

Erasmus + RAISE project

Research Study

Luxembourg Science Center

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1. Vocational Education and Training in Luxembourg

This section of the research report summarizes the current educational structure of VET in Luxembourg. The questions asked were the following: **(1)** *What is understood by Vocational Education and Training in Luxembourg?* **(2)** *What VET subjects are being offered in your country?* **(3)** *How are subjects being structured to reflect VET status?* **(4)** *What is the VET educational set up like in Luxembourg?*

1.2. Definition of Vocational Education and Training

The European Commission defines vocational education and training (VET) as *'education and training which aims to equip people with knowledge, know-how, skills and/or competences required in particular occupations or more broadly in the labor market'* (CEDEFOP, 2014).

VET can be part of formal education and training at secondary, post-secondary or tertiary level or under take place in a non-formal setting such as for example active labor market measures. VET offers opportunities for young people and adults and comprises school-, or company-based learning, or a combination of both (CEDEFOP, 2015).

In Luxembourg, VET mostly refers to technician and vocational programs offered at secondary education level including numerous tracks and possibilities mostly for young people.

1.3. Vocational Education and Training offer in Luxembourg

Bellow an exhaustive list of the current VET offer in Luxembourg including local and cross-border possibilities (CEDEFOP, 2015; MENEJ, 2017):

Administrative and commercial agent; Aircraft mechanic – category A; Architectural drafter; Assistant nurse; Advertising merchant; Agricultural services specialist; Animal keeper; Audiovisual media clerk; Automobile business administrator; Automobile upholsterer; Automotive mechanic assistant Aircraft mechanic – category B.

Baker-confectioner; Bakery products salesperson; Beauty therapist; Bookbinder; Bricklayer; Butcher; Butchery products salesperson; Bank clerk; Bicycle mechanic; Blacksmith for horses; Bobbin winder; Brewer and maltster; Bureau communication tools manager; Baker-confectioner; Bicycle mechanic; Bricklayer Butcher.

Cabinet maker; Care assistant; Carpenter; Clothing alteration hand; Confectioner and ice cream maker; Construction and industrial mechanic; Cook; Cutting machine operator; Chemical laboratory assistant; Chimney sweep and stove fitter; Clerk in public administration; Construction mechanic – specialization in welding; Cooling device installer; Craft glazier; Car upholsterer; Chimney mason and sweep; Clothing alteration hand; Confectioner and ice cream maker; Cook Decorative glass worker.

Dental laboratory technician; Dressmaker; Driving instructor; Designer of digital and print media; Dry construction builder; Dressmaker.

Electrician, Electronics technician – communication; Electronics technician – energy; Electronics technician for automation technology; Electronics technician for devices and systems; Electronics technician for industrial engineering; Electronics technician for motors and drive technology; Equine manager; Event manager; Event technology specialist; Electrician.

Farmer; Floriculturist; Florist; Filling station attendant; Freight forwarding and logistics services clerk; Funeral services specialist; Furrier; Florist assistant Furrier Garden and landscape designer assistant.

Garden and landscape designer; Glass blower; Glazier; Gold- and silversmith; Gunsmith; Gardener assistant Glazier.

Hairdresser; Horticulturist; Hotelier-restaurateur; Hatter; Housekeeping aide.

Industrial and maintenance mechanic; Information technology specialist; Installer for heating and sanitary systems; Information technology specialist – specialization in systems integration;

Insurance and financial services broker; Insurance management assistant; Interior decorator; IT products salesman; Industrial cleaner; Installer for heating and sanitary systems; Interior decorator

Joiner.

Knitting and sewing machine mechanic.

Locksmith; Leather craftsman

Marber; Mechanic for viticultural and agricultural engines; Mechatronics technician; Metal worker; Motor vehicle body builder; Motor vehicle body painter; Motor vehicle body repairer; Motor vehicle technician; Maker and repairer of musical instruments; Maker of orthopedic footwear; Make-up and manicure artist; Management assistant in wholesale and foreign trade ; Marketing and communication manager; Mechanic in plastics and rubber processing; Media agent; Miller; Milliner; Motorbike mechanic; Miller; Motor vehicle body builder; Motor vehicle body painter; Motor vehicle body repairer.

Operator in forestry and natural environment; Optical products salesperson; Optician; Orthopedic technician and truss maker.

Painter and decorator; Parquet floor layer; Pharmacy technician; Photographer; Plasterer; Pedicurist; Pipe, sewer and industrial service technician; Process mechanic for coating technology; Professional caterer; Qualified dental employee; Painter and decorator; Parquet floor layer; Plasterer.

