical thinking, problem-solving, creativity, and collaboration, all of which are essential skills for success in the digital age. As students engage in STEAM activities, they develop a growth mindset, resilience, and a passion for lifelong learning.

Moreover, the use of project outputs can contribute to fostering equity and inclusivity in education. The STEAM scenarios and framework emphasize the integration of arts and technology, ensuring that students from diverse backgrounds and interests can find relevance and engagement in the learning process. By incorporating culturally responsive pedagogy and addressing the unique needs of different student populations, educators can create inclusive learning environments that celebrate diversity and promote equal opportunities for all students. The project outputs provide guidance and resources to support educators in creating culturally sensitive STEAM lessons that resonate with students' identities and experiences.

In addition, the project outputs have implications for research and further development in the field of STEAM education. As educators and policymakers utilize the STEAM scenarios, guidebooks, and framework, they can provide valuable feedback and contribute to the ongoing refinement and improvement of these resources. Through research and evaluation, the impact of the project outputs can be assessed, providing evidence of their effectiveness in enhancing student learning outcomes and promoting innovative teaching practices. This research can also identify areas for further development and exploration, leading to the continuous advancement of STEAM education and its integration into educational systems worldwide.

In conclusion, the use of project outputs such as STEAM scenarios, guidebooks, a teacher training platform for STEAM, and a STEAM framework holds tremendous implications for education. These resources provide educators with the tools, knowledge, and support to create engaging and meaningful learning experiences for students. Policymakers can leverage these outputs to inform policies that promote the integration of STEAM education, while educational institutions can enhance their curricula and professional development programs. The use of these project outputs also contributes to the development of a skilled and adaptable workforce, fosters equity and inclusivity in education, and stimulates further research and innovation in the field of STEAM education. By embracing these project outputs, we can empower educators, inspire students, and shape a future where STEAM education plays a central role in preparing individuals for success in the ever-evolving global landscape.

References

Byers, T., Imms, W. & Hartnell-Young. (2014). Making the case for space: The effect of learning spaces on teaching and learning. Curriculum and Teaching, 29(1), 5-19. https://doi.org/10.7459/ct/29.1.02

Erbilgin, E. (2017). A Comparison of the Mathematical Processes Embedded in the Content Standards of Turkey and Singapore. Research in Social Sciences and Technology, 2(1). https://doi.org/10.46303/ressat.02.01.3

European Union [EU]. (2020). Digital education action plan. https://education.ec.europa.eu/focus-topics/digital-education/action-plan

Kermani, H. & Aldemir, J. (2015). Preparing children for success: Integrating science, maths, and technology in early childhood classroom. Early Child Development and Care, 185(9), 1504-1527. https://doi.org/10.1080/03004430.2015.1007371

Kommers, P.A.M. (2004). Cognitive Support for Learning; Imagining the Unknown. Amsterdam, Nederland: IOS Pre.

Lugthart, S. & van Dartel, M. (2021). Simulating Professional Practice in STEAM Education: A Case Study. European Journal of STEM Education, 6(1), 17. https://doi.org/10.20897/ejsteme/11393

Monkeviciene, O., Autukeviciene, B., Kaminskiene, L. & Monkevicius, J. (2020). Impact of innovative STEAM education practices on teacher professional development and 3-6-year-old children's competence development, Journal of Social Studies Education Research, 4(1), 1-17

Petro, M. (2023). Techniques and Strategies of Communication and Cooperation with Colleagues Inside and Outside the School. European Journal of Language and Literature Studies, 9(1).

Sztejnberg, A. & Finch, E. F. (2006). Adaptive use patterns of secondary school classroom environments. Facilities. Vol. 24(13-14), 490-509. https://doi.org/10.1108/02632770610705275

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