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STREAMpreneur

SCIENCE

TECHNOLOGY

RESEARCH

ENGINEERING

ART

MATH

STREAM Entrepreneurship approach implementation in youth work

Guidelines for youth workers

STREAMpreneur

KA205 - Strategic Partnership for Youth
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KA2 - Cooperation for innovation and the exchange of good practices

Project partners:

HeurekaNet – Freies Institut für Bildung, Forschung und Innovation e.V., Germany (Coordinator)

DOREA Educational Institute, Cyprus

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PREFACE

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Science, technology, engineering and mathematics (STEM for short), combined with creativity, curiosity and entrepreneurship, are considered key drivers of innovation in our economy. Without their high level of development, the prosperity of our societies in Europe and beyond would be inconceivable. This outstanding importance of STEM is not only recognised by experts for the economy, labour market and education planning; in fact, more and more young people are interested in a STEM-related profession or studying one of the STEM subjects. However, the number of degree programmes and apprenticeships completed, fall short of the projected demand for skilled workers and experts.

For some years now, beyond formal educational institutions such as primary and secondary schools, vocational training and universities, various initiatives can be observed that awaken young people's interest in scientific, technical, engineering and mathematical subjects and develop STEM competencies in new formats. The "STREAMpreneur" project, in the context of which these guidelines were produced, follows on from this. Conceptually, the project uses the term "STEAM" coined in the USA and the associated integration of the arts into STEM education. The project title also includes the "R" for "Research" and the "preneur" for "Entrepreneurship", thus emphasising the exploratory and risk-taking attitude inherent in every innovation. In this way, the project "STREAMpreneur" addresses extracurricular educational work with youth or young people, regardless of where and which medium it is realised. Furthermore, it aims to interest the educational staff working there and support them in taking up STEM in a new and innovative way. Another new educational task, those who are active in extracurricular educational work may now ask. The answer is: no and also yes.

No, insofar as extracurricular STEM education work is nothing new, but in some cases even has a long tradition. Think, for example, of the youth fire brigade, the youth of the technical relief organisations, the water rescue service, and so on. There is no way without STEM knowledge, and this knowledge has been prepared by these aid organisations for years and passed on to the younger generation. Nevertheless, these organisations also feel challenged and are working on more modern formats for addressing young people. And then there are also the youth clubs and youth centres where people screw, mix and programme and where STEM projects for girls and boys are running.

Yes, to return to the initial question, STEM education work is a new educational task for the many youth clubs and youth centres that see themselves as places of encounter with minimally structured offerings and where the most visitors are always when it's party time. For these institutions, STEM education would indeed be a new challenge that can be mastered. These places, which see themselves more as places of informal learning, can open up and enable Maker-oriented learning experiences. The same is true for youth centres that focus on youth cultural work or socio-cultural education. STEM-related learning experiences can also be developed from the side of the arts. The Rhode Island School for Design showed exactly this over ten years ago under the motto "Bridging STEM to STEAM". Youth cultural work can do this, too, working to ensure that children, youth and young adults are open to new experiences.

Either way, these guidelines with its six chapters address providers of extracurricular educational work, and those who want to become one, e.g., a newly established Maker Space and a completely new focus, namely STEM in educational work. Each chapter deals with its own focus, is self-contained and the respective author is also responsible for the content. It is not compulsory to read the chapters in a particular order; as a provider of out-of-school educational work with young people, pick out what interests you most in your reflections on contemporary STEM-related educational work.

Chapter 1 provides good arguments for the urgency of STEM education work. Here you will read a basic explanation of STEM/STEAM/STREAM, learn about the relevance of this educational focus for the later career choices of young people and the situation in Europe and in the different countries of the project partnership behind this project. They represent the full spectrum of industrial production, with Germany as an industrial heavyweight, Italy with its important industrial centres in Northern Italy, Denmark and Latvia, and Cyprus, which has about 75% of its gross value added (GVA) in the service sector.

Chapter 2 introduces you to STREAM as a pedagogical approach and explains the interplay between STREAM and entrepreneurship. In this context, the chapter also goes into the EntreComp competence framework and shows the link with STEM employment competencies. The chapter ends by proposing four constitutive elements for designing educational activities: (1) STREAM subject knowledge and content; (2) Entrepreneurial skills; (3) Sustainability; and (4) STREAM careers and opportunities.

Chapter 3 shows successful methodological approaches for the design of STREAMpreneur-related learning activities and gives concrete tips for their design. Then, the article goes into different methodological approaches such as Project-based Learning (PBL), Problem-based Learning, Inquiry-based Learning (IBL), Design-based learning (DBL) and Peripatetic Learning, presents different teaching/learning techniques such as the Experimental Workshop, Simulation, Case Study, etc. and ends with concrete examples for implementation in pedagogical work.

Chapter 4 emphasises the holistic, integrated approach as the starting point for pedagogical implementation. As in real life, the STREAMpreneur approach is characterised by the fact that individual aspects of STEM are not separated but integrated. The article provides ten concrete tips for practical implementation, such as promoting creativity, integrating educational videos, hands-on experience, and much more. It ends with a six-step guide for developing a STREAM learning activity.

Chapter 5 provides guidance to educational staff on evaluating educational activities and programmes in their institution or organisation. The article discusses ethical challenges, clarification of the target functions of an evaluation, the advantages and disadvantages of external or internal evaluation, and introduces the two forms of evaluation, "summative" and "formative". It then describes the practical planning of an evaluation and complements it with a small selection of evaluation models.

Finally, **chapter 6** takes a look at the "big picture". It emphasises that sustainability and green education need to be considered in developing the STREAMpreneurship approach to fully equip young people with the necessary skills for the 21st century. By including the sustainability component in the STREAMpreneurship approach, young people are encouraged to solve real problems in a sustainable way. The chapter ends with references to some related European projects.

As you can see, these guidelines, like a small menu, has very different contributions in store for you. We wish you a stimulating read, and of course, an exciting discussion about this topic in your educational team. You are cordially invited to give feedback to our project team via our various social media channels of the "STREAMpreneur" project or by e-mail to the author of this foreword at flachmeyer@heurekanet.de.

1 DIAGNOSING THE EDUCATIONAL/ TRAINING NEEDS OF YOUTH

broader, collective and individual

STEM DISCIPLINES

The whole economy of modern societies revolves directly or indirectly around STEM disciplines (Science, Technology, Engineering, Mathematics); it is almost impossible to find a part of society that in some way does not interact with the STEM disciplines: in fact, in its broadest definition STEM Education includes the fields of computer science, information technology, engineering, earth sciences, sciences, mathematics, physics, astronomy, chemistry, life sciences.

EMPLOYMENT

According to EU estimates, employment in the STEM professions is set to grow by almost two times faster than the average of other occupations. Moreover it is estimated that by 2025 there will be a shortage of over half a million workers in the information field of e-Communications technology (ICT).

In fact, according to the CEDEFOP analysis, the need for STEM skills in the labour market shows that the employment of STEM professionals and related professionals in the European Union (EU) has increased since 2000 despite the economic crisis. It seems that the STEM skills needed are expected to grow until 2025.

Employment of STEM professionals or related professionals in the EU has increased 12% in 13 years (from 2000 to 2013) and is expected to grow 8% more within 2025. Engagement forecast in STEM-related sectors shows a similar trend: it is estimated to grow within 6.5 % in 2025.

More specifically, according to the Desi (Digital economy and society index of the European Commission), in Europe, by 2025 there will be 8.2 million new jobs for which preparation in the STEM field is needed.

The professions that will produce an increase in jobs are those that fall under the acronym ST(R)EAM. STEM is the integration of Science, Technology, Engineering, and Math. STEAM is the integration of STEM with addition of A, which is Art. STREAM is the integration of STE(A)M with addition of R: Research. STREAM is the necessary evolution of STEM Education.

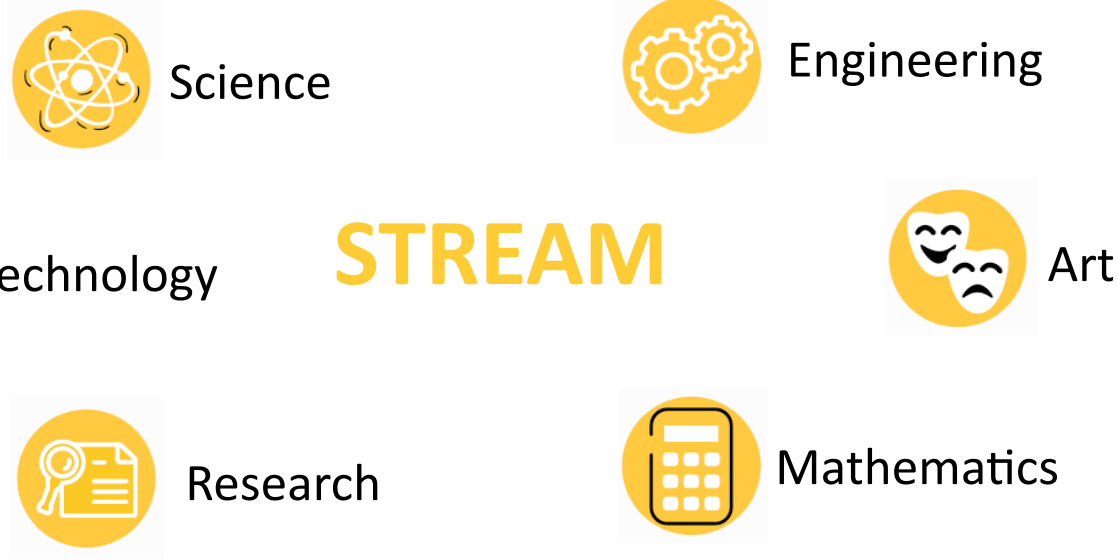
Different Researches on educational matters have found that teaching approaching in scientific disciplines already in primary education, combined with teaching in mathematics, early literacy, and reading (Paprzycki, 2017) is a strong predictor of later achievement in multiple domains (Center for Advancing Discovery Research in Education; Duncan, et al., 2007; Claessens & Engel, 2013; Aubrey, Dahl, & Godfrey, 2006).

Moreover, researches show that one of the main reasons for improving STE(A)M education is the need to attract more students and teachers to STE(A)M studies in order to provide the labour market with adequate resources in qualitative and quantitative terms, starting from primary education.

(AINSN Europe)

YOUNGSTERS NEEDS

Coming on the "training need" of youngsters, one particularity that shows how the STE(A)M education approach is crucial for developing entrepreneurial skills in digital innovation. Most of the new start-ups are engaged in this focus domain. Connection between STE(A)M education and entrepreneurship pass also through digital and literacy financial transversal skills. In this way, ITC skills are crucial as well in STE(A)M approach.



A crucial step of STE(A)M educational approach is that youngsters are not just taught science, mathematics, engineering or technology but also how to learn, ask questions, experiment, and be creative.

On the other hand, focusing on entrepreneurship in STE(A)M, according to Eurydice, entrepreneurship education is more widespread at the upper secondary level, and the approaches are more varied; it is often both a separate subject and an integral part of other subjects, especially social sciences, economics and business studies. Despite this, in this level of education, it is often taught as an optional subject, in line with the fact that, in general, students have more freedom of choice at the upper secondary level than at lower levels (EURYDICE Data, EU).

Jumping back on STRE(A)M youngsters' needs, it is important to see that higher education in STRE(A)M and entrepreneurs are provided mostly in universities courses or technical secondary schools. How the STRE(A)M training approach fits with entrepreneurship is clearly underlined by the fact that financial literacy will be the best glue between STRE(A)M and entrepreneurship.

ENTREPRENEURSHIP

In this way non-formal education can help EU youngsters to fill the gap by overlapping STRE(A)M and entrepreneurship.

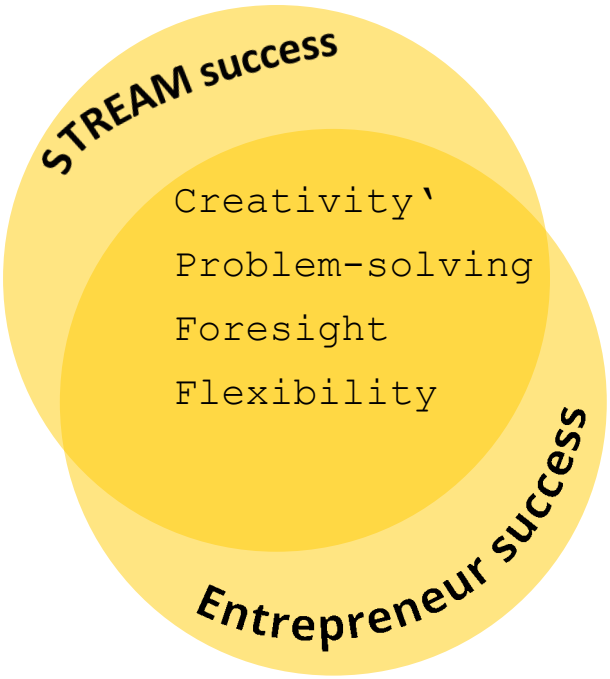
Entrepreneurship skills and STRE(A)M are paralleled. Transversal skills required to succeed in STRE(A)M such as creativity, problem-solving, foresight, flexibility, are equally suited for success as an entrepreneur.

? How to learn?

? How to ask questions?

? How to experiment?

? How to be creative?



STEM IN EUROPE

As the STE(A)M is an interdisciplinary learning method developed since 2000 with the aim of bringing students and youngsters of all social backgrounds closer to mathematical and scientific disciplines when we talk about this approach, however, we are not just talking about individual thematic areas, but, on the contrary, to an integrated system of scientific knowledges. STE(A)M, in fact, are the key to an educational system that looks ahead, oriented to grow, train and prepare individuals capable of managing an unknown and uncertain future.

In the STE(A)M approach, youngsters are encouraged to take an experimental attitude, using imagination and creativity to make new connections between ideas. Over the last few years, Europe has prepared important strategic actions for digital innovation with the Europe 2020 project. Therefore, it is currently of great importance and centrality to improve young people's digital literacy to meet the new needs of the labour market to facilitate their integration with the world of work and industry 4.0.

This STREAM approach, by aiming to improve youth entrepreneurial skills, also promotes this STE(A)M innovation and sustainable solution to real-life problems existing and beyond, by introducing the "ST(R)E(A)M" in entrepreneurship among youth workers, will provide them with new skills and tools to implement management daily youth work.

The problem of STE(A)M skills lacking reflects in the low number of successful start-ups (run by youngsters), bad financial decisions, governess, lack of confidence in life (financial decisions).