Restaurant waiter; Restaurateur; Roofer; Real-estate agent; Recycling and waste management technician; River boatman; Roller shutters and sunshade mechatronic technician; Restaurant waiter; Roofer.

Salesman; Salesperson in clothing alteration; Stonemason; Swimming instructor; Sales assistant; Shoe repairer; Shoemaker; Shutters and blinds builder; Stonemason.

Tailor; Tiler; Tinsmith; Traiteur; Travel agent; Technical building equipment installer; Technical product designer; Textile cleaner; Thermal and noise insulation fitter; Tailor; Tiler; Technician in 3D design; Technician in administration and business; Technician in agriculture; Technician in automotive technology; Technician in building services engineering; Technician in civil engineering; Technician in communication electronics; Technician in computer science; Technician in energy electronics; Technician in forestry and natural environment; Technician in graphic art; Technician in horticulture; Technician in hotel business; Technician in image editing Technician in logistic services; Technician in mechanics Technician in metal construction; Technician in tourism

Visual merchandiser; Visual marketing designer; Warehouse operator for electronic devices.

Warehouse operator; Warehouse operator – automobile sector; Warehouse operator for energy devices; Watchmaker; Water supply engineering technician; Water supply engineering technician; Winemaker; Wine grower

2. Luxembourg's secondary school system and the integration of VET

THE PUBLIC SCHOOL SYSTEM IN THE GRAND DUCHY OF LUXEMBOURG 2018 - 2019

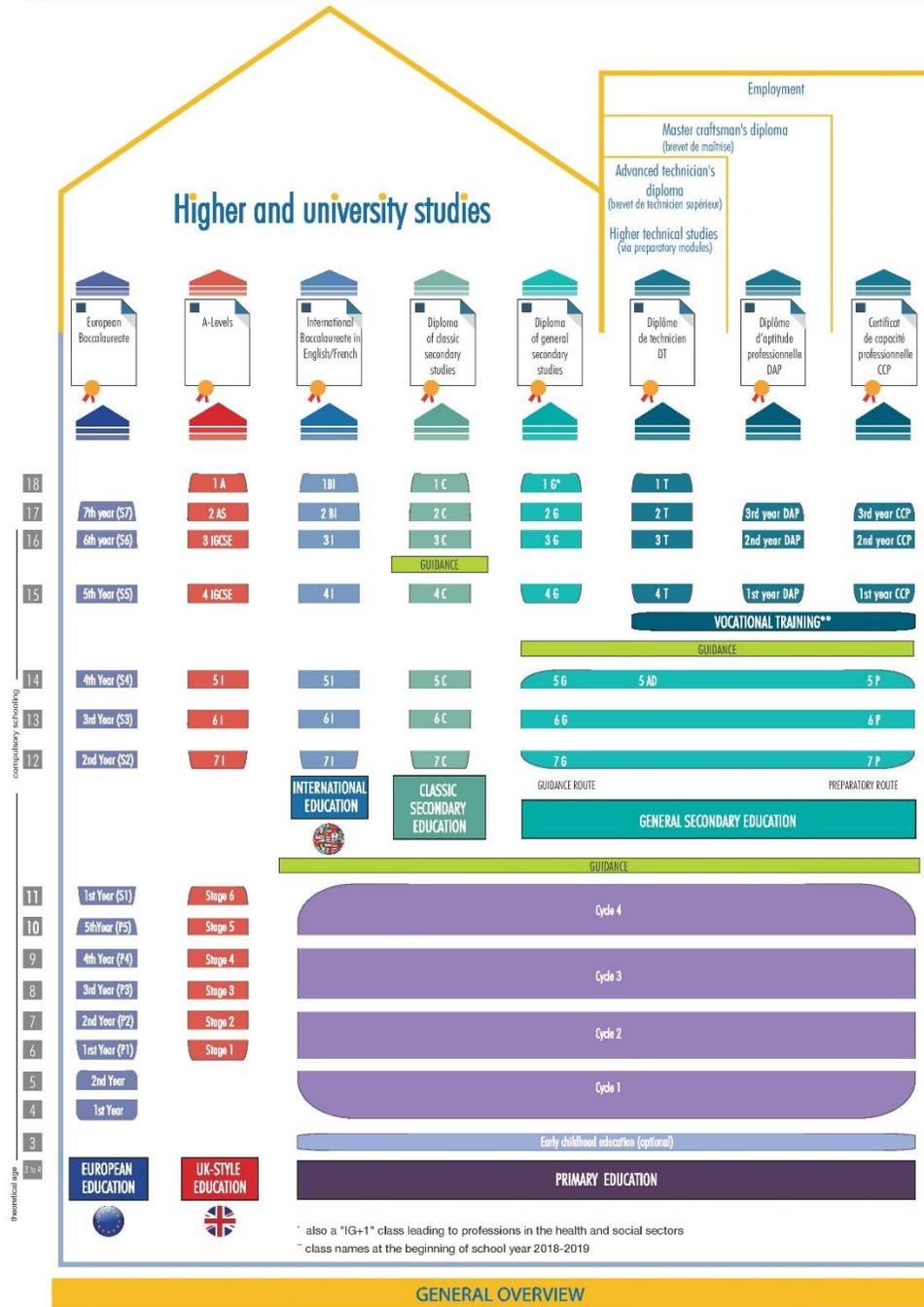


Figure 1: Overview on Luxembourg's secondary education system

Source: file:///C:/Science%20Center/Grants/Erasmus%20+/Research/EducationSyst_Lux.pdf

Luxembourg's public-school system is subdivided into primary (fundamental) and secondary (post-primary) education. Fundamental education is dedicated to pupils aged between 4 and 12 years and covers the first nine years of education (Cycle 1-4) (Figure 1.). Between age 12 and 13 pupils enter secondary education, which is subdivided into two main educational streams: (1) classical secondary education and (2) general secondary education (Figure 1). School attendance in Luxembourg is compulsory between age 4 and 16 (MENEJ, 2018).

2.2. Classical secondary education

Classical secondary education studies last for 7 years, to eventually end with a diploma of classical secondary studies. When reaching 4th grade (age 16) of classical secondary education, students will choose an educational track, that eventually prepares her/him for higher studies in a certain field. The tracks include: (A) Languages; (B) Mathematics and informatics; (C) Natural sciences; (D) Economy and mathematics; (E) Arts; (F) Music; (G) Humanities and social sciences; (I) IT and communication (MENEJ, 2018)(not shown in figure 1.) There is no VET in classical secondary education, this track rather prepares students for higher education and university studies (Figure 1.) (MENEJ, 2018).

