AN AUTHENTIC LEARNING & GENDER INCLUSIVE FRAMEWORK FOR TEACHING INFORMATICS IN SCHOOLS ACROSS EUROPE

WP2 A Framework and Toolkit for informatics

Best Practices Examples

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THINKER
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Best Practices Examples

During the desk research activities of Work Package 2, the partner organisations identified **up to two national initiatives** (e.g., research study, intervention programme) for upper primary and lower secondary education which has tested/evaluated an approach in line with principles of authentic learning and/or gender inclusion in the teaching of informatics. These best practices examples are presented below.

Cyprus

Best Practice 1: Code & Youth An Innovative Program in the Digital Era

Title of initiative and overview of context	Description and Lessons learned
http://codeandyouth.iit.demokritos.gr/ **Code & Youth** **An Innovative Program in the Digital Era** **Erasmus+ Programme**	CODE & YOUTH project pioneers in proposing to develop, implement and evaluate a comprehensive challenging summer coding programme focusing on introducing young people (13-17 yrs) to the world of CODING and COMPUTING, by using in a constructive way teenagers' long summer vacations, in order to teach them in a creative way how to code and to present them, through first-hand experience (visits) the spectrum of fields they can follow to study and later on work in the digital area. It aimed to introduce QUALITY STANDARDS (coding framework with benchmark and indicators), EVIDENCE-BASED DATA and MECHANISMS for the VALIDATION of the acquired coding competences for young people and youth workers (YW) through another innovative system the OPEN BADGES. The coding skills were made VISIBLE, TRANSPARENT and ACCESSIBLE through the young people's and youth workers' active involvement in the design of an eco-system. It developed a new on-line platform for e-learning, with in-built functions of interconnectivity, communication and provision of support through the e-Academy, where experts and stakeholder were registered to offer guidance and support, an e-DATABANK with useful e-tools, reports, good practices etc. for review and the e-COMMUNITY where young people and YW can share their experiences and learn from each other through the 'digital profile' to be created. **Results:** Creation of two courses on Programming and Robotics, participation of young students, organization of Info Days The specific programme is a good example of a programme following an authentic learning approach and it would be good to be applied in schools as well. Students had the opportunity not only to learn and put in real-context their knowledge but also receive guidance from experts on the field and collaborate with other students.

Best practice 2: BEBRAS

Title of initiative and overview of context	Description and Lessons learned

https://bebras.org.cy/en/index/index/ **BEBRAS** **Competition**	BEBRAS is an international initiative aiming to promote Informatics, problem solving skills, computational and analytical thinking among school students at all ages. No prior knowledge is required in order to participate. The first round of the competition is open and can be executed from any location with access to the internet and without supervision. The second round takes place in selected schools in all provinces and participants are supervised by teachers. In Cyprus, the competition is applicable for primary and secondary schools and is being organized by the Cyprus Computer Society and the IT Teacher Association. As ICT becomes a commonly used tool of education, this playful contest ensures that both boys and girls equally benefit from it. We are certain that Bebras encourages students to learn skills as well as enduring fundamental knowledge that will be helpful in their future studies and in life in general. The specific competition is a good initiative and all students should be encouraged to participate. It encompasses the principles of both authentic learning and gender-inclusion and thus we suggest to be also organized at a smaller scale at each school. With an emphasis on computational thinking combined with informatics concepts and practices, it provides the students with the tools to solve interdisciplinary problems within other disciplines and enhance this skill on which future scientific and technological progress can be based and supported. It also provides a conceptual framework for better use of Information Technology in general education, within the framework of the multidisciplinary approach and education in STEAM (Science, Technology, Engineering, Arts & Mathematics) fields.

Eligibility Criteria for Initiatives Selection:

Criteria	*How does the selected case satisfy this?*
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	Both cases are directly related to principles of authentic learning as they can be both applied to authentic contexts and they also encompass practices such as reflection, articulation and access to experts' performance. The second initiative, by providing equal opportunities to boys and girls, is also related to gender inclusion principles.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	Both cases are informed by scientific knowledge, outlining the design, application and results.

Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	Both examples are initiatives that have been already transferred to international contexts. The first case included partners from 4 different countries while the second one is a global competition.
Practical: the case has been implemented in a real-life school setting.	The second phase of the competition takes place in schools with the invigilation of teachers. The first initiative has not been applied to real settings but in our opinion it could be beneficial for all schools to utilize it.