In a scenario of economic turbulence and market shortcoming, where the escalating numbers of low income and unemployed young (16-29) constitute a problem and a challenge to be dealt with in the years to come; a real need for development of the "STE(A)M" competencies of this target has been identified.

This group of EU citizens is one of the largest disadvantaged groups in the European society, constituting almost 35 % (over 40% for some EU countries) of the total youngsters in Europe.

Recent research from the OECD shows that youth unemployment and low income also does further damage by undermining pension saving, placing millions of young people across Europe at risk of having an inadequate income when they are older (according to Eurostat data, in January 2021, the youth unemployment rate was 16.9 % in the EU and 17.1 % in the euro area (Eurostat, EU).

Improving STEAM skills of such a disadvantaged group in the EU (e.g. low income and unemployed young) can have significant benefits for everyone, since good math, science, engineering and technology mean also improve financial literacy skills and so entrepreneurial skills as well. This will help youngsters make the most of opportunities based on their available resources, meet their goals, secure their financial well-being, and contribute to the economic health of society.

Moreover, this project is also complementary with one of the main pillars of the 2020 ACTION PLAN "Reigniting the entrepreneurial spirit in Europe" (Action Pillar 1 – Entrepreneurial education and training to support growth and business creation) as it emphasises the increase in prevalence and quality of entrepreneurial education.

In the youngster training need analysis at EU Level is that, STREAM skills development is expected to play a significant role as economies move toward cleaner energy use, creating new, green jobs. Several countries are already reporting shortages of skills in the renewable energy and other "green" sectors. "There is an urgent need for training in the full complement of skills required across a broad range of jobs so that economies can both continue 'greening' and realize the potential growth in employment the process offers".

STREAM would aim to strengthen the future young entrepreneurs' skills basis by helping them to enhance their critical thinking skills and recognize the intersection of art, science, technology, engineering, and math.

STEM IN ITALY

Although the labour market is increasingly oriented towards digital and STE(A)M professions, the data in Italy are below the European average. Around 26% of young people in Italy graduate in science and mathematics fields, compared to 35% of the biggest other countries in Europe (OECD, Report). In addition, Italy, regarding the digital sector, ranks 25 out of 28 countries in Europe (2020 data).

It is easy to say that in Italy, after graduating, young people struggle to find work. In reality, entire sectors in continuous growth do not find matching profiles and skills.

SMEs and enterprises are increasingly looking for technical-scientific profiles - STE(A)M. Of course, they can pay them more than the average, but it seems that only one in four university students have attended these faculties, and for years, the trend is almost the same. (According to the "Ri-Generation Steam" survey - carried out by the Deloitte Foundation, in collaboration with SWG - on technical-scientific training).

In Italy emerges that young people are still not very attracted to STE(A)M studies as there is a cultural context that favours the humanities studies and, in the crucial moments of the choices, youngsters are influenced more by the family than by the scholastic orientation, not very effective in illustrate the growing employment potential of Stem disciplines.

There is a real gap between the offer in STE(A)M jobs and STE(A)M graduated youngsters: 150 thousand jobs that do not find candidates. This also affects the possibilities for companies dealing with STE(A)M sectors to grow in it. We need to orient youngsters to develop their talents in order to cover this gap.

STEM IN GERMANY

According to OECD statistics Germany has in Europe the most increasing of STE(A)M graduates which are around 34%. However, according to the German Economic Institute, STE(A)M qualifications or personnel are not sufficiently available in Germany.

In 2020, the share of socially insured employees in STEM occupations was almost 25 percent of all socially insured employees (Bundesagentur für Arbeit, 2021). Still, according to the German Economic Institute, the demand is much higher. In April 2021, there were a total of around 359,900 vacancies to be filled in STEM occupations, while at the same time 228,500 people nationwide were registered as unemployed and looking for a STEM occupation. If the qualification mismatch is now also considered, the German Economic Institute assumes a STEM gap of 145,100 people in April 2021. The largest bottleneck of 72,000 persons is seen in STEM expert occupations, followed by 60,200 persons in the segment of STEM skilled worker occupations and 13,000 in the segment of specialist or master craftsman and technician occupations. (Anger et al., 2021).

The number of students choosing a STEM subject has increased enormously in Germany in recent decades. In 2019, 348,763 students were registered in the first semester of a STEM degree programme at a German university. The number of male first-semester students has roughly quadrupled, and the number of females first-semester students has even increased tenfold. However, it is important to mention that STEM subjects even though being quite attractive for first-year students, have a high dropout rate. The average dropout rate for students on a university bachelor's degree programme in mathematics/science is 43 per cent, in engineering 35 per cent.

In the middle STEM qualification segment, among professionals with vocational qualifications, there is also an increase in the number of young people who decide to take up an apprenticeship programme. According to employment statistics, the number of apprentices in STEM occupations as of 31 December 2018 was 530,000 across all training cohorts, 2.8 per cent more than in the previous year.

At only 11.2 per cent, the proportion of female trainees in 2018 continues to be very low (36.9 per cent for all newly concluded training contracts). In the MINT Nachwuchsbarometer 2020, this obvious gender difference is named as a challenge for schools, but also for society.

STEM IN DENMARK

Denmark, like most countries in Europe, is facing an increasing skills shortage with companies struggling to recruit enough young people with the right skills in STEM industries. In fact, by 2025, the country is expected to have a shortfall of 6,500 engineering and 3,500 natural science graduates, with a further 19,000 unfilled IT job positions expected by 2030.

Another critical issue that needs to be addressed is the low representation of women within STEM sectors. In Denmark, only a third of university applicants for STEM related degrees are female.

According to The Think Tank DEA research in partnership with Microsoft, there is a steep decline in STEM interest among teens between 11 and 16. But the decrease is much more significant for girls, dropping by 21 per cent within the subjects of biology, chemistry, and math, compared with only 13 per cent for boys.

The Danish government has also recognised a number of challenges that need to be addressed in relation to STEM education, some of which are:

- Lack of motivation among children and young people to pursue science subjects in their further education
- Lack of widespread understanding of the importance of science
- Insufficient focus on pupils' understanding of the professional application of the individual science subjects as well as not enough practice with real-life cases and issues
- Lack of coherence and weak links between science training along the educational chain
- Lack of focus on classroom equipment and exploitation of new technological opportunities to support the investigative work in science subjects;

In relation to these identified shortcomings, the Danish Ministry of Education introduced a STEM strategy in 2018, which outlines five areas of development, namely:

1. Strengthen motivation and professional narrative
2. Improve the academic and didactic skills of teachers in science
3. Continuous professional renewal of science subjects
4. Strengthen talent development and exploit new technological opportunities
5. Local prioritisation, professional networks, and cooperation

The strategy also sets out two national objectives:

1. More children and young people should take an interest in science in primary school and pursue STEM programmes in secondary and vocational education
2. More children and young people need to acquire skills and competences in professional and vocational STEM programmes.

STEM IN CYPRUS

In Cyprus, although the number of graduates has presented a significant grown every year, either in early or tertiary levels of education, and the employability after graduation is also increasing (representing in 2019, 81,7% of the student and positioned above the average), there is a lack of STEAM professionals.

According to the European Education and training monitor 2020 , “Cyprus employability among young graduates has risen in 2019, however, there are not but health and science, technology, engineering and mathematics (STEM) graduates remain scarce”.

Cyprus has fewer STEM graduates compared with most of the EU countries: STEM graduates represent 15% of the national total, compared to the EU average of 25%, in 2018. Of those 15%, only 2,7% graduate in ICT, also under the EU average of 3.6%. Other STEM fields also struggle to develop in the country, Cypriot performance in maths and science are quite below the EU average.

However, there are numbers of initiatives in Cyprus aimed to engage youth in STEM activities. Such initiatives include - The Robotics Academy at Frederick University Cyprus, The STEAMers programme implemented by the Youth Board of Cyprus, Youth Makerspace Larnaca, various national competitions fostering STEAM, etc.

STEM IN LATVIA

According to OECD statistics Latvia has around 20% of STE(A)M graduates.

Currently, in Latvia one of the economic growth hindering problems is shortage of skills required by the labour market. More than two-thirds of employers report a shortage of skills in the workforce which is a significant barrier to long-term investment decisions. This shortage is particularly acute in the areas of STEM and health care in Latvia - a report of the Ministry of Economics in Latvia in 2020 predicted shortage of highly qualified specialists in natural sciences, ICT and engineering; which can increase to about 17 thousands in 2025. There were only 3400 graduates from STEM programs in 2017.

Since it is forecasted that Latvia's economic growth will be primarily based on digitalization, innovation, the use of new technologies and process optimization, STEAM skills will be in high demand in the future in Latvia.

Another fact about STEM education is that regardless that females constitute the largest share of higher education students in Latvia, science and technical fields are more often chosen by males. For example, in 2019, totally 14 848 students acquired a degree or qualification in higher education institutions of Latvia, of which females accounted for 65.2 %. However, females constituted only one third (29.5 %) of the science and technical field (life science, mathematics, IT, engineering, manufacturing and construction) graduates. Therefore, STEM skills development among girls and women is also a priority for Latvia.

TO SUMMARIZE…

We all talk about the STE(A)M skills gap and we know that businesses are suffering lacking of STE(A)M skills, but it's difficult to know what 'STE(A)M' jobs will look like in the future because of the rapid rate of change when it comes to technology. Moreover we know that new entrepreneurs need to be approached to all the ST(R)E(A)Ms matters including the Research skills.

It's however important to consider that one of the most valuable skills that comes from STE(A)M is creativity – something that all of us have to some degree. In addition to facilitating creative thinking, STE(A)M subjects also involve skills like learning to problem-solve, being inventive and learning to fail.

STE(A)M doesn't support one particular job sector, but rather it empowers us to create new things which is a skill that is transferable to lots of jobs, not just those in science, mathematics, technology and engineering.

The connection between science and entrepreneurship is very strong. One of the cornerstones of entrepreneurship is business idea generation. One common method of idea generation for new products or services is to design a solution to a given problem. Finding solutions to problems is a foundation of every field of science.

2 STREAM Entrepreneurship

STREAMpreneurship

Is an educational approach that uses STREAM activities and methods to improve youth entrepreneurial skills and promote sustainable entrepreneurship.

INTRODUCTION TO STREAM

Education is constantly evolving to fit the needs of learners and society as well as the labour market. So while STEM is not a new concept, it has gradually evolved to STE(A)M and now STREAM over the past couple of years.

STEM is known as learning to integrate several disciplines, namely Science, Technology, Engineering and Math. STEAM is the integration of STEM with the addition of A, which is Art. STREAM is the integration of STEAM with and addition of R: which can in different context be interpreted as Reading and wRiting, Religion or Research. In the context of the STREAMpreneur project, the letter R stands for research. Research is a crucial skill needed in planning, launching and running a business. For example, entrepreneurs have to research the market, competitors and issues as they come up.

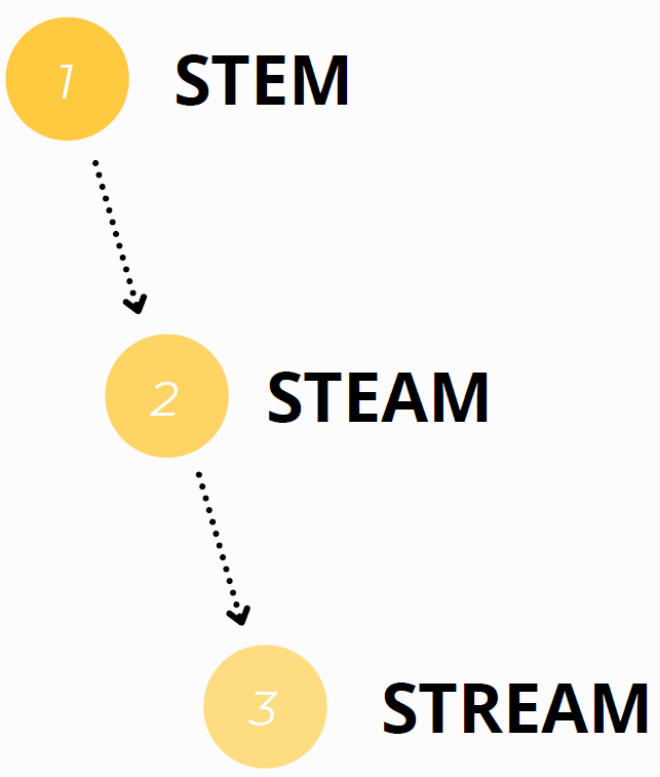


Figure 1. The Evolution of the STEM approach

Thus, STREAM is a comprehensive, unique and holistic educational approach that integrates **Science, Technology, Research, Engineering, Arts, and Mathematics** into the teaching and learning process. This approach encourages learners to see things from inventors, creators, designers, problem-solvers, and collaborators perspective and allows them to apply their learning in real-life situations.

BENEFITS OF STREAM:

- It promotes 21st-century skills, which includes collaboration, communication, creativity and critical thinking;
- It unleashes the inner creativity of learners, which is required in any discipline;
- It is multidisciplinary, holistic, shows variation – making learning a fun experience and attractive to learners;
- It allows the application of learning to real-life situations;
- It promotes hands-on learning, making learners well-rounded.

STREAM AND ENTREPRENEURSHIP

In the future, increasingly focused on innovation, inclusion, and sustainability, STREAM education and entrepreneurship will be more linked than ever before. Entrepreneurship skills and STREAM education go hand-in-hand. The competencies developed in STREAM education – creativity, problem-solving, analytical thinking, adaptability, etc. are equally important for the development of a successful entrepreneur. Both STREAM and Entrepreneurship education produce individuals who take thoughtful risks, engage in experiential learning, persist in problem-solving, value collaboration, and work through the creative process to solve real-life problems.

Let us look at 10 STEM employability skills and skills from the EntreComp framework to understand better how STEM and entrepreneurship are linked.

Table 1. STEM employability skills and EntreComp framework skills

10 STEM employability skills	Corresponding skills in EntreComp[1] framework
Using your initiative and being self-motivated	Motivation and perseverance
Organisational skills	Planning and management
Working under pressure and to deadlines	Coping with ambiguity, uncertainty and risk; Self-awareness and self-efficiency
Ability to learn and adapt	
Communication and interpersonal skills	Mobilising others
Team working	Working with others; Learning by doing
Negotiation skills	Spotting opportunities; Mobilising others
Valuing diversity and difference	Valuing ideas
Problem-solving skills	Creativity
Numeracy	Financial and economic literacy

1. *EntreComp model is a reference framework that can be adapted to support the development and understanding of entrepreneurial competence in any setting.*

Looking at the table on the previous page, we can see that skills developed during STEM education are the same skills that are essential for successful entrepreneurs to have. Additionally, by introducing research (R) and arts (A) to traditional STEM as one of the core elements of discovering new knowledge, the STREAM approach will provide a well-rounded learning experience.

