Introduction

We use sports to connect university students with disadvantaged children from surrounding schools to promote and support them in pursuing higher education in STEM.

- Selinay Kunter (Politecnico di Milano)
- Adam Mallalieu (Chalmers University of Technology)
- Aaron Pütting (RWTH Aachen)
- Kevin Riehl (ETH Zürich)
- Elise Tadema (TU Delft)

This project was initiated at the SDG summer school of the IDEA League at Politecnico di Milano in July 2024. Our task was to develop an idea that supports the IDEA League universities addressing one or more of the SDGs using sports. Our challenge was inspired by the existing inequalities in pursuing higher education in STEM. Experiences from all members, both professionally and personally, make us deeply care about enabling everyone to have the same opportunities. Additionally, there are several external issues related to the topic of STEM education, such as a declining number of student applicants to STEM programs[1], and the lack of qualified engineers in the European industry[2].

Problem

In Europe, one in four children is at risk of poverty and social exclusion[3], circumstances limiting their chances and ability to pursue higher education[4]. Higher education can support children from disadvantaged backgrounds to achieve better health[5], and economic stability while also integrating themselves into society[6,7]. A bachelor's degree can reduce the risk of unemployment by 50% and increase income by 50%[7]. This initiative therefore aims to,

- Ensure more children from disadvantaged backgrounds pursue higher education in STEM
- Improve the quality of disadvantaged children's lives through better social inclusion and economic growth

[1] Teknikföretagen, (2024). "Children's attitude to STEM". Accessible at [https://www.teknikforetagen.se/globalassets/rapporter--publikationer/kompetensforsorjning/ungas-attityder-till-stem.pdf?tAeiFG]
[2] World Economic Forum, (2023). "Future of jobs report". Accessible at [https://www3.weforum.org/docs/WEF_Future_of_Jobs_2023.pdf]
[3] European Statistics Department, (2024). "Children at risk of poverty or social exclusion 2023". Accessible at [https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20240719-1]
[4] OECD, (2012). "Education at a glance 2012". Accessible at [https://www.oecd-ilibrary.org/docserver/eag-2012-10-en.pdf?expires=1725609582&id=id&accname=oid029007&checksum=833D27D11FB049A95EC91C6FFF5FD1E9]
[5] Zajacova, A., & Lawrence, E. M. (2018). The relationship between education and health: reducing disparities through a contextual approach. *Annual review of public health*, *39*(1), 273-289.
[6] UNESCO, (2024). "What you need to know about higher education". Accessible at [https://www.unesco.org/en/higher-education/need-know]
[7] Center on society and health, (2015). "Why education matters to health: exploring the causes". Accessible at [https://societyhealth.vcu.edu/work/the-projects/why-education-matters-to-health-exploring-the-causes.html#gsc.tab=0]

Certain underlying issues cause disadvantaged children to be underrepresented in higher education, including prejudices and low self-esteem attitudes towards higher education, and a lack of role models and support from family[8]. One in three children is advised to avoid higher STEM education typically associated with "Minecraft guys"[8], and children with non-academic parents are half as likely to pursue higher education[4]. In parallel, Europe faces an engineering competency crisis[2], the number of applicants for STEM programs declines[1], and different policies to promote STEM are in development[8].

Solution

Sport4Stem is a scalable program that uses sports to connect with disadvantaged children while promoting higher STEM education, consisting of three phases.

Figure 1. Conceptual illustration of the key activities in the program.

The novelty of our approach lies in promoting STEM with sports. Competing efforts use Sci-Fi, computer games, and science competitions to reach children, but fail to challenge existing prejudices and biases STEM. Sports enable us to do so while also reaching children of other target groups, as more than 50% of children do sports[9]. We show that it is possible to work with STEM and sports, which might be more attractive to some children than rockets and programming.