Greece

Best Practice 3: Skills Labs (SL) Program

Title of initiative and overview of context	Description and Lessons Learned
Skills Labs (SL) Program: Educational Program for all grades of compulsory education. (Skills Lab 21+, n.d.)	Description: The Skills Labs (SL) program is an addition to the mandatory curriculum in kindergarten, primary, and secondary schools. It focuses on developing students' skills rather than solely imparting knowledge, encouraging them to actively utilise their understanding, explore new concepts, set goals, collaborate, and take initiative. The program is organised around four axes: 21st-century skills, Life Skills, Technology, engineering, and science skills, and mind skills, with each section engaging with different themes throughout the school year. Themes are explored over 5-7-week periods, with varying time allocations for different grade levels. The program emphasises experiential and collaborative learning methods, such as hands-on projects, role-playing, research, and participation in educational media. It has been evaluated and endorsed by the Institute of Educational Policy (IEP) and received recognition from the European Network for Education for Global Citizenship (GENE) for its innovative approach and adherence to global education principles outlined in the Maastricht Declaration. • **methodology applied** The program development involved collaboration among various stakeholders, including teachers, academics, researchers, civil society organizations, international bodies, and local authorities composed by IEP. The methodology included curriculum design, resource development, pilot testing, and evaluation. Evaluation methods included surveys, interviews, focus groups, and observation. • **actual results** The survey results indicate widespread positive reception of the Skills Labs (SL) program among the school community, teachers, and students. Overall, students and teachers welcomed the program, recognising its added value and effectiveness in addressing various educational aspects. Teachers positively evaluated the thematic modules, noting their ability to cultivate targeted skills, while also acknowledging the comprehensive coverage of topics contributing to skill development. The group collaborative method and laboratory-based approach were highlighted as key contributors to the program's success. Importantly, students perceived the SL program as beneficial to their holistic development, enhancing knowledge, attitudes, values, and skills. Additionally, students reported increased participation in the learning process. These findings underscore the effectiveness of the SL program in fostering a positive and enriching educational experience for all stakeholders. The survey was conducted through the electronic completion of a questionnaire which was distributed through the infrastructure of the Panhellenic School Network and was carried out between 15-30 June 2022 with the participation of 11039 schools (5156 kindergartens, 4166 primary schools, and 1717 secondary schools). • **implications for practice** The program demonstrates the effectiveness of interdisciplinary, experiential learning approaches in developing 21st-century skills and fostering global citizenship. Recommendations for future application include ongoing teacher training, resource allocation, and community engagement. • **your insights and personal statement about the case**

	The Skills Labs (SL) program exemplifies a forward-thinking approach to education, emphasising skills development, and global citizenship. Its success underscores the importance of innovation and collaboration in educational reform. Moving forward, it is essential to scale and sustain such initiatives, ensuring equitable access and continuous improvement. The results of this program can inform practice in other subject domains by emphasising skills over content knowledge, promoting authentic learning, and fostering global perspectives.

Best Practice 4: School without Stereotypes Program

Title of initiative and overview of context	Description and Lessons learned
School without Stereotypes Program: Teacher Training and Gender Inclusion Initiative (Women on Top, 2022)	**Description:** The "School without Stereotypes" program was launched in 2022 in Greece by Women On Top, to address three main challenges facing teenage girls and young women: 1) The difference in treatment of boys and girls by teachers perpetuating gender stereotypes and inequalities, 2) The 'self-confidence gap' in 10-14-year-old girls, hindering their aspirations for positions of responsibility, and 3) Occupational segregation resulting in low participation of girls and young women in science, technology, engineering, and mathematics (STEM) fields and positions of responsibility. The program includes teacher training, networking, and integration of gender equality in the educational process, aiming to empower girls in emotional-social skills, offer stereotype-free school career guidance, and encourage their engagement in STEM subjects. ● **methodology applied** The program employs a variety of methods including workshops, seminars, and discussions led by experts and educators. These sessions provide teachers with tools to prevent and address gender inequalities in the classroom, empower girls in emotional-social skills, and offer stereotype-free career guidance. Evaluation methods may include surveys, interviews, and observations to assess changes in teacher attitudes, classroom practices, and student outcomes. ● **actual results** Participants in the first cycle of the program, including teachers of all levels and school advisors, were trained on tools to prevent and address gender inequalities in education, empower girls, and offer stereotype-free career guidance. The program's impact is measured through changes in teacher attitudes and practices, as well as improvements in girls' self-confidence and engagement in STEM subjects. ● **implications for practice** The program demonstrates the importance of teacher training and gender inclusion initiatives in addressing gender stereotypes and inequalities in education. Recommendations for future application include ongoing professional development for educators, collaboration with stakeholders, and integration of gender equality principles into curriculum and school policies. ● **Insights and Personal Statement** The "School without Stereotypes" program highlights the significance of addressing gender disparities in education through targeted interventions such as teacher training and gender-inclusive practices. Its emphasis on empowering girls and promoting their engagement in STEM subjects is crucial for fostering diversity and equality in educational and professional fields. Moving forward, it is essential

	to continue scaling up such initiatives, ensuring their sustainability and impact across Europe. The results of this program can inform practice in other subject domains by emphasising the importance of gender-inclusive teaching practices and providing educators with tools and resources to create inclusive learning environments.