Thus, to foster and create future entrepreneurs – drivers for future growth who will find the solutions for emerging problems societies are facing as well as create new jobs – we need to combine these to concepts and produce innovative entrepreneurship programmes that will integrate the updated educational concept of STREAM, providing youth with a wide range of knowledge and skills.

STREAMpreneur approach: designing activities

Like in the traditional STEM approach, we suggest that STREAM activities in the context of entrepreneurship (STREAMpreneurship) should be comprised of two, three or all four of these elements:

1. ***STREAM subject knowledge and content*** – to enthuse and teach young people about an area of STREAM knowledge or develop a STREAM skill through activities such as an experiment, design of a novel solution, a research and presentation project, using a specific piece of technology, etc.

2. ***Entrepreneurial skills*** – to develop the skills and competencies essential for successful entrepreneurs (focused on the 15 competencies named in the EntreComp framework).

3. ***Sustainability*** - to enhance young people's understanding of sustainability and encourage them to develop sustainable business ideas and innovations.

STREAM ACTIVITY

4. ***STREAM careers and opportunities*** – to inspire young people who may not necessarily want to be entrepreneurs to follow STREAM careers by providing careers-related information and examples (e.g., job descriptions and career retrospectives) and advice on STREAM career pathways (e.g., options and qualifications needed, etc.).

3 DESIGNING EDUCATIONAL/TRAINING ACTIVITIES AND PROGRAMMES

methods, techniques, tools and aids

CHARACTERISTICS AND CHALLENGES OF STREAM ACTIVITIES

Beyond teaching subjects in an integrated manner, STREAM is a philosophy of education that embraces developing skills and competencies by taking a point of departure in real-life problems. The purpose of interlacing the different disciplines is to help learners better understand the transferability of knowledge from one context to another and to be able to utilize that knowledge in real life scenarios creatively (Brewer, 2018). The underlying principle of ST(R)E(A)M is that understanding how knowledge and skills can be applied is just as important as learning the knowledge and skills itself (Knowles, 2016).

Many of the present-day challenges we face, such as climate change, resource management, health, biodiversity, and much more, require a more comprehensive approach that encompasses different perspectives and angles of the problem. For example, the Covid-19 outbreak in 2020 was an unprecedented global crisis to which no government had any pre-existing solutions or quick fixes. In this situation, we can see how STREAM helps target a problem on multiple levels. Science isolates the virus, studies its genetic material, its impact on the human body, the causes for infection, its spreadability and so on. Through the use of modern technology and engineering, we are able to develop and test vaccines that provide immunity against the virus and find ways to distribute them to countries across the globe. Through research, we determine which part of the population is most vulnerable, the most common transmission methods, the best-proven practices for protection against infection, etc. Art is used to create communication materials (videos and short films, infographics, and others) that explain to the general public in an accessible way the information gathered by scientists and researchers and instruct them on what precautions to take. Mathematics is used across all disciplines, as well as, in gathering statistics such as number of infections and percentage of the population that is infected, in order to inform policies and measures taken by governments to restrict the spread of the virus.

Although the idea of STEM education has been contemplated since the 1990s in the USA, the challenge of operationalizing it in different learning environments persists to this day. Some of the reasons for this are the lack of a globally accepted definition of ST(R)E(A)M education and the difficulty in identifying ways in which the disciplines are equitable. (Knowles, 2016).

Another challenge can be that learners have little or no understanding of the relevant ideas contained in the individual areas. What is more, some learners are not used to applying their knowledge in integrated contexts and may need help to connect ideas efficiently in order to employ them in resolving tasks. (National Academy of Engineering and National Research Council [NAE & NRC], 2014).

Many educators/ facilitators use the problem-based learning method when working with ST(R)EAM, as they recognize that ST(R)EAM is not just about the activity content but rather the process of thinking creatively and critically and integrating knowledge from different fields. (Miller, 2017) Furthermore, when learning is grounded within a specific problem, learning is authentic and relevant, therefore representative of an experience found in actual STEM practice. (Knowles, 2016)

"As a facilitator, you will want to focus on identifying authentic problems that learners can work on".

Author of *STEM by Design (Routledge)*, Anne Jolly, has several tips on how to do that (Jolly, 2017):

1. The problem must be real.

It should involve an authentic challenge grounded in compelling societal, economic, and environmental issues that affect people's lives and communities.

2. Learners must be able to relate to the problem.

If learners don't care about the problem, their buy-in will be limited. It might be a problem in their own life or community. Alternatively, you might build a context to help them connect with an unfamiliar problem by using videos, speakers, or study visits.

3. The problem should be "doable."

For a ST(R)AEM project to be successful, learners should have access to the resources, knowledge, and skills they need to solve the problem—and the scope of the problem should be manageable.

4. The problem must allow for multiple acceptable approaches and solutions.

It's best to avoid problems with a single, predetermined approach and "right" or "wrong" answer. Learners should be able to choose a different approach for solving the problem, and several different solutions may work.

5. You can encourage learners to come up with the problem.

This approach can often generate the most enthusiasm and engagement. You might start by asking the participants to think of problems in their home, community, or country.

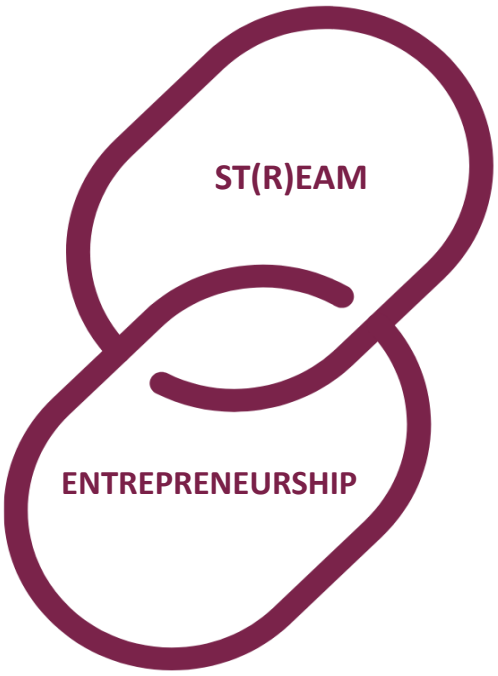
For example, they might have noticed a problem with plastic pollution in a local body of water, or they have read about a sudden drop in the production of staple crops in their country, which is essential for providing affordable nutrition to the population.

COMBINING STREAM AND ENTREPRENEURSHIP ACTIVITIES

There is a strong connection between ST(R)EAM and entrepreneurship, as both concepts require taking thoughtful risks, engaging in experiential learning and problem-solving, embracing collaboration and working through the creative process. Furthermore, one of the cornerstones of entrepreneurship is business idea generation. One method of idea generation for new products or services is to design a solution to a given problem, which is also what ST(R)EAM specialises in (Radloff, 2018).

Entrepreneurship complements STREAM, as it can take a scientific idea or breakthrough and mould it into a product or service that can address an unmet need, present it in a "digestible" form to a large audience, and find ways to develop its competitive advantage on the market. Case studies presented in the online journal *Bioentrepreneur* show the great potential of combining STREAM and entrepreneurship, as STREAM brings an internal approach to the new venture (a technology push), whereas entrepreneurship uses an external path (a market pull) (Mehta, 2004). What is more, the combination of the two often leads to inventions and/or services that benefit the population rather than being purely focused on profit margins.

Integrating STREAM entrepreneurship in your activities with young people can help them develop essential skills such as critical and creative thinking, problem-solving and problem identification, flexibility, managing risk, failure and uncertainty, decision-making, willingness to experiment, being open-minded, and ability to transfer and apply knowledge across disciplines. Thus, they will be equipped not only with the ability to come up with creative ideas but will also have insight into the practical know-how of how to bring their idea to life and use data-driven evidence to back up their ideas and assumptions. This will put them in the unique position to create change and value for their communities through the businesses and initiatives that they put into motion.



LEARNING METHODS FOR STREAM AND ENTERPRENEURSHIP ACTIVITIES

Project-based Learning (PBL)

This is an instructional methodology that encourages learners to acquire and apply knowledge and skills through engaging experiences. The projects may be suggested by the facilitator, but they are all executed and planned by the learners themselves. In order for learners to be ready to solve the complex challenges and problems that exist in our world, they have to have had the opportunity to practice doing so. This is true whether young people pursue a career in a STREAM field, the arts, or in the humanities.

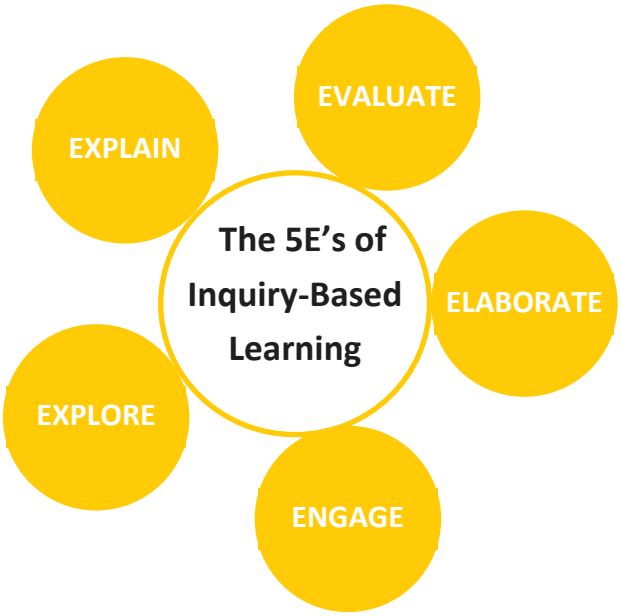
Example of a good practice in PBL: Four teachers from four different classrooms at Huntington Middle School (PA) used their individual strengths in a rotational, project-based model to teach middle school students how to apply STEM to real-world situations. The team included a technology teacher, the library media specialist, math teacher, and science teacher who split the students into four classes and rotated them every three days. During the nine-week project, students were tasked to use STEM skills to create their own artificial island. They used knowledge from all four teachers to finish the multifaceted, cross-curricular project and presented it to their classmates.

Problem-based Learning

This is a method that requires learners to analyse, create and evaluate a given problem. Such problems are often open-ended and might not have solutions, however, the young people can proffer potential solutions and questions set principles or narratives. The problem-based learning, which is also similar to Inquiry-Based Learning (IBL), encourages learners to ask questions and work in groups, whereas, in IBL, they are required to work individually. The teams of learners could be interdisciplinary, cutting across various fields in the sciences, all working together to proffer a solution. Often this problem is provided by corporates, as is seen in hackathons where the problem is presented, and the groups apply critical thinking skills to analyse and proffer solutions. PBL as a strategy is a top-down process that requires learners to solve problems, analyse, synthesize, think critically, and communicate knowledge from several disciplines promoted by constructivism (Terhart, 2003).

Inquiry-based Learning (IBL)

The learning method focuses on questioning, critical thinking and problem-solving. Often confused with Problem Based Learning, where the problems provided are open-ended and most times without a set solution, IBL questions have definite answers and solutions. Using IBL in STREAM helps learners understand the various set principles involved in the final answers to the problems posed, ensuring that they fully understand and can apply the knowledge where necessary.



ENGAGEMENT

Mentally engaging learners with a question or creativity and raising their interest in a topic.

EXPLORATION

Letting learners carry out hands-on activities to make sense of a concept. These activities will help them use prior knowledge to inquire, generate new ideas and conduct preliminary examinations.

EXPLANATION

Encouraging learners to explain their understanding of concepts and correcting any misconceptions that might occur.

ELABORATION

Letting learners conduct additional activities to apply learning to new situations. This stage in the learning cycle presents opportunities to integrate science with other content areas.

EVALUATION

Letting learners review and reflect on their learning (Self-assessment, etc.). encourages them to assess their understanding and abilities.

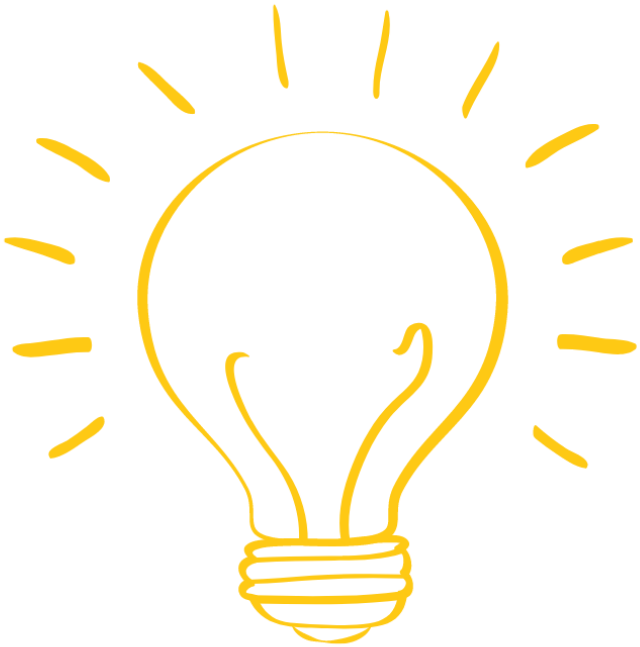
Design based learning (DBL)

DBL, also known as design-based instruction, is an inquiry-based form of learning based on integration of design thinking and the design process into learning environments. Design-based learning environments can be found across many disciplines, including those traditionally associated with design (e.g., art, architecture, engineering, interior design, graphic design), as well as others not normally considered to be design-related (science, technology, business, humanities, STEM, STEAM).

In the education community, there is a growing emphasis on the importance of creativity, critical thinking, collaboration, and communication, all inherent skills to design. Design-based learning fosters these competencies while supporting the learning of curricular subjects, skills, and knowledge. This approach has similarities to problem-based and inquiry-based learning, but with an emphasis on creativity and future thinking. In this way, learners experience and acquire the concept and knowledge presented in the design project.

Peripatetic Learning

The idea of this learning method is to learn while moving. The core approach here is to use guided walks through landscapes that are full of examples of innovation – and explore them while in the open air, walking and discussing them away from the traditional learning context. For example, you can use this method to understand a number of key innovation theories brought to life by viewing them using real, but historical examples in an industrial/natural heritage environment.