[8] Teknikföretagen, (2023). "How to acquire more engineers to the Swedish industry". Accessible at [https://www.teknikforetagen.se/globalassets/rapporter--publikationer/kompetensforsorjning/pm-prioritera-ingenjorsutbildningen.pdf?g1zX4L]

[9] Statistikmyndigheten, (2018). "How young people live in Sweden". Accessible at [https://www.scb.se/hitta-statistik/artiklar/2018/unga-i-sverige/]

Sport4STEM addresses SDG 1[10], 4, and 11. There are also possible side effects such as increasing the representation of disadvantaged groups in international organizations, social mobility, and mitigating the engineering competence crisis. Three types of KPIs can be tracked to quantify the impact of Sport4STEM:

(i) The number of participating disadvantaged children (short term)
(ii) The number of disadvantaged children that enrolled for higher education programs in STEM (mid-term)
(iii) The number of disadvantaged children who complete the program and work in a STEM-related position (long-term).

Table 1. Targeted impact and link to SDGs

	SDG	Indicator	KPI Link
4.3	By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and tertiary education, including university	Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex	1 & 2
4.4	By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	Proportion of youth and adults with information and communications technology (ICT) skills, by type of skill	1 & 2
10.1	By 2030, progressively achieve and sustain income growth of the bottom 40 per cent of the population at a rate higher than the national average	Growth rates of household expenditure or income per capita among the bottom 40 per cent of the population and the total population	3
10.2	By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status	Proportion of people living below 50 per cent of median income, by sex, age and persons with disabilities	3
1.2	By 2030, reduce at least by half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	Proportion of population living below the national poverty line, by sex and age **AND** Proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions	1, 2 & 3

[10] The definition of poverty goes beyond economic dimensions. "Poverty entails more than the lack of income and productive resources to ensure sustainable livelihoods. Its manifestations include hunger and malnutrition, limited access to education and other basic services, social discrimination and exclusion, as well as the lack of participation in decision-making." (United Nations, 2024) – Accessible at [https://web.archive.org/web/20200909130506/https://www.un.org/en/sections/issues-depth/poverty/]

Description of Prototype

Inspire: University students visit schools to inspire disadvantaged children using sports to communicate STEM in a fun way. This includes doing sports followed by interactive lessons explaining sports with science.

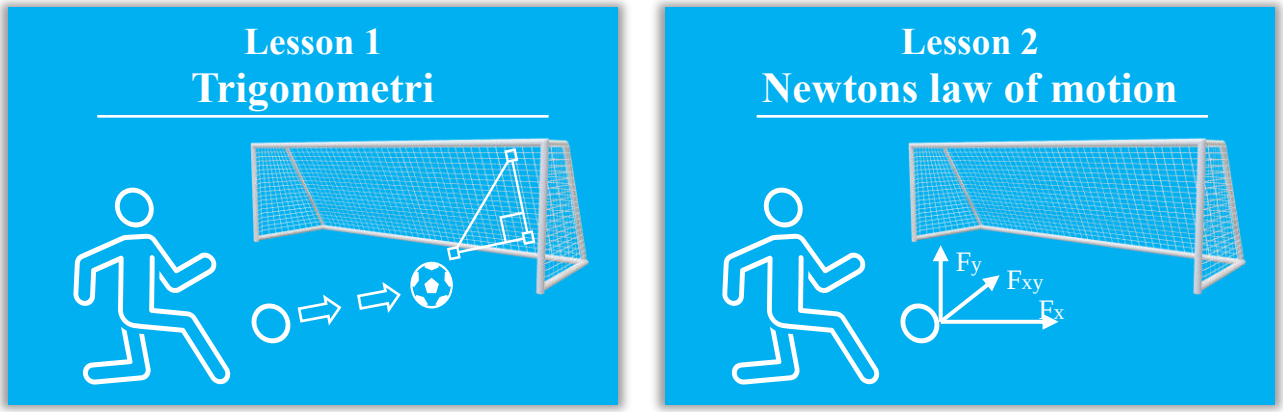

Figure 2. Illustrations of how STEM-related subjects can be taught by relating them to football.

Capture: Disadvantaged children are invited to the University to capture their interest in STEM. This includes interactive tours to show what opportunities and facilities higher STEM education can offer, with sports in focus.