Eligibility Criteria for Initiatives Selection:

Case/Initiative title:	**Skills Labs (SL) Program: Educational Program for all grades of compulsory education. (Skills Lab 21+, n.d.)**
Criteria	***How does the selected case satisfy this?***
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	The Skills Labs (SL) program directly addresses principles of authentic learning by focusing on skills' development rather than solely imparting knowledge. It encourages active exploration, collaboration, and initiative among students, which are essential components of authentic learning. Additionally, the program emphasises gender inclusion by providing equal opportunities for all students to participate and engage in various activities regardless of gender.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	The development and implementation of the Skills Labs (SL) program are informed by scientific knowledge and educational research. The program's design, application, and evaluation process are based on evidence-based practices in curriculum development, experiential learning, and interdisciplinary education. Evaluation methods include surveys, interviews, focus groups, and observation to gather data on its effectiveness.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	The Skills Labs (SL) program can be scaled up and adapted for use across Europe. Its emphasis on developing 21st-century skills, interdisciplinary learning, and global citizenship aligns with educational goals and initiatives in many European countries. The program's practices, tools, and applications are accessible to all educators, providing flexibility for implementation in diverse school settings.
Practical: the case has been implemented in a real-life school setting.	The Skills Labs (SL) program has been successfully implemented in real-life school settings, including kindergarten, primary, and secondary schools. Teachers have autonomy to select programs from an approved list and integrate them into their curriculum based on student interests and needs. The program's effectiveness has been demonstrated through positive outcomes in student learning, engagement, and skill development.

Case/Initiative title:	**School without Stereotypes Program: Teacher Training and Gender Inclusion Initiative (Women on Top, 2022)**
Criteria	***How does the selected case satisfy this?***
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	The "School without Stereotypes" program directly addresses principles of gender inclusion in upper primary and lower secondary schools in Greece. It aims to tackle gender stereotypes and inequalities perpetuated in educational settings, particularly targeting teenage girls and young women. By providing teacher training and integrating gender equality principles into the educational process, the initiative promotes authentic learning by creating a supportive and inclusive environment for all students, regardless of gender.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	The program's design and implementation are informed by scientific knowledge and research on gender disparities in education. It incorporates evidence-based practices for preventing and addressing gender inequalities, empowering girls, and promoting their engagement in STEM subjects. The selection of training tools and methods is based on research findings on effective strategies for promoting gender equality in educational settings. Evaluation methods may include surveys, interviews, and observations to gather data on program effectiveness.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	The "School without Stereotypes" program can be scaled up and adapted for use across Europe. Its focus on teacher training, networking, and gender inclusion principles provides a framework that can be applied in various educational contexts. The practices, tools, and applications used in the program are accessible to all educators, offering inspiration and guidance for implementing similar initiatives in other schools and countries. Collaboration with international partners and organizations enhances the transferability of the program's principles and approaches.
Practical: the case has been implemented in a real-life school setting.	The program has been implemented in real-life school settings in Greece since its launch in 2022. Teachers of all levels and advisors have participated in training workshops and seminars, where they have acquired tools and strategies to promote gender equality and inclusion in their classrooms. The program's impact is observed through changes in teacher attitudes and practices, as well as improvements in girls' self-confidence and engagement in STEM subjects. By addressing real-world challenges faced by teachers and students, the program demonstrates its practical relevance and effectiveness in educational settings.