NON-FORMAL METHODS AND APPROACHES FOR DESIGNING STREAM ENTREPRENEURSHIP ACTIVITIES

Non-formal education encompasses an array of different approaches and activities that are generally flexible and can be adapted to specific target groups and environments. The content of these activities is functional and based on specific contexts and learning objectives aimed at addressing pre-established needs centred on the learner. It works with heterogeneous target groups in which participants are usually from different backgrounds and might have different sets of skills and knowledge. (Hamadache, 1991)

Thus, the methods employed most often encourage group work and collaboration to stimulate the process of discussion and knowledge exchange between the participants. Its value is derived from the fact that the competencies and skills gained through it can be immediately relevant and put into practice.

Some examples of frequently used non-formal activities are problem-solving activities, storytelling, presentation, role play, drawing/painting/design, scavenger hunt, concept mapping, improv games, discussion, debate, experiments, brainstorming, etc. What is more, non-formal training can be used in face-to-face, blended, and online learning, though exercises and methods will need to be adapted to the specific requirements and conditions of each environment.

Because of its flexible and hands-on nature, non-formal education is a perfect fit for introducing STREAM entrepreneurship to learners. The non-formal approach can help you break down complex problems and processes while harnessing the creative abilities of your participants, thus creating a positive learning environment that promotes engagement and retention of knowledge.

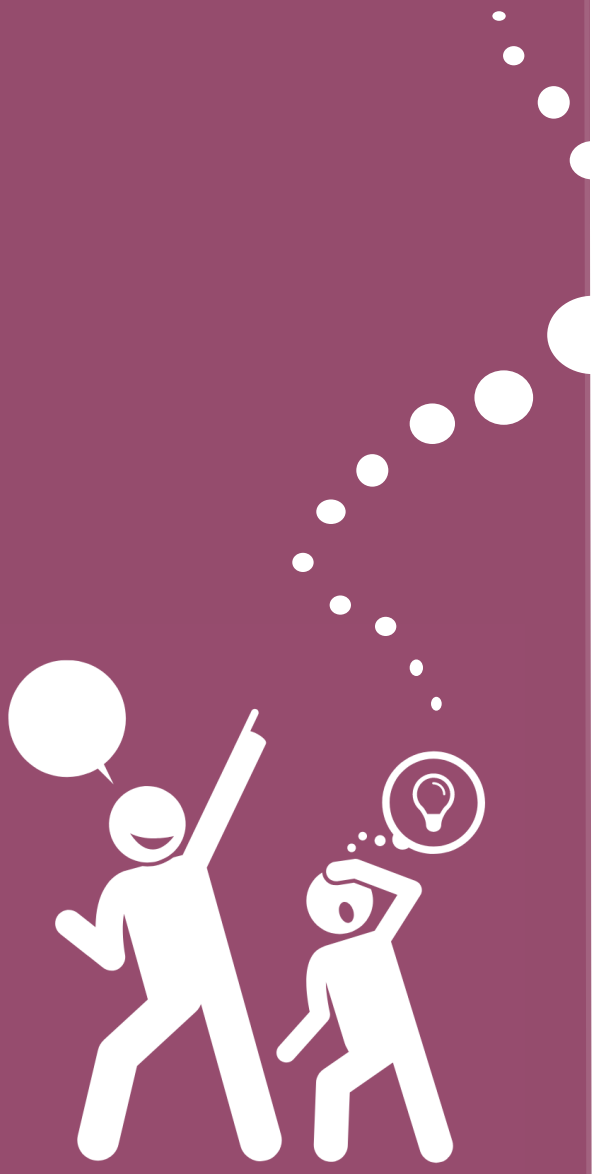
As a youth worker, you most likely have experience using various non-formal methods and tools and have your observations on what exercises work best for your target groups. Therefore, how you fuse together your regular activities with STREAM and entrepreneurship training will largely depend on your past experiences as a youth worker and the specific needs of your target group. To help you in this endeavour, we will provide you with some general guidelines and suggestions you can take into consideration when designing STREAM entrepreneurship activities.

You might want to consider that STREAM often requires numerous materials and resources for learners to investigate solutions to real-world problems through designing, expressing, testing, and revising their ideas. Materials can include construction tools such as saws, measuring devices, and hammers; electronic materials such as computers, design programs, robotics kits, and calculators;

and other materials used in the design, which could include wood, styrofoam, glue, cardboard, or construction paper. Through the use of these materials in design activities, learners can better understand technology and engineering. (Stohlmann et al., 2012)

Understanding scientific concepts and developing genuine curiosity and scientific inquiry is also a considerable part of STREAM. You may often find it more efficient to ask participants to do individual research on specific concepts and ideas beforehand to be prepared to apply them during the actual activity programme. You can encourage them to do so by watching short documentaries, inviting a guest speaker, organising a field trip, reading an article, etc.

When interlacing STREAM with entrepreneurship, focus on developing tasks that encourage participants to come up with specific results and outcomes while utilising concrete knowledge (Problem-based, project -based, and design-based learning). This way, learners can develop an increased understanding and effectiveness in opportunity recognition, creativity, and coping with uncertainty, risks, and the liabilities of newness. Another important learning objective of facilitating both STREAM and entrepreneurship activities is developing social skills. Entrepreneurs need social relationships and diverse networks to acquire information, resources and gather opinions on their ideas. In light of these facts, it can be concluded that some of the best non-formal methods for STREAM entre-preneurship are problem- solving activities, concept mapping, idea design and pitching, group work and discussions, reflections on real-life applicability of concepts and solutions, etc. In the following sections, you can find some suggested learning techniques as well as specific examples of activities to get you started.



1. DISCUSSION

Discussion plays a critical role in learning, especially in STREAM when talking about big and sometimes complicated ideas. Discussion gets learners actively engaged with new topics, recalling related material, and understanding how and where STREAM relates to their lives. Working through these discussion topics gives them a deeper context and can propel interest in learning.

2. WORK IN GROUPS

When in work teams, young people are encouraged to become active, rather than passive, learners. With each young person in charge of his or her own success, the opportunity exists for self-esteem building and self-learning satisfaction. The opportunity to learn from and teach others provides context and facilitates deeper learning. Team activities help young people develop socially and emotionally, with challenges that mirror the realities and diversity of the workplace. Team activities are effective when they are set up with clear guidelines and well-defined goals. They should provide opportunities for youth to work together and accomplish a specific task, and there should be active roles for everyone. Interactions and "doing" should be a team activity's primary focus, and this is why STREAM could provide the perfect environment.

3. EXPERIENTIAL WORKSHOP

Participants meet an expert lector. The lector guides the participants through a prepared programme using various techniques (feedback, role-playing, model situations etc.). The workshop is always focused on a specific topic and emphasises the participants' personal experiences. E.g. inviting a guest entrepreneur to share his expertise in a specific area.

SUGGESTED LEARNING TECHNIQUES

4. ROLE-PLAYING

Role-playing is a learning structure that allows young people to immediately apply content e.g. as they are put in the role of a decision-maker who must make a decision regarding a policy, resource allocation, or some other outcome. This technique is an excellent tool for engaging participants and allowing them to interact with their peers as they try to complete the task assigned to them in their specific roles. This work can be done in cooperative groups, and/or students can maintain the persona of their role throughout the activity. As a result, participants are more engaged as they try to respond to the material from their character's perspective. It is important to note that this role-based team approach helps learners use, practice, and develop skills by allowing them to experience diverse roles that emphasise different skill areas and strengths. Notably, one of the benefits of a role-based approach is its flexibility. Using roles, a facilitator can integrate and accommodate students with different needs more seamlessly. For example, the facilitator may choose to have some young people work in a narrower subset of roles.

Using roles within groups, the facilitator can ensure that all participants have a vehicle for actively contributing to the group building or testing.

5. SNOWBALL

Snowball is an instructional strategy wherein participants write a discussion prompt related to a topic or concept on a piece of paper. The prompt is intended to encourage discussion and/or help them to understand the subject matter better. This instructional strategy can be led with an instructor question or prompt, but ultimately, the participants drive the discussion focus. These prompts can relate to a reading, video, previous lecture, or a question about the course content. This is how you could run a snowball activity:

1. Give learners a task to do individually for one minute. For example: “What you think are the three most important points from the last activity?”, or “What two suggestions you would come up with to solve the problem presented?”, or “Suggest three responses you could make in the scenario I have just outlined.”
2. Individuals form pairs and have two minutes to hear what each has come up with and agree on their joint response.
3. Pairs form groups of four and have three minutes to agree on their joint response.
4. Fours form groups of eight and have three minutes to agree and appoint one person ready to announce what they have agreed as a group.
5. At this point, you may want to hear briefly from each group of eight and comment on or record their suggestions. In a sense, what you do at this point is less important than the previous stages because everyone in the group, however large the group is, has had to talk and be actively involved in the task.

6. GAMES AND SIMULATIONS

Simulation is a very general and flexible teaching approach that can be used in most disciplines, but this means that how it is implemented will vary greatly. The key to simulation is that it is a dynamic rather than fixed experience, with the scenario changing realistically according to the actions of the participants and the participants adapting as a result of changes to the scenario; in a sense, a simulation is a mechanism for learners to obtain real-time feedback on their actions. This allows learners to develop experience of specific situations by applying their wider learning and knowledge. To get started with learning through simulation one should ask: Where would this approach work best in the course/module? What situations would the participants benefit from exploring in a controlled environment? What timescale should be used? Real-time? Faster? Slower? How much technology should be involved? Which tools are most suited? What support would be needed? Are the participants and the facilitator ready for this?

7. CASE STUDIES

A case study is a research method that allows a person to understand why and how to investigate questions. In a studied case, there are many factors that affect the phenomenon and can be described only by the case study. Case studies can be used for many purposes as they allow the capacity to describe different factors and their interaction with each other in real contexts. Furthermore, it offers various learning opportunities and experiences by influencing the different theories practice. Learners can actively engage in finding out the principles by abstracting from the examples. Moreover, they can develop skills like problem solving, coping with ambiguities, analytical, quantitative, qualitative tools depending on the case and decision making in complex situations.

Online sources for STREAM concepts can be found here and here.

8. BRAINSTORMING

Brainstorming is a creative activity that encourages the free flow of ideas and helps generate many potential solutions to a problem. The facilitator begins the exercise by posing a question, issue, or introducing a topic in this process. Then the participants express possible answers, relevant words, and ideas, and their contribution is accepted without criticism or judgment and is summarised on a whiteboard. These ideas are then examined, usually in an open discussion format.

11. SITE VISITS/EXCURSIONS

Participants visit a specific site/business for a limited period of time and gather information about an evaluation object either through their own experience or through the reported experiences of others.

9. STORYTELLING

Storytelling occurs when knowledge, ideas, products, or other information is conveyed to the recipient by fictional or real stories. Using the story allows the information to be presented as simply as possible and can therefore be easily comprehended and ingrained in long-term memory. The purpose of storytelling is to convey messages, knowledge, and data, anchoring the information in the recipients' minds by harnessing the power of creative thinking and associations.

10. EXPERIMENT

There are different types of experiments you can choose to perform. The type of experiment chosen might depend on various factors, including the participants, the hypothesis, and the resources available to you and the learners.

ACTIVITY EXAMPLES

When designing a programme of activities for STREAM entrepreneurship, whether online or offline, you will want to incorporate a variety of exercises such as energisers, problem-solving activities, discussions, presentations, debriefs, and so on.

ENERGIZER: SPOON 101

This activity is a warm-up that takes about 10 – 15 minutes and helps learners come up quickly with out-of-the-box ideas. It is a remarkably simple exercise but is very effective in preparing learners for further brainstorming when, for example, identifying specific problems to work with.

Show the group a spoon (or another everyday object) and ask each participant to name a different use for it other than eating (e.g. put on your shoes, make noise to call attention, make music, bind up one's hair). Make a few rounds until you feel the participants have exhausted their ideas. Finally, summarize by speaking about how innovation and thinking out of the box generate new business ideas. (Fora Hvidovre and InterCollege ApS, 2019)

DESIGN, RESEARCH AND PROBLEM-SOLVING: THE PERFECT WALLET

The method was developed by Stanford d.school, a hub for innovation, collaboration and creativity at Stanford. The original wallet project was created to introduce design thinking for the d.school's inaugural Boot Camp class in the Winter of 2006. It has since been contributed to, modified, stretched, and evolved by collaborators.

The Wallet Project is an immersive activity meant to give participants a complete cycle through the design thinking process in as short a time as possible. In a nutshell, participants are paired together, and they interview each other about how and when they use a wallet, what is its content, what that content reveals about their life, etc. They then have to reflect on the insights they have captured and brainstorm at least five different concepts that meet the need of the interviewee. They then present their solutions and get feedback on their applicability.

Find the full method description here.

It is undoubtedly possible to facilitate a similar project with a different topic. For example, the d.school has also done the "oral-hygiene project" to make it more personal and had participants observe their partners/family in their homes previous to the beginning of the workshop.

PRESENTATION: STOP-MOTION VIDEO

Ask the participants to form groups of 2-3 and allow each group to choose a scientific concept that they will research and present (e.g. How does gravity work?; Why do we only see one side of the moon?; etc.) Then ask them to create a stop-motion video no longer than 2 minutes that explains the science behind their chosen phenomena and add either narration or music to the video file.

How to Make a Stop Motion Video

DEBRIEF: FROM THIS TRAINING I TAKE HOME...

Ask the participants to sit comfortably on the floor, forming a circle. Tell the participants that they will burn a single match one by one. While the match is burning, they shall speak, continuing the sentence "From this training I take home….". Instruct the participants that each one of them shall speak only for the time that the match is burning. When all the participants have spoken, allow extra time for those who did not manage to finish their thoughts and/or final thoughts.

GET INSPIRED...

https://www.nureva.com/blog/education/15-active-learning-activities-to-energize-your-next-college-class

https://www.steampoweredfamily.com/education/14-brilliant-stem-activities-for-elementary/

4 IMPLEMENTING THE EDUCATIONAL / TRAINING ACTIVITIES/PROGRAMMES

The STREAM learning approach is an appropriate solution to master 21st-century skills and respond to changes in educational innovation due to the industrial revolution 4.0. The essence of STREAM education is to prepare the 21st-century workforce with STEM skills and its related activities so that students can take what they learn in the classroom/ laboratory and apply it to their future jobs in the real world.