2.3. General secondary education

General secondary education is subdivided into various branches and lasts for 6 to 8 years. General secondary education comprises the following tracks:

- General secondary programs leading to a diploma of general secondary studies (Figure 1.).
 - Takes 7 years and allows students to access higher education and university studies but also the preparation of a profession. Grade 7 to 5 consist of a general orientation (Guidance route in Figure 1.). At the end of 5th grade students will choose one of the following tracks and eventually focus on a certain field:
 - Administration and commerce
 - Health and social professions
 - General education
 - Art

- Hotel and tourism
 - Technician programs leading to the acquisition of a technician's diploma (“Diplôme de technicien” (DT) in Figure 1.).
 - Vocational programs resulting in a professional competence diploma (“Diplôme d'aptitude professionnelle” (DAP) in Figure 1.).
 - Basic vocational programs leading to a certificate of professional competence (“Certificat de capacité professionnelle” (CCP) in Figure 1.).

Technician programs, vocational programs and basic vocational programs are part of VET in the secondary Luxembourgish education system (MENEJ, 2018).

2.4. VET governance

In Luxembourg, the Ministry of Education oversees VET and governs together with the Ministry of Labor, Employment and the Social and Solidarity Economy. Cooperation between the government and the various social partners is considered a core principle of VET in Luxembourg. Social partners are essential stakeholders and participate in the organization and implementation of VET. Among the social partners, the five professional chambers: (1) The Chamber of Commerce, (2) the Chamber of Trades and Skilled Crafts, (3) the Chamber of Agriculture, (4) The Chamber of Employees, (5) the Chamber of Civil Servants and Public Employees who act as independent policy makers, are implicated in Luxembourg’s legislative procedures and are consulted on education matters, including VET (CEDEFOP, 2015).

2.5. The reformation of the VET law

Notably between the school year 2010/11 and 2013/14 a new reform of the 2008 VET law (MENJE, 2008) was implemented in order to reinforce the links between VET and the Luxembourgish labor market. Concordantly the implication of the five professional chambers into VET has yet been reinforced. Their tasks include: (a) the identification of training needs; (b) guidance and information on training; (c) determination of the professions or trades incorporated in VET; (d) training offers; (e) organization of the training; (f) the design of training frameworks; (g) assessing

training programs and the training system; (h) qualifications and validating experience acquired (CEDEFOP, 2015).