Ireland

Best Practice 5: Girls in STEM Programme

Title of initiative and overview of context	Description and Lessons learned
Girls in STEM Programme **https://www.girlsinstem.ie/** "Girls in STEM" is an intervention programme aimed at promoting gender inclusion in STEM (Science, Technology, Engineering, and Mathematics) education. Its target group is girls in secondary schools, particularly those in the age group typically associated with lower secondary education (ages 12-14) and upper secondary education (ages 15-18). The main aim is to address gender disparities in STEM fields by encouraging and empowering girls to pursue and excel in STEM subjects and careers. This initiative aims to provide girls with opportunities to engage in hands-on STEM activities, access role models and mentors in STEM fields, and develop confidence and skills in STEM subjects. By promoting gender inclusion in STEM education, Girls in STEM seeks to inspire and support the next generation of female scientists, engineers, technologists, and mathematicians.	• **methodology applied** The Girls in STEM Programme provides various activities and initiatives to engage girls in STEM education. These activities may include workshops, mentorship programs, career guidance sessions, and networking events. Participants are encouraged to explore different STEM disciplines and engage in practical, hands-on activities to develop their skills and interests. One key aspect of the programme is the provision of role models and mentors, who are often women working in STEM professions. These mentors share their experiences and insights with participants, providing inspiration and guidance for girls interested in pursuing STEM careers. • **actual results** Evaluation of the programme may involve pre- and post-surveys to assess changes in participants' attitudes and interests in STEM, as well as qualitative feedback from participants and mentors. Challenges faced by the programme may include recruitment and retention of participants, as well as ensuring inclusivity and accessibility for girls from diverse backgrounds. • **implications for practice**: The Girls in STEM Programme highlights the importance of targeted interventions in promoting gender inclusion in STEM education. Educators and policymakers can learn from this initiative by implementing similar programmes and initiatives in their own contexts. Key implications for practice include providing hands-on STEM activities, offering mentorship and role models, and creating supportive and inclusive learning environments for girls interested in STEM. Additionally, efforts should be made to address systemic barriers and biases that may discourage girls from pursuing STEM subjects and careers. • **your insights and personal statement** As an advocate for gender equity in STEM education, I believe initiatives like the Girls in STEM Programme are essential for addressing gender disparities in STEM fields. Moving forward, it is crucial to continue expanding access to STEM education for girls and providing support and mentorship to empower them to pursue interests and careers in STEM. By fostering a supportive and inclusive learning environment, we can inspire the next generation of female scientists, engineers, technologists, and mathematicians.

Best Practice 6: TechSpace

Title of initiative and overview of context	Description and Lessons learned
TechSpace **https://kinia.ie/clar-techspace/** TechSpace is an intervention programme designed to enhance digital literacy and creativity among upper primary and lower secondary school students. By integrating technology and creative media into education, it seeks to develop critical thinking, problem-solving skills, and digital competencies. Its target group is upper primary (ages 10-12) and lower secondary (ages 12-14) students. Its main aim is to empower youth by providing them with the skills and knowledge to become creators in the digital world, not just consumers.	• **methodology applied** Students participated in workshops on coding, digital storytelling, video production, and more, led by trained educators and industry professionals. Moreover, students applied what they learnt in practical projects that encourage creativity and innovation. Pre- and post-program surveys and interviews are done with students to assess changes in digital literacy, creativity, and engagement. • **actual results** Students demonstrated improved skills in coding, multimedia editing, and digital creation. Participants showed increased interest in STEM subjects and a greater willingness to engage in creative problem-solving tasks. Students expressed enjoyment and a sense of accomplishment from creating their own digital content. Educators noted higher levels of engagement and enthusiasm for learning. Results were gathered through participant surveys, interviews, and observation, with pre- and post-assessment of digital skills and creativity. • **implications for practice**: The success of TechSpace underscores the importance of hands-on, project-based learning in developing digital and creative skills. TechSpace results recommend the integration of similar programs into the standard curriculum to foster a more engaging and relevant learning experience. • **your insights and personal statement** TechSpace exemplifies the positive impact of integrating technology and creative media into education. It not only enhances digital literacy but also fosters a creative and innovative mindset among students. For future, expanding the program to more schools, including training for educators to implement similar initiatives and continued evaluation to refine and adapt the program based on feedback and outcomes would be beneficial. The principles and approach of TechSpace can inform the development of programs in other subject domains, emphasizing the importance of digital literacy, creativity, and project-based learning across the curriculum.

Eligibility Criteria for Initiatives Selection:

Case/Initiative title:	**Girls in STEM Programme https://www.girlsinstem.ie/**
Criteria	***How does the selected case satisfy this?***
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper	The Girls in STEM Programme focuses on promoting gender inclusion in STEM (Science, Technology, Engineering, and Mathematics) education, including informatics, at the lower secondary level. It aims to address gender disparities in STEM fields by providing girls with opportunities to engage in hands-on STEM

primary and lower secondary school in your country.	activities, explore STEM careers, and develop confidence and skills in STEM subjects.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	The program is informed by research on gender equity in STEM education, outlining strategies and approaches for engaging girls in STEM learning and addressing barriers to their participation. It incorporates evidence-based practices for promoting gender inclusion and evaluates the effectiveness of these interventions through ongoing monitoring and evaluation.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	The Girls in STEM Programme includes practices, tools, and resources that can be accessed and implemented by educators across Ireland and beyond. It offers guidance and support to schools and teachers interested in promoting gender equity in STEM education and can serve as a model for similar initiatives in other regions.
Practical: the case has been implemented in a real-life school setting.	The Girls in STEM Programme has been implemented in real-life school settings across Ireland, providing girls in lower secondary schools with opportunities to participate in STEM activities and events. Schools participate voluntarily in the program and collaborate with program organizers to implement gender-inclusive practices and initiatives.