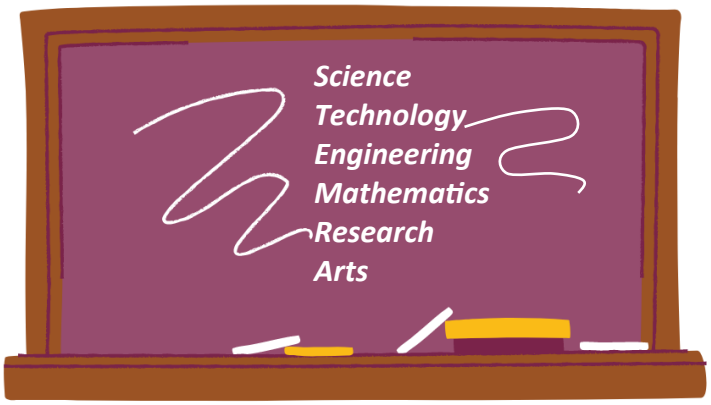
Educators, industry and the business community should work as a team to develop curricula that will enhance this expectation. More importantly, in addition to curricula development, this collaboration between schools and professionals in the industry should include internships, mentoring, the delivery of hands-on activities in the classroom to introduce the students to careers across STEM fields and fundamental skills.

Teachers who implement STEAM learning in their classrooms help shape the country's future leaders. Experts have contended that students require scientific and technological skills to face challenges that arise with the adjusting economy in this information-based society. STEM education is the key to finding solutions to problems that occur due to technology and globalization.

Encouraging students on the importance of these disciplines and involving them assists them in illustrating their ideas. STEAM learning is essential to the nation's economy and the increasing competition between other industrialized countries. In addition, the potential gap that is set to emerge in the next decade due to the advancement in technology requires a great supply of workers with STEM education.

STEM learning involves implementing four subjects: Science, Technology, Engineering, and Mathematics as the core basis of teaching. In the STREAM approach, four subjects are complemented by the Research element and Arts.

Due to the overall low performance of high school students on STEM courses, there has been an emerging need for repairing the gaps in the education system. Therefore, school teachers, trainers, facilitators of non-formal education activities, and youth workers can integrate STREAM into their existing activities.



IMPLEMENTATION OF STREAM

Into entrepreneurship training curriculum - practical ways

It is acknowledged that people solve problems through integrative thinking and applications in real life. They do not separate aspects of science, mathematics, art, and so on; instead, they draw from all the disciplines and confront the problems holistically.

Below are several tips for implementing STREAM activities in the educational activities and learning environment.

1. **Make students familiar with modern educational technology & digital technologies**
2. **Introduce concepts like 'experiment', 'model' and 'design' to training activities**
3. **Implement STREAM activities out of the classroom**
4. **Implement entrepreneurship activities through arts and boost creativity**
5. **Teach young people critical thinking**
6. **Ask "why are we teaching this?" instead of "what to teach"**
7. **Integrate STEM educational videos in the learning process**
8. **Provide more hands-on experience to students and foster engagement**
9. **Invite field experts and entrepreneurs**
10. **Stream STREAM activities**

1.

Make students familiar with modern educational technology & digital technologies

Giving young people access to computers and cell phones during classes for learning purposes broadens their minds. The internet and various applications are resourceful tools in terms of information. Tasks such as searching for information, math, drafting essays, and creating graphics can be done with the help of digital technologies. It will make the STREAM skills learning process more effective during your training.

Currently, there is no learning without computer skills and Internet use. Programming itself is becoming just as important. This is another skill that is starting to dominate the world of science because it makes life so much easier. Caring about the future of the labour market, one should know that soon all jobs will require digital skills, and entrepreneurs are no exception.

2.

Introduce concepts like 'experiment', 'model' and 'design' to training activities

This allows students to explore and put their skills into practice. Creativity is employed at its peak, ultimately preparing students for real -life challenges. Students should be asked to discern problems around them and require solutions. For example, a teacher can request their students to design a system model that will curb global warming. As finding and providing solutions is a primary goal of entrepreneurship, this implementation tip can be handy for STREAM entrepreneurship training activities.

By empowering students with daily issues, they will discover that real-world problems have numerous solutions. In addition, these activities promote teamwork and effective communication, which are essential in a young entrepreneur's activities.

3.

Implement STREAM activities out of the classroom

An essential part of implementing STREAM entrepreneurship activities is taking them in non-formal or informal settings. Going to the museum, walking in the park, or going to the zoo are excellent examples of activities that can complement STEM education. In this way, we can demonstrate specific phenomena in practice. In addition, we can find a lot of teaching aids that support field research: from tablets that you can take with you on a trip to always having access to up-to-date information through laboratory kits that will make your fieldwork feel like a professional job. Museums, zoos, nature centres, aquariums, and planetariums are among the top informal science institutions that regularly engage young people in observing, learning, and using STREAM knowledge and skills.

Study visits to enterprises or tech start-ups are another way to bring learners out of the training room, show the practical application of ideas, and create solutions in STEM fields.

4.

Implement entrepreneurship activities through arts and boost creativity

As Arts is an integral part of the STREAM concept, it can be used to implement entrepreneurial training activities under the STREAM entrepreneurship concept. The arts aspect embeds areas of performing arts (i.e. dance, music and theatre), presenting arts (i.e. visual arts) and producing arts (i.e. media arts), as well as languages. The introduction of various artistic activities can significantly enrich your training curriculum. Creativity is an essential soft skill for young entrepreneurs, and it can be perfectly developed through the arts!

5.

Teach young people critical thinking

To implement the STREAM approach, it is important for youth workers and teachers/ trainers to teach young people to find and verify the information by themselves to increase their knowledge and ensure that the sources they use are reliable and up to date. Training activities and school programs are limited in time and cannot provide all necessary knowledge and practical competencies, so the crucial ability for young entrepreneurs is learning. STEM subjects are perfectly designed to develop critical thinking.

From this perspective, the teacher is a mentor whose task is to adapt new generations to the future world. Whatever your activity is, try to set the focus of your group on researching more on the topic on their own. It is helpful to encourage students to continue exploring and supplementing their knowledge when they show interest in the topic being discussed. They should know that learning is an ongoing process. It is only up to us how much time we spend on learning new stuff.

6.

Ask “why are we teaching this?” instead of “what to teach”

When implementing activities, a teacher or trainer must put his or her focus on the purpose of the activity, not just the subject. STEM subjects, in this case, are not a priority, as there is no sense of teaching math, technology or engineering skills taken out of entrepreneurship context. Instead, teachers and facilitators should always focus on the goal of each activity.

Another tip: make your students ask a question: “why am I learning this?” instead of “what I learn”. It will foster their understanding of how STEM skills and the STREAM approach contribute to their entrepreneurship career, increase motivation to study, and get their thinking in the right direction from the beginning of the learning process.

7.

Integrate STEM educational videos in the learning process

Another tip would be to show science videos to learners to make an entrepreneurship training process more engaging and fun. In this case, science videos should do more than just inform; they should inspire. A teacher should choose videos that get young people to explore, create, and try things. Those materials should provide an eye-opening experience and free us to think about exciting experiments and projects. At the end of the lesson, science videos should make students want to explore and discover and make a change and think about the possibilities. Do not hesitate to start a discussion with the class to reflect on what has been seen in the video. With the Covid-19 crisis and pandemic, there is a special priority to show that STEM competencies are of particular importance to solve topical problems and society challenges and create new products.

8.

Provide more hands-on experience to students and foster engagement

STEM education focuses on problem-solving, analytical thinking, and project management, and the same goes for entrepreneurship education. Contrary to stereotypes about exact sciences, it is more engaging in learning than classical methods. Not only does it identify problems and theoretically talk about problem-solving, concepts, models and experiments, but it is necessary to let youngsters do experiments or create real solutions by their own hands. Practice is about committing time to solve a problem with any tools and materials available. Hands-on instruction uses kinesthetic and tactile methods, where touch, feel, smell, taste, and hearing can enhance the learning experience. Also, this method leads to improvement. The more you can practice activity, the better your performance. Practice is not about being perfect, however. Young participants need to recognize mistakes will happen, so teachers should use them as learning moments. Implementing activities, don't forget to give feedback to learners on their outputs. Promoting active learning and practicalities in classrooms is a way of engaging students.

Hands-on experiences take the information in textbooks and lectures and bring it to life, making it more meaningful and helping students store it in their long-term memory. This is one of the best ways to retain the curriculum.

9.

Invite field experts and entrepreneurs

To make a teaching process more interactive, a teacher can also invite experts from outside of school as an incentive to excite students about both science, math, technology and entrepreneurship. It also means visiting labs and start-ups or real enterprises to get first-hand experience about the application of STREAM to entrepreneurship.

10.

Stream STREAM activities

Currently, most education is switched to an online format. Bearing in mind different obstacles to making educational activities on site face-to-face, there is also the possibility of implementing STREAM activities in a virtual environment. Do not be afraid of making science online. First, as mentioned above, digital skills and knowledge of IT tools are a "must-have" nowadays. Taking STREAM education online is a perfect chance to explore the use of technology directly.

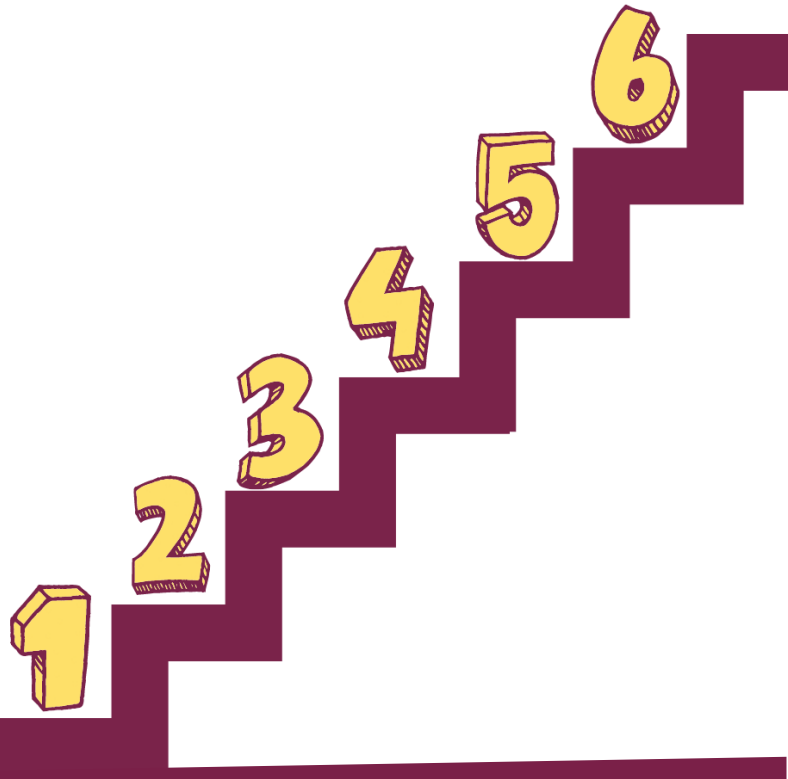
Secondly, according to the best practice of STEM projects being implemented during a pandemic, non-formal or informal science workshops can also be carried out in online space: for example, the particular location or equipment for experiments was no longer laboratories and expensive machinery or toxic substances but was replaced by participants' kitchens using baking powder or vinegar. Therefore, STREAM workshops can be undertaken either at a specific location or with special equipment (materials for the workshops) or be location independent.

In addition, there are few implementation steps on how to better build an educational or training activity with the STREAM approach.

HOW TO CREATE A STREAM LESSON: 6 steps

There are six steps to creating a STREAM centred classroom/training activity. You're working through both the classical STEM plus the arts and research approaches to address a central problem or essential question in each step.

This process can be used to help plan for a lesson and also to facilitate the actual learning process in your STEAM classroom. Let's take a look at each step.



1 - FOCUS

The first step to implement the STREAM approach to educational and training programmes, is to select an essential question to answer or problem to solve. It's important to have a clear focus on both how this question or problem relates to the entrepreneurship area you've chosen.

2 - DETAIL

During the detail phase, you're looking for the elements contributing to the problem or question. When you're observing the correlations to other areas or why the problem exists, you begin to unearth a lot of key background information, skills or processes that students already have to address the question.

3 - DISCOVERY

Discovery is all about active research and intentional teaching. In this step, students are researching current solutions, as well as what isn't working based on the solutions that already exist. As a teacher, you can use this stage to analyze the gaps your students may have in a skill or process and teach those skills or processes explicitly.

4 - APPLICATION

After students have dived deep into a problem or question and have analyzed current solutions and what still needs to be addressed, they can begin to create their solution or composition to the problem. This is where they use the skills, processes, and knowledge taught in the discovery stage and put them to work.

5 - PRESENTATION

Once students have created their solution or composition, it's time to share it. It's important that the work is presented for feedback and as a way for expression based on a student's own perspective surrounding the question or problem at hand. This is also an important opportunity to facilitate feedback and help students learn to give and receive input. Presentation skills are a significant skill needed for future entrepreneurs.

6 - REFLECTION

This step is what closes the loop. Students have a chance to reflect on the feedback that was shared and on their own processes and skills. Based on that reflection, students can revise their work as needed and produce an even better solution.

5 EVALUATION OF THE EDUCATIONAL / TRAINING ACTIVITIES/ PROGRAMME AND IMPACT MEASUREMENT

INTRODUCTION

Today, the needs assessment, the planning/ organisation, and the implementation of educational activities are part of the methodological spectrum of youth work and their evaluation and improvement. However, in practice, the focus is on "doing", understood as planning, organising, and implementing. Therefore, evaluation plays a rather subordinate role; it usually appears as satisfaction surveys and is a well-proven way of giving all young people a chance to have their say. On the other hand, the evaluation of educational programmes, usually initiated by the funder or/and the executing agency, does not exactly trigger enthusiasm among many professional and voluntary youth workers and the young people themselves. "Well, if that's what it takes..." is often the reaction.

This chapter does not aim to provide the definitive recipe for generating enthusiasm for evaluation in youth work. This is in the hands of the professional and voluntary staff who have to decide again and again whether and in which way the effects of their pedagogical work, educational activities and educational programmes are systematically recorded, presented and communicated. Instead, this chapter provides some guidance for such decisions.

Firstly, it discusses the ethical challenges of an evaluation and clarifies the target functions, then goes into the external or internal evaluation question before discussing the two forms of evaluation, "summative" and/or "formative". The practical planning of an evaluation is then in focus, supplemented with four evaluation models applicable in non-formal education and three programme evaluation models that are very much in line with the self-image and mission of youth work organisations. In these explanations - as far as space allows - the implementation possibilities are addressed in organisations working with young people and specifically in STEM education.

DEFINITIONS

First, the terms already used in the chapter title are determined to create a common starting point for reading this chapter. Although these determinations are rather formal, they will be concretised in the further course of the chapter.