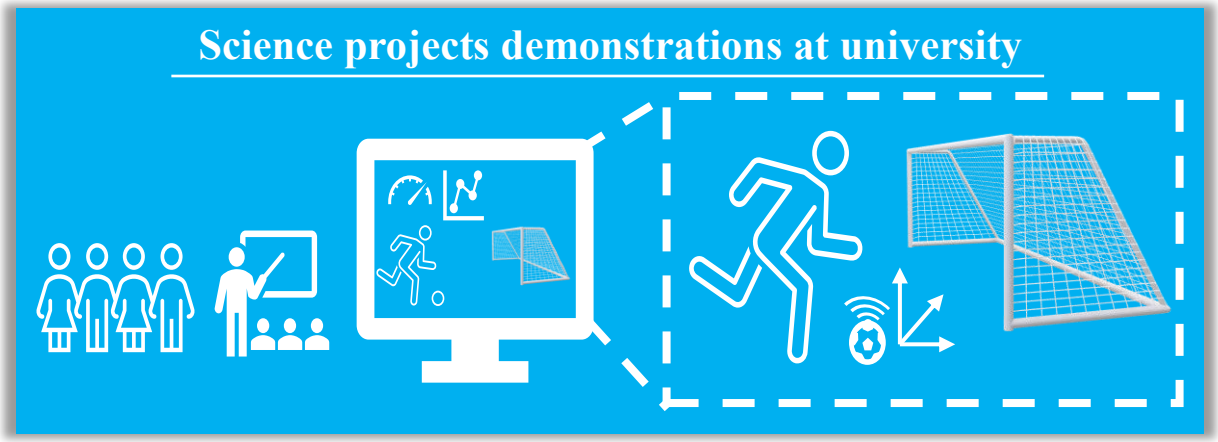

Figure 3. Interactive session using advanced technology to explain football.

Navigate: Disadvantaged children are offered tutoring support and help to navigate different opportunities in higher STEM education.

Key aspects of the program require further development and testing to ensure that; (i) university students are recruited efficiently; (ii) sport is integrated with STEM effectively; and (iii) we interact with disadvantaged children appropriately. We plan to start the program with the IDEA League Universities, and later scale with STEM universities all across Europe. We plan to initiate bachelor theses during the spring to investigate the program and these aspects in more detail, and this would make it possible to begin initial testing of the program before the end of 2025.

Value proposition & Feasibility

Several interviews were conducted, which highlighted the feasibility and support for Sport4STEM from different stakeholders.

Table 2. Quotes from relevant stakeholders.

Stakeholder	Quote
Department Head, at ETH Zürich	*"It is increasingly challenging for us to confront the decreasing student numbers. We welcome and support your initiative."*
Professor at a Chalmers University of Technology	*"This project is exciting, and we should plan to detail it out as a bachelor student project during the spring."*
Volunteer at a student tutoring organization	*"Usually we have more volunteers than we find opportunities for them for tutoring. Your initiative is more than welcome."*
Teacher from the Netherlands	*"Your project shows a lot of potential, as it is innovative, and by using students, you will really connect with the children"*
Swedish girl (15 years old)	*"It (this type of program) would have increased the chances of me pursuing an engineer education"*
Senior researcher at Politecnico di Milano	*"It would not be a problem to utilize our infrastructure for such a program."*

The potential social impact of the proposed solution is significant. In Gothenburg alone, it is possible to reach approximately 5,500 disadvantaged children doing sports between the ages of 9-13. Assuming we can reach 90% of these via *Inspire*, get 50% into *Capture*, and 10% into *Navigate*, we provide approximately 50 children (per year) a good chance of entering higher education in STEM.

We actively target disadvantaged children aged 9-13 with two main arguments[11,12]. (i) Children start to dream and idolize individuals around this age, and providing role models and inspiration is crucial. The University students in STEM are key stakeholders since they represent attainable role models for these children to aspire for. (ii) Children start to think about what it means to be a grown-up around this age, making the timing of the program appropriate. We highlight what type of careers they can pursue in STEM, which can increase their self-esteem by making them believe they can pursue a career in STEM.