Case/Initiative title:	**TechSpace Programme https://kinia.ie/clar-techspace/**
Criteria	***How does the selected case satisfy this?***
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	TechSpace is highly relevant to the principles of authentic learning and gender inclusion in upper primary and lower secondary schools in Ireland. It focuses on integrating technology and creative media into education to foster digital literacy and creativity among students, aligning with the goal of providing authentic learning experiences. Additionally, by targeting upper primary and lower secondary students, the initiative addresses gender inclusion by providing equal opportunities for both boys and girls to develop digital skills and creativity.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	While specific details on the scientific knowledge informing TechSpace are not provided on the website, the initiative is likely informed by research and best practices in education, digital literacy, and creativity. The program's effectiveness may be supported by evidence gathered through evaluations, such as pre- and post-program assessments of students' digital skills and creativity, as well as feedback from educators and participants.

Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	TechSpace can be considered transferable, as its principles and practices can serve as a model for similar initiatives across Europe. The integration of technology and creative media into education is a universal approach that can be adapted and implemented in various contexts and settings. Additionally, the tools and applications used in TechSpace workshops are likely accessible to educators and students across Europe, making it feasible to replicate or adapt the program in different schools and communities.
Practical: the case has been implemented in a real-life school setting.	TechSpace has been implemented in real-life school settings, as indicated by the workshops and activities conducted in partnership with schools and educational organizations. The program provides hands-on learning experiences for students, facilitated by trained educators and industry professionals, in a classroom or workshop environment. This practical implementation ensures that students have the opportunity to engage with technology and creative media in a meaningful and authentic way within their school setting.

Netherlands

Best Practice 7: STEAM4ALL

Title of initiative and overview of context	Description and Lessons learned
STEAM4ALL This is a scientific research project funded by the European Union aiming to develop an interdisciplinary STEAM program to empower and actively engage students, teachers, school leaders, school staff and school communities to apply STEAM activities, robotics and digital tools.	In order for young people to seize new opportunities and keep up with the demands of today's knowledge-based economy, the education system needs to innovate and respond to such changing realities, by providing students with the necessary knowledge, skills, and competences. STEAM education has been proven to be a promising methodology that can support the development of such crucial skills for students. However, school systems seem to struggle with providing sufficient key competences, such as digital and social skills. At the same time, there is evidence of skills shortages in the STEAM fields, despite such demand for skills being on the rise and expected to grow in the following years. This is a reality that school teachers and school curricula have to take into account. STEAM4ALL project explores and attempts to address these issues among pupils and school teachers. The project aims to: 1. Encourage and motivate all students with developmentally appropriate activities for all students to be engaged in the fields of STEAM. 2. Build the capacity of educators, school leaders, and school staff to organize and implement STEAM activities in schools with the use of digital tools (such as robotics) and non-digital tools. 3. Develop digital skills, critical thinking, creativity, problem solving, self-esteem and collaboration to all students. The project results generated output in a form of: 1. Toolkit for Learners: a practical Toolkit for schools, with resources for STEAM education, research, pedagogical material, activities, and OERs. 2. e-Learning Platform and Blended Learning Modules: an open-access e-learning platform that host the project results and the blended learning modules. (https://elearning.steam4all-project.eu/?_ga=2.41096608.347518984.1713520393-16064774.1713520393&_gl=1*fe7sw8*_ga*MTYwNjQ3NzQuMTcxMzUyMDM5Mw..*_ga_XZLPX4KRSM*MTcxMzUyMDM5Mi4xLjEuMTcxMzUyMTE0NC4wLjAuMA..) 3. Guide for Educators: a Guide composed of resources for STEAM education for daily practice in schools – reading material, STEAM reports, good practices, pedagogical resources and activities. This project holds significance as it directly involves target participants like THINKER and investigates the impact on their interest in STEM fields. The

	project's results include valuable output including insights into effective strategies for integrating STEM education across diverse learning contexts. Additionally, it provides a collection of experimentally validated interventions mirroring authentic learning practices, that can be adapted to align with specific requirements of the THINKER project. Finally, the project takes into consideration gender differences, which are relevant also for THINKER. These differences, or their absence, serve as valuable source of knowledge for crafting teaching and learning materials within THINKER.

Eligibility Criteria for Initiatives Selection:

Case/Initiative title:	**STEAM4ALL**
Criteria	***How does the selected case satisfy this?***
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	A guide for educators can play a pivotal role in facilitating various aspects crucial for authentic and inclusive learning environments. Such guides enhance teacher awareness and understanding of these topics, offering clear informative resources and direction that enable educators to address challenges for implementing authentic and inclusive learning (e.g. high workload)
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	A large and continuously growing body of literature has demonstrated how certain social groups and communities encounter institutional and systemic oppression and marginalization leads to low participation rates in STEM education.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	Outputs from the project's theoretical framework should be adapted as a tool that can promote authentic learning and inclusivity in teaching informatics. For example, the E-learning platform is available free to use and accessible for teachers.
Practical: the case has been implemented in a real-life school setting.	STEAM studies put into practice in some schools (Budapest School ; Vörösmarty Elementary School of Újszász).