EVALUATION

Evaluation is to be understood both as process, and as a result. Scriven calls evaluation a "process of determining the merit or the worth or the significance of something; or the product of that process". (1981, p. 53). He defines the central terms contained therein: "Merit" is the "intrinsic value as opposed to extrinsic or system-based value/worth" (p. 94), "Worth" is "the system value by contrast with intrinsic value" (p. 167) and "Significance" is the "overall, synthesised conclusion of an evaluation, may relate to social or professional or intellectual significance." (p. 145). The objects of evaluations can be diverse, including programmes, projects, services such as training, products, personnel, organisations, data, theories, policies.

EDUCATIONAL ACTIVITIES

Educational activities and educational programmes span the entire spectrum of informal and non-formal education. In this context, a programme is to be understood as the larger and more complex format, namely a whole bundle of interrelated measures or activities with a specific long-term goal, usually conceived, developed and implemented top-down. The Joint Committee on Standards for Educational Evaluation (JCSEE) defines a programme as an "orchestrated initiative that dedicates resources and inputs to a series of activities intended to achieve specific process, product, services, output, and outcome goals" (Yarbrough, et al., 2011, p. 291). On the other hand, educational activities are the smaller and less complex format; they may or may not be part of educational programmes. Educational activities, e.g. in a youth centre, often have a rather singular character; they re-act in the short term to young people's visible or expressed needs, their strategic dimension often remains unclear. However, they can also have a precise strategic dimension, e.g., the competencies of leaders in youth associations.

TRAINING ACTIVITIES

Training activities and programmes also differ in the characteristics described: training programmes are a bundle of interrelated training measures or activities with a specific long-term goal (see above). Therefore, training is to be understood as a specific form of non-formal education in youth work. According to a definition from the European youth work context, training aims to empower young people by developing knowledge and competencies for personal and (increasingly) professional life, where the training content is intrinsically relevant and useful (Council of Europe, 2021). On the provider's side, the teaching objectives (and possible learning goals) for such training are usually formulated. The training content is methodologically-didactically prepared, the training is structured in terms of time, and a trainer is provided.

IMPACT MEASSUREMENT

Impact measurement is a variant of evaluation that has always had a special place. Scriven defines impact evaluation as follows: "An evaluation focused on outcomes or pay-off rather than process delivery or implementation evaluation" (1981, p. 74). Although outcomes are usually the post-treatment effects, there are often effects during treatment.

EVALUATION AND RESPONSIBILITY/ETHICS

Regardless of whether it is the evaluation of a single training or a complex educational programme, those who initiate or conduct an assessment should be aware that with an evaluation, they are entering a field of expertise that is characterised by extensive theoretical foundations and diverse practical experiences. Moreover, as can already be seen in the basic definition, an evaluation always involves value judgments (which can, of course, be assessed again). Therefore, evaluations should always be set up with the awareness that value judgements require an even higher degree of responsibility for the procedure and the results compared to mere descriptions or analyses.

In any case, reservations about evaluation are very much on the rise, as they touch on fundamental questions of power and ethics. Such questions are not unfamiliar to the evaluator community, on the contrary. Evaluation standards are, among other things, an attempt to create more security for all those involved in this demanding terrain. The Joint Committee on Standards for Educational Evaluation (JCSEE), which codified the basic consensus of the evaluation discipline with evaluation standards for the first time in 1981, is leading the way here. There are thirty standards in the current version of the JCSEE Handbook of Evaluation Standards (Yarbrough, et al., 2011), divided into five dimensions: Utility, Feasibility, Propriety, Accuracy and Accountability. These standards aim at responsible evaluation of educational programmes, projects and materials. They are to be understood as "guardrails" that can point towards a responsible evaluation project when formulating a concrete evaluation project.

These five dimensions or categories of good evaluation quality, characterised by care and fairness, contain thirty standards. Each of the thirty standards is described in the JCSEE manual in such a way as first to set out its meaning and purpose, followed by very detailed guidelines for applying the standard, a list of frequent mistakes and one or more illustrative examples of the practical application of the standard. This structure underlines the intention to actually influence the practice of evaluation and lead to responsible and ethical evaluation projects.

When an evaluation is planned and carried out in child and youth work, the questions of power and ethics inherent in any evaluation arise once again in a special way. Evaluation is called upon to address young people in a way that corresponds to their cognitive and emotional development stage and considers their specific need for protection. Evaluation understood as practice research or applied research can benefit from discourse in the research community that has been going on for several years, e.g. from the ERIC project. The project "Ethical Research Involving Children" (ERIC) sees itself as a forum and initiator for the research community to ensure that the rights of children and young people are also fully respected in research processes. The ERIC Guidelines call on researchers to address the complexity of ethical issues and their values, attitudes, beliefs, and assumptions and recognise how they influence their decisions in the research process. (UNICEF: Office of Research - Innocenti ERIC, 2013).

TARGET FUNCTIONS OF EVALUATION

Stockmann (2004) distinguishes four goal functions:

1.

Gaining knowledge (knowledge function)

Evaluations should provide insights that are of interest, valuable and useful to the clients of the evaluation and the target groups of the programme (the object of evaluation).

2.

Execution of control (control function)

Stockmann assumes that while the primary interest in evaluation is to gain knowledge, he also sees clients' interest in executing control. This is very familiar to organisations that work with public funds since interim and final reports or monitoring discussions are always about whether and how the submitted plan is realised, what difficulties there are and how they are dealt with. "I.e. every evaluation is directly or indirectly connected with a form of control." (Stockmann, 2004, p. 4).

3.

Creation of transparency to enable dialogue (learning function)

Stockmann (2004) always sees evaluations as an opportunity for transparency and dialogue, a concern that is particularly essential for work with children and young people. But it is generally true that if the findings of an evaluation are made transparent, they enable a dialogue between different stakeholders such as the donors, the implementing organisation, the target groups and other participants and affected parties. This always provides a basis for collective learning.

4.

Documentation of success (legitimation function)

Evaluations very often aim to legitimise a specific use of resources (input) and a particular procedure (process) and to relate them to the result (output/outcome/impact). This is not always trivial, and complex evaluation questions also require very elaborate evaluation designs (which cost money). Nevertheless, the results can be used by implementing organisations (and donors) to legitimise their work.

Stockmann (2004) also points out that evaluations are very often ascribed "tactical" functions when the results of evaluations are only to legitimise certain decisions that have already been made or because it has to be easy (p. 4). In this context, he refers to Pollitt, who already lamented a "pathological side" in 1998: "Unfortunately, however, there is a pathological side to these developments. There are temptations for politicians to use evaluations as baubles or as bolsters-as decorative symbols of modernity or simply as reinforcements for courses of action they had already decided upon for other reasons" (p. 223).

INTERNAL AND EXTERNAL EVALUATION

Especially in the evaluation of more complex educational activities such as educational programmes or even somewhat larger, project-based educational activities, the question often arises very quickly in practice as to whether an evaluation contract is awarded externally (external evaluation) or whether the evaluation can/should be planned and implemented with the institution's staff (internal evaluation). Trivial factors often determine the answer to this question. The reason for an internal evaluation decision is often simply the lack of money for an external evaluation. If there is money, the commissioners of an external evaluation usually expect more distance, a more comprehensive view and more objectivity; at the same time, they sometimes want to prevent the impression that they are not interested in an objective evaluation from the outside.

INTERNAL EVALUATION

With internal self-evaluation, the design, planning and implementation (and meta-evaluation if necessary) are entirely in the organisation's hands. This has a lot of advantages. For example, it can be assumed that access to the field of practice to be evaluated is possible without problems. The evaluation can be fitted methodologically and temporally tightly into the pedagogical processes, which facilitates data collection. Conceptually, the organisation itself has a deep understanding of the object to be evaluated. Considering the background, it can ask the right questions, classify the collected data, and interpret them close to its practice.

A possible disadvantage could be the lack of distance to the subject matter. This potential disadvantage has at least two facets, (1) a research paradigmatic and (2) a professional facet. In terms of the research paradigm, it is often argued that a lack of distance from the subject matter impairs the objectivity of the evaluation or even makes it impossible. Here it must be considered whether an objectivist understanding of evaluation/ research is appropriate to the object and the project, or whether other approaches, e.g. reconstructive social research or action research, do not fit better. The second facet, that of professionalism (of the organisation), also needs to be clarified. An essential characteristic of professionalism is reflexivity, i.e. the ability to consider and classify one's actions and think in terms of alternatives; it is the first prerequisite for internal evaluation. It is likely to be more and more given in the professionalisation of work with young people.

EXTERNAL EVALUATION

In an external evaluation of mostly larger, complex educational programmes, the organisation places itself in the hands of external specialists and rightly expects highly specialised declarative and procedural knowledge. This is an expected advantage of external evaluation, especially since it can be assumed that the external institute and its evaluators are independent and implement the standards of responsible evaluation.

INTERNAL AND EXTERNAL EVALUATION

Therefore, if the donor expects an external evaluation or if the commissioning organisation lacks its capacity, external evaluation is the procedure of choice.

However, choosing an external evaluation does not mean that the client can sit back and just pay. A successful external evaluation depends on the cooperation of the client. A good evaluation institute develops the evaluation design with the client, plans the procedure with the client, and implements it in close coordination and with the necessary support of the commissioning organisation. It prepares - according to the agreement - interim reports and the final report and, if necessary, presents the results. The own organisation is thus relieved and, at the same time, methodically guided through the evaluation project.

Nevertheless, possible risks and problems of external evaluation must be taken into account. For example, it is not uncommon that an external evaluation is not necessarily welcomed at the working team level, triggering defensive reactions. This may not only affect the quality of the data, but the evaluation may also not fit into the pedagogical processes in a way that might be desirable. In addition, there is the risk of misinterpreting the data due to a lack of insider knowledge (depending on the evaluation design) and drawing conclusions that are wrong and unusable. These potential problems have long been known in the evaluation discussion and were, among other things, the impetus for the "fourth generation evaluation" (Guba & Lincoln, 1989), which includes the stakeholders and especially those who are "researched" in the interpretation, classification and evaluation. Behind this concept is, on the one hand, a constructivist understanding of knowledge and science and, on the other hand, the insight that an evaluation is only helpful if the stakeholders participate in the evaluation in a co-creative way, make its results their own and then, intrinsically motivated, take them into account in practice as part of their professional self-understanding.

FORMATIVE AND SUMMATIVE EVALUATION

The terms formative and summative evaluation was coined by Scriven (1967), dating back to an exchange with Lee Cronbach, who took a completely different view of the goal function of evaluation than Scriven himself. Cronbach (1963) held that evaluating an educational programme is particularly useful if it gives indications for improvement already during the implementation of the educational programme (and not only at the end). In his view, such benefit is far more valuable to teachers than the after-the-fact evaluation of the educational programme.

Scriven (1967) took up this argument in the context of a discussion on the roles and goals of curriculum evaluation. Thus, he also considered it worthwhile to test during the development work and process the findings in the development process. He called this form of evaluation formative evaluation (p. 41). An evaluation that retrospectively assesses a curriculum (or any other product) as a whole, he called summative evaluation.

Evaluation models and evaluation practice today often make use of both forms of evaluation.

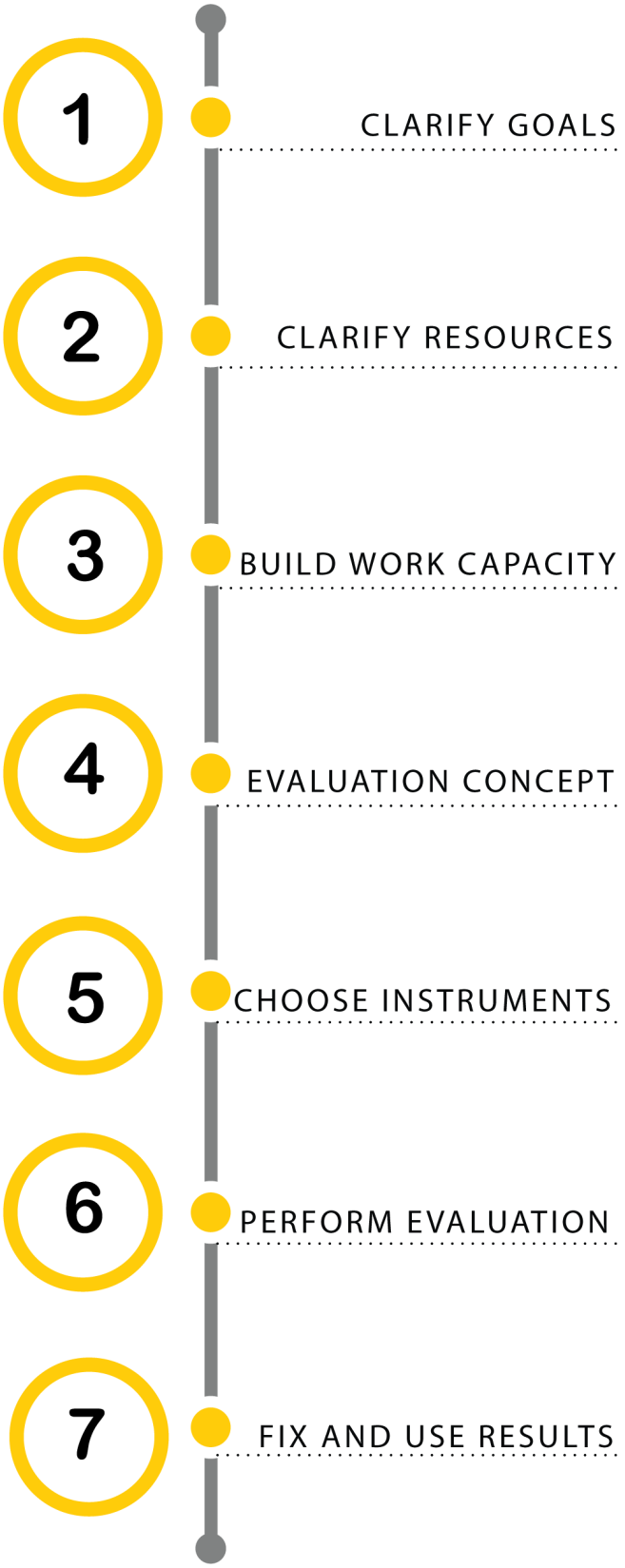
In the course of the educational programme, the educational project or the educational activity, data are collected at several sensibly selected points to influence the implementation process positively. The data is processed and, in a participatory approach, also comprehensively reintroduced into the implementation process of the measure. Such a participatory approach is a must, especially when working with children and young people (cf. Hart, 2008, among others), but it is not a foregone conclusion. The results must always be prepared appropriately for the target group and meaningfully linked to the primary pedagogical process, an approach that is not always easy to implement in practice and must be carefully planned.