The program can be started with minimal effort, as most infrastructure is already in place to begin *Inspire*. Access to specific equipment such as sensors and motion capture technologies to make interactive tours in *Capture* varies between universities. The impact of our program later scales with the number of volunteering university students, if appropriate infrastructure is in place. There are similar initiatives where student volunteers are utilized[13,14], and the quote in

[11] Swedish healthcare advice, (2024). "Development of children 8-9". Accessible at [https://www.1177.se/barn--gravid/sa-vaxer-och-utvecklas-barn/barnets-utveckling/barnets-utveckling-8-9-ar/]
[12] Swedish healthcare advice, (2024). "Development of children 10-12". Accessible at [https://www.1177.se/barn--gravid/sa-vaxer-och-utvecklas-barn/barnets-utveckling/barnets-utveckling-10-12-ar/]
[13] Engineers without borders Sweden, (2024). "Inspire youth". Accessible at [https://www.ewb-swe.org/inspire-youth-2]
[14] Mattecentrum, (2024). "Become a coach in math". Accessible at [https://www.mattecentrum.se/for-volontarer/bli-volontar-mattecoach]

Table 2 also supports our idea of recruiting students as volunteers. Other approaches involving incentives will be explored if recruiting students as volunteers proves difficult.

Conclusion

Education is not equally accessible to all children, and especially disadvantaged children lack the encouragement and support to pursue higher education, which is vital to enable them to have a sustainable future. STEM student numbers are also declining, and Europe lacks qualified labor. Sport4STEM is an innovative program that employs sports to motivate STEM education. The potential impact is huge since we have an approximate target group of 6.8 million disadvantaged children[15] for the whole of Europe. The conceptual idea of the Sport4STEM is already in place and the next steps will be further developed using resources available within the existing University infrastructure.

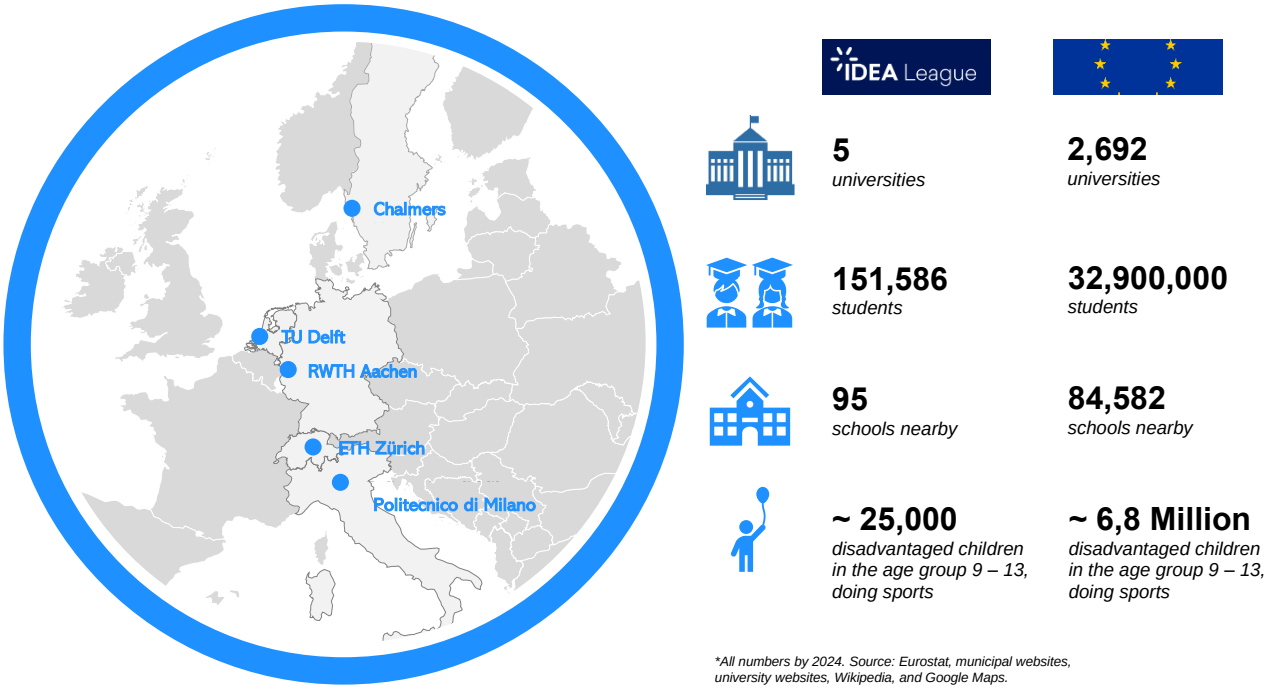

Figure 4. Potential Impact For IDEA League Universities & Europe.

[15] Extrapolated from numbers in Sweden to European population.