Croatia

Best Practice 8: Professional Aspirations Towards STEM Careers During Elementary School: A Longitudinal Study of Achievement, Beliefs About Own Competencies, and Interest in Careers - JOBSTEM

Title of initiative and overview of context	Description and Lessons learned
***Professional Aspirations Towards STEM Careers During Elementary School: A Longitudinal Study of Achievement, Beliefs About Own Competencies, and Interest in Careers* - JOBSTEM** This is a scientific research project funded by the Croatian Science Foundation aiming to increase interest of pupils aged 10 to 15 (upper primary education) for STEM using various interventions (workshops, field trips, lectures) making STEM professions more accessible and demonstrating how interesting they can be.	JOBSTEM project explores and attempts to change the evident lack of interest among pupils aged 10 to 15 in STEM fields, their insufficient belief in their own success or potential for success, the negative impact of parental experiences and practices, and widespread gender stereotyping as foundational causes or outcomes in the STEM area. Challenges such as a shortage of STEM professionals, weak innovation capacity, or lesser economic competitiveness represent some of the most significant societal challenges identified. Current educational and psychological research suggests that the primary school period is critical for addressing these challenges more intensively. The project focuses on how pupils develop or change their general and specific interests in STEM. It questions whether there's an interconnection between school success in STEM and student beliefs about success with a general interest in STEM and careers in STEM and attempts to answer the questions including: ● What precedes later interests in STEM careers more significantly – early student interest, earlier school success in STEM, or a student's developed belief in their own success? ● To what extent do girls and boys believe that STEM is more suitable for a specific gender, how do their interests in STEM differ, and how do gender stereotypical beliefs change during schooling, under what conditions and in what way? ● How do parents' education, experiences, and opportunities determine the success and important outcomes of their children in the STEM area? ● The project also included an experimental intervention through a well-designed STEM intervention program aimed at comprehensively evaluating the utility of STEM programs in changing interests, beliefs, and student success, or as a form of increasing student interest in the STEM area. JOBSTEM is **methodologically** based on a longitudinal-sequential design with an included intervention study. The research included longitudinal monitoring of 1920 primary school pupils aged 10 to 15 years, alongside a parallel survey of 1920 of their parents or guardians. The project resulted in a number of scientific publications as **results** indicating that: ● STEM interventions **can, to some degree, increase** pupils **motivation for STEM** [30], ● pupils who have **stereotype-consistent interests** in school subjects tend to **show stronger stereotype endorsement** than others and male gender and prior achievement in STEM-related school subjects were also positively related to stereotype endorsement [31],

	• boys express more interest in STEM occupations than girls, with the biggest differences in the fields of Technology and Engineering [32] • children's importance value of the STEM school fields is best explained by their perceptions of parental values and behaviours in STEM, while parents' self-reported values and behaviours had a weak effect in predicting children's values, (which can be explained by inaccurate children's perceptions of their parents) [33] This national project is important as it directly included target participants as THINKER (pupils aged 10 to 14) and explored how their interest for STEM (which includes informatics) can be affected. The projects' results include valuable lessons including that affecting pupils' interest in something might be challenging and possible only in a limited way and by a certain age (15). The project also offers a set of experimentally validated interventions that resemble authentic learning practices (programming mBots, learning programming through Hour of Code games available at https://hourofcode.com/) that can be further adapted to the needs of the THINKER project. Finally, the project does all this accounting for gender differences which is also relevant for THINKER. Those differences or their lack should be used as a knowledge source when developing teaching and learning materials within the project.

Best Practice 9: Audience response systems (ARS) research

Title of initiative and overview of context	Description and Lessons learned
Audience response systems (ARS) research conducted at the University of Zagreb Faculty of electrical engineering and computing. This is a scientific research and development project funded by UniZg FER and later through an Erasmus+ project *Active learning through improved interactivity*. The project aimed to develop and promote good usage practices related to audience response systems. Such systems are a valuable resource for teachers as they can foster interaction in live lectures in a scalable and efficient way.	Audience Response Systems (ARS), also known as clickers or student response systems, offer an interactive way to engage pupils and facilitate authentic learning in educational settings through: • **Immediate Feedback**: ARS allows for instant feedback on questions posed during a lesson, enabling pupils to immediately understand their grasp of the material. This real-time feedback can help pupils identify areas where they need further study, aligning with the principle of authentic learning by showing real consequences of their knowledge application. • **Increased Engagement**: By actively pupils in the learning process through ARS, pupils are more likely to be engaged and interested in the material. This higher level of engagement can lead to a deeper understanding of real-world applications of the content being taught. • **Peer Learning**: ARS can facilitate discussions among pupils, encouraging them to explain their reasoning or understand different perspectives. This peer-to-peer interaction is a key component of authentic learning, as it mirrors real-world collaboration and problem-solving. • **Critical Thinking and Decision Making**: Many ARS tools allow for the use of scenario-based questions or case studies that require analysis, evaluation, and decision-making—skills crucial for