Once the educational programme, the educational project or the educational activity has been completed, data is collected again, directly after the end and/or with a time lag. They are the basis for the summative evaluation, which assesses the measure as a whole in retrospect; findings from the formative assessment are usually included.

The purpose of formative assessment is to monitor student learning and provide ongoing feedback to staff and students.

The goal of summative assessment is to evaluate student learning at the end of an instructional unit by comparing it against some standard or benchmark.

PLANNING AN EVALUATION



The number of manuals and checklists that can help plan and implement an evaluation project is now almost unmanageable. On the one hand, this reflects the extent to which evaluation has moved beyond the field of education programmes, which has been exclusive for many years, into other areas such as health, transport, environment, society, etc. On the other hand, it shows that evaluation has developed and differentiated from within in the way it is planned and implemented. It is also subject to external trends, such as those visible in project management. Whereas in the 1980s and 1990s, careful and lengthy analyses, definitions and planning followed by a very linear implementation of the project plan were the "state of the art", today flexibility, agility, and collaboration are the order of the day (Michaelides & Antonacopoulou, 2021). All in all, there is not only an unmanageable number but also a variety of approaches and not one silver bullet.

Against this background, which path an organisation in youth work and its pedagogical staff take is also and especially a question of organisational culture, its own abilities and practices. An evaluation must "fit" and embed itself to improve the pedagogical approach's essential function. In this respect, the following planning steps are to be understood as recommendations, which always need to be adapted to one's own needs without compromising the evaluation quality.

Step 1: Clarify reasons, goals and subject of the evaluation, establish consensus

It is helpful if the different stakeholders and users are clear about the evaluation at the beginning. This urgency exists not only in the evaluation of educational programmes and projects but - broken down accordingly - also in the evaluation of a training course. Even with a comparatively small unit, legitimacy and transparency are needed. This already starts with the trigger. "Who came up with this idea?" - "It's a condition of the funding programme" can then be the clear answer in the case of an educational project, for example. Most of the time, the purpose of the evaluation (see above) is already clear from the trigger. "What is the thrust?" It is helpful if it is about control if this is also made clear in no uncertain terms. But perhaps difficulties have arisen, and the cause of these difficulties is not entirely clear to the pedagogical staff member in charge, in which case the insight function is in the foreground. And the object of the evaluation should also be narrowed down directly. "What is to be looked at?" This focus helps to be well prepared for the next step.

Step 2: Clarify capacities and resources

Once a consensus has been reached on the evaluation, it can be quickly clarified whether the organisation has the necessary capabilities and resources for an evaluation project. It hardly matters whether the evaluation is of an educational programme, an educational project or an individual educational activity such as a training course. Much more decisive for assessing one's capabilities and resources is an idea of what the evaluation is supposed to be about (and what methodological and instrumental effort this will probably require).

Suppose the organisation has the impression that it has the professional capabilities to plan and conduct an evaluation itself. In that case, it will also be in a position to quantify the internal resources required. An initial budget should be outlined at this point, based on which it can be assessed whether an internal evaluation is in a positive relationship to the expected results. For example, if the evaluation is of an externally financed educational project or activity, it may be possible to finance the calculated expenditure there.

Suppose the organisation has the impression that it does not have the necessary professional capabilities itself or prefers an external evaluation for other reasons. In that case, it should have an offer made by a professionally experienced institute. A well-made offer will give an initial indication of the institute's approach and information on the fee and roughly the type and extent of the required participation.

Once this step is taken, the organisation has sufficient clarity regarding its own capabilities and resources. In this context, the question of an internal or external evaluation has also been clarified. Now the available information should be sufficient for a decision for or against an evaluation.

Step 3: Build working capacity

Once this decision has been made, there is a lot of work to be done, for which human and possibly material resources need to be made available. Depending on the scope of the evaluation project, it may only need a few days of work by a single person, but perhaps a project team will now start work, which must be related to the organisation. If it is an external evaluation, the relationship between the organisation as the client and the external institute as the contractor must be contractually fixed. Also, in the case of an internal evaluation, the person or the project team needs a clear legitimation and clear rules on the part of the organisation. The internal principle must be clearly defined, and the relationship to a conceivable steering group or advisory board must be regulated.

Step 4: Set up the evaluation concept

Although it is still common in the practice of calls and tenders that the development of an evaluation concept, the development of instruments and the planning of implementation take place before the approval or commitment, this is neither resource-saving nor efficient. Therefore, the decision to plan and implement an evaluation should be made to have the resources to develop an evaluation concept in close consultation with stakeholders and participants.

But what is meant by an evaluation concept? In the German-language glossary of evaluation, an evaluation plan (alternatively: evaluation concept) is defined as

> A detailed, consistent and written outline of the intended procedure of a specific evaluation. It presents the chosen evaluation approach, the steps to be taken, and the evaluation methods to be used (e.g. data collection plan). In addition, it specifies responsibilities, reporting procedures and the intended use of the evaluation. The planning is based on the agreed purpose of the evaluation and the evaluation questions. (Eval-Wiki: Glossary of Evaluation, 05.11.2020).

Regarding the special field of use, the work with young people, the evaluation concept should additionally specify how young people's cognitive and emotional developmental level and their specific need for protection is taken into account.

Once this step has been taken, a framework is available for all participants and stakeholders that provides information on the methodological decisions and the procedure.

Step 5: Develop/assemble instruments

Once the framework is set, the methods mentioned in it can be instrumented. The first step is data collection, followed by data processing/presentation and data evaluation. In principle, the entire range of empirical social research is available for this purpose, including the broad field of quantitative, qualitative and mixed-method research.

The selection or development of survey instruments requires that the evaluation questions are broken down to the level of research questions. Research questions are much more specific and can focus on the research process. Especially in the case of quantitative impact measurement, they ideally include already introduced constructs such as self-efficacy expectations, willingness to take risks, need for cognition, etc. and are thus the access to already validated item scales. Alternatively, in a quantitative research approach, indicators and items still need to be developed.

Once the research questions are clear, questionnaires, observation forms, interview guides, discussion guides, etc., can be selected or developed. If existing instruments are used, legal rights must be clarified beforehand. The instruments must meet specific validity criteria. The instruments and the medium must take into account the respondents with their cognitive, motivational and cultural characteristics.

The processing of data, especially qualitative data, requires a considerable investment of time and an appropriate choice of technical tools. Quantitative data can be processed to an astonishing extent even with MS-Excel; a qualitative content analysis of the results of a group discussion, a narrative interview, a sociodrama, etc., can be done within the framework of a small to medium evaluation project even without analysis software such as MAXQDA. Once the data have been processed, it is essential to remember to present the collected data so that they arouse interest, are comprehensible and are experienced as useful. This target group-specific presentation costs time (and thus money).

The analysis and evaluation of the data should be planned so that the evaluators encourage the stakeholders and participants to contribute their interpretations and classifications. This can happen in workshops, one-on-one interviews, the results report via the pdf comment function, etc. However, it should not be underestimated that this participatory evaluation requires stimulating formats and resources.

Step 6: Implement the evaluation

Implementing the evaluation concept and its instruments and procedures needs one thing above all: trust, transparency and commitment.

Important promoters are the staff members who give full importance to this evaluation project, communicate it credibly and thus act as role models. It is also beneficial when young people who are key players make a strong case for it, e.g. in social media.

Depending on the size of the evaluation project and its importance for the organisation, great emphasis should be placed on communication via different media.

Step 7: Fix and use the results

The evaluation concept has already specified the reporting procedures and the intended use of the evaluation, including the final reporting and the final results. In a good evaluation concept, these measures are designed to effectively and efficiently support the evaluation project's goal function(s). However, a certain degree of uncertainty remains as to whether these measures can be implemented as successfully as intended.

A structural challenge is the time gap between the end of the educational activity and the processing of the summative evaluation results. Although processing the results in a report, podcast or videocast, etc., requires a certain amount of time in practice, participatory formats such as a results workshop for stakeholders and participants are sometimes difficult to realise because the young people are no longer approachable are already focused on other things.

If the stakeholders and participants are actually to take note of the results, their commitment to the organisation and the educational activity/ project is a prerequisite. Evaluation approaches with maximum participation, such as empower-ment evaluation (Fetterman, 1994), are also effective. They favour the knowledge of the results and the utilisation in the sense of an improvement of the product.

APPLICATION OF EVALUATION MODELS TO NON-FORMAL EDUCATION

When designing one's evaluation project, it is very helpful to fall back on proven evaluation models, no matter how small. When we talk about models here, we are not talking about mathematical models used to establish theories but concepts and structures. The authors approach the object to be evaluated and which are often used in practice.

The models cited in this section all originate from training evaluation. Even though some are somewhat older and their beginnings go back to the 1950s, they are still relevant today. In particular, Kirkpatrick's 4-level model (first: 1959a) is still ubiquitous in training evaluation today.

Models from training evaluation are always interesting for the design of one's own evaluation project if the product to be evaluated is characterised by intentionality and teaching/learning objectives are perhaps even prepared with the help of learning objective taxonomies (e.g. Anderson, et al., 2009; Bloom & Krathwohl, 1956; Krathwohl et al., 1966; Simpson, 1966, 1972). This is partly the case in out-of-school educational work with young people. The small selection of training evaluation models presented here, namely the models of Kirkpatrick (1959a, 1959b, 1960a, 1960b), Kaufman and Keller (1964), Phillips (1991) and Warr, Bird and Rackham (1970), show many similarities, but also striking differences that can be inspiring for one's evaluation project.

THE KIRKPATRICK MODEL

Internationally, probably the best-known model of training evaluation is Kirkpatrick's model. Kirkpatrick developed his model for the evaluation of training of the American aid organisation Heifer International at the end of the 1950s and published it for the first time in 1959 and 1960 with a series of four articles.

Kirkpatrick structures training evaluation with four steps (Kirkpatrick, 1959a, 1959b, 1960a, 1960b) or levels (Kirkpatrick & Kirkpatrick, 2006): (1) response, (2) learning, (3) behaviour, and (4) outcomes.

THE KIRKPATRICK MODEL

1. REACTION

At level (1) Reaction, the immediate reaction of the participants is evaluated, most likely expressed in terms such as pleasure or satisfaction. Typical questions or items are "I am completely satisfied with the training", "The venue was suitable" or "The trainer was competent", "The training was useful", or "The level of difficulty was just right".

2. LEARNING

Level (2) Learning is about what the participants have learned in training. Depending on the content and objective of the training, this might be mainly procedural knowledge, certain skills, and attitudes in youth work. Youth work in particular also works on attitudes (anti-racism training, democracy, human rights, etc.). Concerning STEM, an outstanding goal is to break down gender stereotypes and broaden the individual spectrum of perception and creativity.

3. BEHAVIOUR

Level (3) Behaviour evaluates the extent to which the learning content of training or what has been learned is reflected in the participants' later behaviour, i.e. what has been learned is applied. Evaluations show that this transfer of training is not automatically successful and that what has been learnt is only partially reflected in the participant's natural habitat. This transfer problem has been the subject of research over many years (e.g. Baldwin & Ford, 1988). An evaluation at level 3 should therefore be designed so that the obstacles to transfer are also addressed. This broadens the focus; the individual participant is now seen as part of social (and socio-technical) systems. This is also where evaluation takes place. In principle, a wide range of methods and instruments are available: Questioning and observation of the respective participant, 360-degree feedback, logbook, etc.

4. OUTCOMES

At this level, the training is evaluated in terms of the outcomes that are considered desirable by the organisation that initiated the participation. These will often be outcomes that are directly or indirectly of a financial nature. For example, the reduction of costs, staff turnover, absenteeism, complaints, the increase of quality and quantity in production, and the improvement of the working atmosphere. This can be transferred to youth organisations and institutions, including when it comes to developing young people's STEM skills and entrepreneurial attitudes.

Kaufman's (and Keller's) model of learning evaluation

Roger Kaufman and John M. Keller published a 5-level evaluation model in 1994 in response to Kirkpatrick's very popular model. Kaufman and Keller suggest that there are at least three reasons for this: (1) the most commonly used definitions and models of evaluation are often too narrow; (2) the right questions are not asked for evaluation to answer; and (3) the relationship between goals and means is not made clear in the evaluation, planning and implementation processes (p. 371).

As a response to this, Kaufman and Keller broaden the focus of training evaluation to include resources that act as enablers of a learning process and the social consequences of the training activity/ programme. Their model consists of five stages or levels:

1(a). ENABLING

Enabling, which is predominantly referred to as input in the receptions of the Kaufman model, all resources that flow into the teaching/learning process can be evaluated in principle. These are primarily the learning materials provided, the technical equipment, the qualification of the trainers, the premises. However, the individual learners' access requirements and the group's composition are also important input factors or enablers.

1(b). REACTION

The focus is on the teaching/ learning experience of the participants. Here, the acceptance and efficiency of the methods used, the resources and the process are recorded and evaluated.

2. ACQUISITION

The acquisition of the learning content is recorded and evaluated. Kaufman and Keller speak here of mastery and competency, both of the individual learner and a small group. Therefore, it is a question of whether and to what extent the participants have achieved the teaching/learning objectives. Evaluation at this level is comparable to Kirkpatrick's level 2.

3. APPLICATION

it is recorded and evaluated whether and how well the participants apply what they have learned in their practice. Evaluation at this level is comparable to Kirkpatrick's level 3.

4. ORGANISATION OUTPUTS

The benefits to the organisation are recorded and evaluated. The evaluation is carried out from the organisation's perspective that initiated participation in the training measure, on the slide of the results it wants. Evaluation at this level corresponds to level 4 of the Kirkpatrick model. Level 2, 3, 4 is also referred to as the macro-level in the Kaufman model.

5. SOCIETAL OUTCOMES

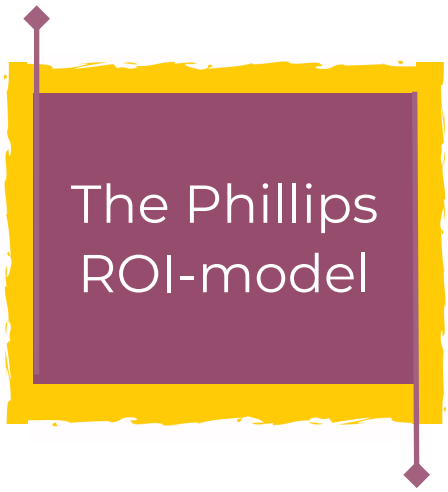
The authors' evaluation model raises the question of whether and to what extent the strengthened organisation (and thus the training) makes a desirable contribution to the welfare of society. At level 5, questions about health, prosperity, environment, security, etc., are to be asked and answered, which have lost none of their relevance.

Phillips (1996,1998) adds a fifth stage (or level) to the Kirkpatrick model, evaluating the ROI of a training intervention. The ROI or return on investment is a benchmark from financial management that indicates the relationship between profit and invested capital, thus an indicator of the profitability of an investment. Phillips transfers this indicator to human resource development or HRM; his evaluation model wants to show the value of training investment in financial terms (Phillips, 1991). If the models of Kaufman (1994) and Phillips (1996,1998) are compared, the respective extension with the fifth level (and thus accentuation) could hardly be more different.

Level **(1) Reaction**, like Kirkpatrick's Level 1, captures and assesses participant satisfaction with the training intervention. In addition, the Phillips ROI model asks what ideas or plans the participants have for applying what they have learned.

Level **(2) Learning** of the Phillips model essentially corresponds to that of the Kirkpatrick model. The focus is on learning gains, which are recorded and assessed based on the teaching/learning objectives.

At level **(3) Application** in the workplace, the focus is - as in Kirkpatrick (1960a) and Kaufman and Keller (1994) - on behavioural changes in the workplace or, more generally, in the performance of tasks. What is evaluated is whether and to what extent what has been learned is actually transferred into practice and implemented there.



At level **(5) Return on Investment/ROI**, the ultimate level of evaluation in Phillips' understanding, the monetary gain of training participation is compared with the costs. For him, determining the financial cost-benefit ratio is the necessary step to complete an evaluation (Phillips, 1998).

The evaluation at level **(4) Business results** parallels the Kirkpatrick Model, but the focus is narrower. At this level, the focus is on whether and to what extent participation in the training translates into business results for an organisation. This can be higher productivity, less time spent, lower costs, quality, higher customer satisfaction and much more. That this can also be interesting for organisations in youth welfare has already been explained in the discussion of the Kirkpatrick model.

CIRO (Context, Input, Reaction, Outcome) model

The CIRO model of Warr, Bird and Rackham (1970) closely follows good planning and implementation of training and accordingly starts with evaluation even before the actual training activity takes place. It introduces a new level, which the authors call context evaluation. Otherwise, there are many parallels to the Kirkpatrick model, although some are structured in a new and different way. The CIRO model has four levels: (1) context, (2) input, (3) response and (4) outcome.

Level 1: Context level

At this level, the quality of the analysis of the current (and future) application situation, from which the training needs are then identified and the training goals determined, is evaluated. This extended focus considers that severe errors at this planning level are reflected at the latest in the non-transfer of what has been learned into practice. In this case, the CIRO model wants to identify the cause of the failure where it lies.

Level 2: Input

At level 2, the quality of the implementation of the training measure, including its conception and planning, is evaluated. The CIRO model now focuses on whether and how information about possible training techniques and methods was collected, a selection made, the training design created, and the training appropriately planned. Attention is also paid to whether and how the organisation's resources have been used in the best possible way to achieve the desired objectives. Then comes the actual input, namely the management and methodological-didactic implementation of the training. All these aspects are the focus of the input evaluation.

Level 3: Reaction

At level 3, the participants' reactions are recorded and processed to improve the process. This includes the participants' views on the training they experienced as well as their suggestions for improvement.

Level 4: Output

At level 4, results with different scopes are analysed: the immediate results in the form of learning gains, the intermediate results at the point of transfer into practice and the ultimate outcomes that the organisation can realise thanks to the training or the training programme. Thus, evaluation at this level is similar to evaluation at the three Kirkpatrick levels of learning, behaviour and results.

APPLICATION OF EVALUATION MODELS TO NON-FORMAL AND INFORMAL EDUCATION

Non-formal and informal education or informal learning in a youth work organisation is a highly complex process. The evaluation is as complex and demanding as the object of evaluation itself, given the multitude of influencing variables to be controlled. Accordingly, such evaluations require expertise that is usually only found in highly specialised institutes. They use various models of educational programme evaluation, some of which have been used for many decades, especially in the United States of America, in local, regional, and national settings.

The literature on programme evaluation is almost impossible to survey. However, an adequate presentation of the relevant models or approaches regularly fills at least an entire book (e.g. Stufflebeam & Coryn, 2014) or an entire website (e.g. Better Evaluation, 2021). When discussing one's own ideas on the evaluation approach, these are recommended reading in discussions with potential external contractors for an evaluation. At this point, only three models or approaches should be briefly mentioned, without wishing

Responsive Evaluation (Stake)

Robert Stake designed his approach of responsive evaluation as a contrast to an approach he called "higher-order evaluation", which was characterised by a formal determination of goals, standardised testing of student performance, value standards of academic staff and reports in the style of a scientific journal (1976, p. 19).

Stake contrasted this with his approach of responsive evaluation. His approach is characterised more by pedagogical questions than by objectives or hypotheses, methodologically it works with direct and indirect observation of programme participation, it addresses the plurality of value standards of different groups, not only those of the teaching staff, and it shows continuous attention to the information needs of the various participants and stakeholders (1976, p. 19).

Responsive evaluation, in Stakes' understanding, "is not participatory evaluation, but it is organised partly around stakeholder concerns, and it is not uncommon for responsive evaluation feedback to occur early and throughout the evaluation period" (Stake, 2003, p. 66).

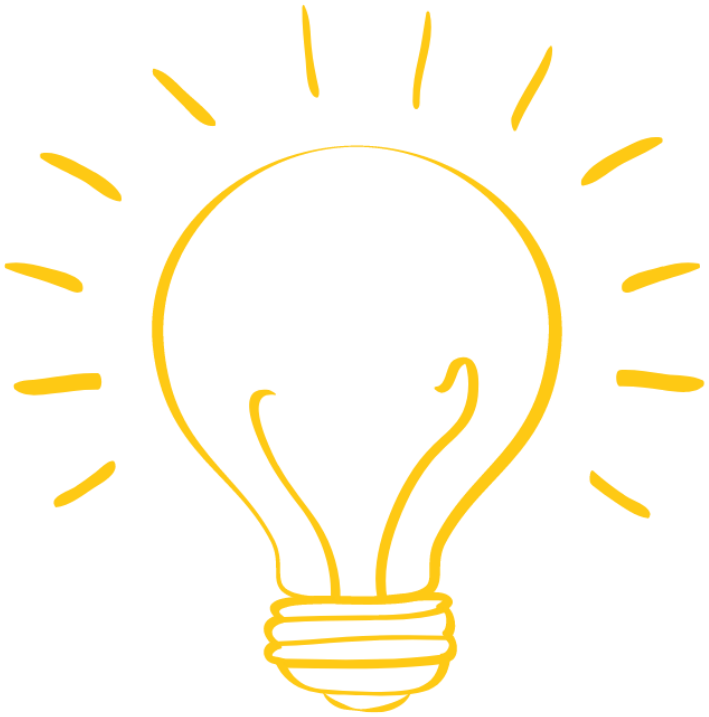
Participatory Evaluation (Cousins und Earl)

Bradley Cousins and Lorna Earl (1992) understand their participatory evaluation approach as an extension of the stakeholder-based model, which emphasises improving the use of evaluation through more intensive and broader participation of primary users in the applied research process. At the same time, this approach is embedded in the concept of professionalisation (here of teaching) and the learning organisation or organisational learning (among others Argyris & Schön, 1978; Argyris, 1993; Huber, 1991; Levitt & March, 1988).

Empowerment Evaluation (Fetterman)

The empowerment evaluation approach (Fetterman, 1994) differs from the evaluation models mentioned in several ways. First, it is programmatic and places its intention of enabling improvement and promoting people's self-determination centrally. To this end, "any means is welcome",, i.e. other evaluation concepts, a broad spectrum of evaluation techniques and the cooperatively developed evaluation results. Consistently, Fetterman also assigns new roles to the participants and the evaluators. The role of the evaluators is to provide those involved in the education programme with the necessary procedures and tools to assess the planning, implementation and self-evaluation of their education programme. Ideally, they empower them so that they can continue evaluating and improving their education programme on their own, even beyond the evaluation.

The realisation of an empowerment evaluation is very flexible and possible with all conceivable instruments. Ten principles (Fetterman, 2005), a very simple three-step structure (Fetterman, 2001), which was later refined into a ten-step approach (Chinman, Imm and Wandersman, 2004), and a (non-finalised) fund of instruments help to realise empowerment evaluation successfully.



CONCLUSION...

This chapter aimed to provide some basic guidance on the essential aspects of evaluation for academic staff in youth work who are faced with the decision to evaluate a training, an educational project or even an educational programme. To this end, the paper first discussed the ethical challenges of an evaluation and the importance of clarifying the goals. The chapter then presented the advantages and disadvantages of external and internal evaluation and discussed the two forms of evaluation, "summative" and/or "formative".

The practical planning of an evaluation was then in focus, complemented with a presentation of four evaluation models applicable in non-formal education and references to three programme evaluation models that are very much in line with the self-image and mission of youth work organisations.

6 BROADER PICTURE

Sustainability and STREAMpreneurship

Education is being called upon to prepare responsible citizens to meet the complex challenges we are currently facing to address the rising economic, social, or environmental challenges. However, to bring meaningful changes in the educational practice, changes must be implemented at the curricula both in formal and non-formal education and at all education levels.

To fully equip young people with the skills needed for the 21st century, sustainability and green education must be considered when developing the STREAMpreneurship approach. In this case, STREAMpreneurship could be viewed as a means (how), and sustainability should be the end-in-mind (why). Therefore, embedding sustainability component in STREAMpreneurship approach would bring these benefits:

- ***Promoting innovation that solves real-world problems globally.*** Sustainability is an initiative and a set of actions that manage the preservation of three primary factors - economic, environmental and social. In a sense, it encompasses all the big problems of the world. Linking STREAMpreneurship and sustainability can increase student engagement. Nowadays, young people more than ever want to be part of the solution, not a helpless recipient of previous generations' mishaps.
- ***Reducing unintended consequences.*** Too often, we have solved one problem only to create a bigger one. Since sustainability involves looking at the interconnections between the environment, economy and community, it reduces the chance that innovations will have serious unintended consequences. At minimum sustainable thinking will help identify potential consequences so they can be managed.
- ***Promoting sustainable entrepreneurship.*** Through a holistic STREAMpreneurship approach and activities, we can provide inspiration, scientific knowledge and entrepreneurial skills for young people to develop their sustainable entrepreneurship projects.

Including the sustainability component in the STREAMpreneurship approach will encourage young people to solve real-life problems in a sustainable way, reducing the chance that created innovations will have serious unintended consequences to the environment, economy or community.

Therefore, the STREAMpreneurship approach should consider and include "17 Sustainable Development Goals" developed by the United Nations. These goals are at the forefront of all sustainability frameworks and address the global challenges we all face.

GOOD PRACTISE

There are several projects focused on STEM and entrepreneurship in the EU. However, most of the good practice comes from America. Below you can see several examples of current and previous projects and programmes developed to enhance learners' skills in STEM and entrepreneurship.

STEMitUP

Instilling interest in STEM entrepreneurship

The project was funded by the ERASMUS+ KA2 programme in 2017. STEMitUP aimed at developing a state-of-the-art comprehensive educational programme that will fill STEM teachers' quiver with innovative and fun pedagogical tools. The overall was to make STEM-related courses fun and interesting for learners at lower secondary schools aged 11-15 and strategically plant a "seed of interest" that could grow into an exciting and rewarding STEM entrepreneurship career.

STEMitUP was developed on three pillars: STEM Education, Entrepreneurship and Gender Balance. Thus, an inclusive science, technology, and entrepreneurship education model that encourages learners' participation from diverse cultural and socioeconomic backgrounds was adopted.

"Green STEAM Incubator"

The project aims to investigate the common borders of STEAM and entrepreneurship by identifying ways in which STEM-oriented knowledge can be utilised along the path of enhancing agriculture, environmental engineering and social innovation under the context of Youth-oriented activities. Simultaneously, the project aspires to set a fertile ground for promoting a culture of social enterprises, agro-businesses and start-ups, capable of utilising recent technological innovations.

STEM-E

Youth Career Development Programme

The programme teaches critical thinking, problem solving, creativity, innovation, professional business skills, such as leadership and teamwork, and self-teaching, meaning we teach learners how to teach themselves. The programme uses STEM and entrepreneurship as a vehicle because those fields tend to utilise all of those skills every day. It includes various workshops and speaking engagements, and annual opportunities fair, that is a one-day event with speakers, company exhibitors and hands-on activities.

TO SUMMARIZE...

It is essential to understand that there is no "one size fits all" approach. It is crucial to adapt any approach to fit the needs of the young people and, in general, the expertise and environment of the organisation that provides activities based on this approach.

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Ņina Linde (Dr.paed.) is the Director of the Institute of Economics of the Latvian Academy of Sciences since 2014. Her main interests over the years have been business economics, entrepreneurship skills development for youth, management psychology and expertise. Dr. N.Linde is also an entrepreneur, provides consultations related to the area of scientific researches, business and EU projects, consults the Latvian Chamber of Commerce and Industry, being the initiator and developer of pilot projects for identification of social enterprises and evaluation of their economic impact in Latvia. Dr. Linde is the main organizer and moderator of the annual International Economic Forum, which takes place in Riga, at the Latvian Academy of Sciences. She is also the President of the Baltic Ontopsychology Association since 2009 where she is developing different youth projects, educational activities and studies regarding improvement of realization of youth potential and development of self-confidence for increasing youth competitiveness in rapidly changing society.

Petrina Ganeva

Petrina Ganeva has been working as a project coordinator at InterCollege since January 2019. She has worked with a variety of projects within the youth, VET and school sectors of the Erasmus+ programme, and through that experience she has built up her competences and knowledge in creating and delivering non-formal learning methodologies and managing project outcomes and deliverables. Petrina holds a BA in Natural and Cultural Heritage Management and currently she is also pursuing a master's degree in Urban Design with a focus on Mobility Studies at Aalborg University.

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Viktorija Triuskaite

Researcher and EU projects' coordinator at "DOREA Educational Institute". Her research work focuses on social inclusion, digital learning entrepreneurship, and intercultural education. She has developed numerous educational materials such as publications, guidebooks, training programmes, online courses, etc., focusing on transversal skills, entrepreneurship, career guidance and skills development, cyber security, etc.

Viktorija also has extensive experience in the development and management of Erasmus+ programme projects, development and implementation of digital marketing tools, as well as the organisation of different events – conferences, training courses, information meetings, etc.

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