	authentic learning. Pupils must apply what they have learned in a theoretical context to a practical, often complex, situation. ● **Anonymity and Risk-Taking**: ARS often allows pupils to respond anonymously, which can encourage risk-taking and reduce the fear of failure. This safety net encourages pupils to apply their knowledge in new ways, a critical aspect of authentic learning. ● **Customization of Learning**: Instructors can use data from ARS to tailor their teaching to the needs of their pupils, addressing areas of difficulty and adjusting the pace of lessons. This customization ensures that learning is relevant and appropriately challenging for each student. ● **Assessment for Learning**: Beyond quizzes, ARS can be used for formative assessment that informs both teaching and learning. This approach aligns with authentic learning by emphasizing the process of learning and the application of knowledge, rather than just the final product. ● **Real-World Application**: By integrating real-world scenarios and data into ARS questions, educators can directly connect classroom learning with its application outside the academic environment. This not only makes learning more relevant but also helps pupils to see the practical value of their education. ● **Facilitation of Reflective Learning**: The immediate feedback provided by ARS can prompt pupils to reflect on their understanding and learning strategies. This reflection is a key part of authentic learning, as it encourages pupils to become self-directed learners who can adapt their approaches to problem-solving in various contexts. UniZg FER (and THINKER project team members from this institution) have more than 10 years of experience in developing and using audience response systems [34], [35], [36], [37], and since then, ARS benefits for teaching and learning have been confirmed in a variety of educational settings [38], [39], [40], [41], [42], [43] and many such tools have been developed including AudIT (https://audit.altii.online/, the last generation of an ARS developed at the UniZg FER), Kahoot (https://kahoot.it/), Socrative (https://www.socrative.com/), Mentimeter (https://www.mentimeter.com/), etc. Due to their usefulness in learning, they should be considered a must in educational settings when teaching informatics. Examples of their usage fostering efficient communication in classrooms, fostering anonymous question posing for pupils, and providing formative feedback to both teachers and pupils should be available to teachers to improve their practice.

Eligibility Criteria for Initiatives Selection:

Case/Initiative title:	**Professional Aspirations Towards STEM Careers During Elementary School: A Longitudinal Study of Achievement, Beliefs About Own Competencies, and Interest in Careers - JOBSTEM**

Criteria	*How does the selected case satisfy this?*
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	This project explores methods to increase STEM interests in 10- to 15-year-olds. Informatic is a part of STEM. Increasing interest in STEM or informatics would increase pupils' informatics competences which is the ultimate goal of improving informatics education through THINKER project. This project also takes into account and investigates gender stereotypes in STEM making it relevant for both main aspects of the THINKER project.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	This project was funded by Croatian Science Foundation having rigorous funding criteria. It is based on longitudinal design with well elaborated methodology and a project team consisting of internationally recognized scientists. Project results were published in leading Croatian and international scientific journals.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	Practices used in the project like Hour of Code games teaching elementary programming concepts can and should be scaled up and recommended as tools in informatics education.
Practical: the case has been implemented in a real-life school setting.	The case has been implemented in a real-life school setting with the same target population as THINKER.

Case/Initiative title:	**Audience response systems (ARS) research conducted at the University of Zagreb Faculty of electrical engineering and computing.**
Criteria	*How does the selected case satisfy this?*
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	Audience response systems can facilitate many aspects crucial for authentic learning. They foster pupils' activity in a scalable way, provide pupils with an opportunity to ask question without being inhibited by unwillingness to talk in front of the class and can be used to provide both teachers and pupils with fast formative feedback about their understanding of the teaching content. Informatics teachers should be familiarized with them, especially through well elaborated practical examples of their usage.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	Several studies related to ARS have been published by UniZg FER team [34], [35], [36], [37], but numerous more have demonstrated that this educational tool can and should be used in a variety of educational contexts [38], [39], [40], [41], [42], [43]. Still, like with any educational technology, ARS must be used carefully, and their usage must be motivated by educational needs defined in a given context.

Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	ARS can and should be used as a tool that can facilitate informatics teaching. A number of such tools, including AUdIT, developed by UniZg FER, are available for free usage and are accessible to educators.
Practical: the case has been implemented in a real-life school setting.	While UniZg FER ARS have been used and evaluated mostly in higher educational settings on classes of typically 250 students in size, there is no reason not to use ARS in primary or secondary education as well. Several studies have demonstrated ARS efficiency in teaching in elementary schools [44], [45], [46], [47], [48].

Italy

Best Practice 10: IN 2 STEAM - Inspiring next generation of girls through inclusive STE(A)M learning in primary education

Title of initiative and overview of context	Description and Lessons learned
https://in2steam.eu/ **IN 2 STEAM** **Inspiring next generation of girls through inclusive STE(A)M learning in primary education** **Erasmus+ Programme KA2+**	IN2STEAMis not specifically focused on the teaching of informatics, but more generally on the teaching of STEM. The project aims to enhance, encourage and foster innovative educational approach that integrates STE(A)M learning (applying art and design principles to science education) in primary education through gender-inclusive methods and resources to promote a positive change of attitudes towards non–stereotyping choices in education in order to attract more girls into STEM fields. It aims to increase the competence development of teachers and educators so as to enable to teach and expose STE(A)M concepts to young children at primary school, with a focus on girls, in order to foster creativity, critical thinking and problem-solving competences; To increase and nurture girls' interest in STEM fields through the development of gender-inclusive teaching methods and open resources focused on STE(A)M learning in primary education; To support the interest in STEM disciplines by adopting an inclusive teaching methodology that motivates young girls to develop their potential and motivation for a future career in the scientific field, contrasting gender stereotypes. Within the project, (1) an online training curriculum in STE(A)M learning and gender sensitive practices was developed so as to support teachers and trainers to increase their competences and skills to use STE(A)M educational approach as access points for guiding student inquiry, critical thinking and problem solving among children aged 8-11, especially among young girls; (2) a digital teacher's toolkit with STE(A)M activity kit for primary school which compiles a set of activities for teachers fruitful as resources to work in the classroom directly with young students; (3) a European Charter for STE(A)M education with the objective to raise attention on the importance of interdisciplinary learning approaches of combining arts & science disciplines together. The Charter contains recommendations for decision makers in school education. The programme proposes activities that are based on an authentic learning approach that combines inquiry-based learning, design thinking, creative thinking and art-based learning, as well as THINKERing.

Best Practice 11: Girls Code It Better

Title of initiative and overview of context	Description and Lessons learned
Girls Code It Better https://girlscodeitbetter.it/chi-siamo/	Girls Code It Better is a national project launched by Officina Futuro Fondazione W-Group in 2013. It consists of the organization of coding clubs for girls in lower and upper secondary schools across Italy. The project aims

	at improving the approach girls have to informatics and giving them the preparatory skills and models to follow a career path in technology. The club activities take place once a week for the whole school year. The participants are: 20 students; a coordinating teacher; a coach maker who shares their knowledge. Areas of learning are: electronics and automation; digital manufacturing, modeling and 3d printing; web design and web development; app development and gaming; augmented virtual reality.In 10 years of activity, 341 schools participated in the project, 583 clubs took place and 13042 girls joined a club. The project managed through the years to create a national network of schools, municipalities and enterprises that enhances communication at the local level and sets the ground for future projects in informatics and gender equality.

Eligibility Criteria for Initiatives Selection:

Criteria	*How does the selected case satisfy this?*
Relevant: the case is directly related to principles of authentic learning and/or gender inclusion in upper primary and lower secondary school in your country.	Authentic learning and gender inclusiveness are proper to both case studies - although the first one shows a prevalence of authentic learning, the second of gender inclusive themes. The first case study targets teachers in upper primary and lower secondary school, while the second directly targets girl students in lower secondary school.
Evidence-based: the case is informed by scientific knowledge, outlining the design, application and results.	The first case study is a European project whose deliverables' quality was tested and approved by the European Commission. The second case study was the object of an academic research by Carlana and Fort (2022) "Hacking Gender Stereotypes: Girls' Participation in Coding Clubs." The paper shows that participation in coding clubs increases the likelihood of wanting to become an IT programmer by about 10 percentage points compared to not having this experience.
Transferable: the case can be scaled up, used as an inspiration, in part or as whole, across Europe. the case includes practices, tools, applications that all educators can access.	The first case study was realized in partnership with organizations from 5 European countries. The transferability of the deliverables was a key requirement since the beginning of the project. The second case study managed to exponentially increase its reach across 18 Italian regions, stretching across a variety of socio-economic conditions. This serves as a proof that the project is transferable and could work in other countries.
Practical: the case has been implemented in a real-life school setting.	As evidence shows, both case studies had extensive testing and implementation phases in school.