The key principles of the VET law include: (a) the promotion of VET; (b) improvements in VET quality; (c) the promotion of lifelong learning; (d) the strengthening of collaborations with the labor market; (e) competence-based teaching and evaluation; (f) a teaching structure by units and modules; (g) an assessment and a certification in apprenticeships which is based on learning outcomes; (h) a VET training for teachers; (i) the introduction of 'adult teachers'; (j) stronger collaborations between the Luxembourgish State and the social partners (CEDEFOP, 2015).

2.6. VET in the Luxembourgish secondary general education system

Depending on the track, secondary education lasts between six and eight years. Learners can change from technical to general secondary education and vice versa if the school grades allow them to do so. In the Luxembourgish school system, a preparatory program is foreseen for students with difficulties to directly enter the general secondary education system (Preparatory route in Figure 1.). It applies a modular approach and prioritizes practical training over theoretical education (CEDEFOP, 2015).

The lower cycle of technical secondary education is a pre-VET cycle (Guidance route in Figure 1.) and lasts three years. It consists of an orientation phase at the end of which students will decide to go in one or the other direction and will pursue studies to continue in the medium cycle of technical, technician or vocational programs. Practical training during lower cycle VET help learners in choosing their career path while they are oriented towards a theoretical or a multidisciplinary study track - depending on their performance. These two tracks differ in their general orientation, the relative time spend on certain subjects matters and the teaching methods (CEDEFOP, 2015).

After successful completion, students enter VET as part of their middle-cycle of secondary education and eventually choose their study track: (1) technician program, (2) a vocational program, or (3) a basic vocational program depending on their scholar performance and interest. Currently, about 120 VET subjects are offered in Luxembourg and are steadily imbedded into the middle and upper cycles of general secondary education. The modified law of December 19th, 2008 about VET lead to a profound reorganization including: (1) a better qualification of youngster and thus better integration into professional life; (2) supporting lifelong learning; (3) decrease drop out and failure at school (CEDEFOP, 2015).

The medium and upper cycles of technical secondary education consist of school-based VET programs, apprenticeships and similar schemes. Learners acquire occupational qualifications for which they are eventually awarded a certificate or a diploma: (a) a secondary school leaving diploma at successful completion of technical program; (b) vocational capacity certificate at the end of vocational programs; (c) a vocational aptitude diploma after completion of vocational programs; (d) a technician diploma at successful completion of technician program (CEDEFOP, 2015).

2.6.1. Technical programs

The technical program covers 10th – 13th grade and for some social and health professions 10th – 14th grade. The technical program offers 4 tracks: (1) Administration and commerce; (2) Health and social professions; (3) General education; (4) Art. The school curriculum comprises both practical and theoretical education. The time spend on the practical part of the education depends on the track and the grade and varies from 25 to 65%. Successful students are awarded a technical secondary school leaving diploma equivalent to a general secondary education diploma while students can enter the labor market or pursue higher education (CEDEFOP, 2015).

2.6.2. Vocational programs including apprenticeship

Vocational programs are composed of a three-year long program that combines company-based and school-based learning. The general education, the theoretical part of VET, and some practical

modules are offered in technical school workshops while learners themselves apply for an appropriate training place in an enterprise. Enterprises offering apprenticeship places need to comply with certain criteria, verified by the professional chambers (CEDEFOP, 2015).

2.6.3. Vocational programs

Apprenticeships prepare learners for the labor market and end with a vocational capacity certificate (“certificat de capacité professionnelle” or CCP in figure 1.). The program is designed for students with learning difficulties whose grades are insufficient to enter other vocational programs. A vocational capacity certificate attests that the holder has the social and basic practical skills to exert a profession as semi-skilled worker. Once a student has acquired a vocational capacity certificate he can pursue his studies and progress in the second year of the DAP program (« diplôme d’aptitude professionnelle » or DAP in figure 1.) upon positive decision of the class council (CEDEFOP, 2015).

The vocational aptitude diploma also prepares learners for the labor market. This program can be offered as full-time track where all training occurs at school or with a 12 weeks’ practical training or in as an apprenticeship or internship contract within an institution. The vocational aptitude diploma proves that the holder has the skills to perform a profession as skilled worker. After acquiring a vocational aptitude diploma may continue at the technician program or may become a master craftsman (CEDEFOP, 2015).

The curriculum of each vocational track in what concerns the number of hours spend on general education and VET theory and practice vary by trade (CEDEFOP, 2015).

2.6.4. Technician program

Technician programs (“programme de la formation de technicien” in Figure 1.) cover 10th to 13th grade and eventually lead to the acquisition of technician diploma (“diplôme de technicien” or DT in Figure 1.). This is a full-time track program where training mainly occurs at school and includes a minimum of 12 weeks internship in the respective job. Training focuses on the requirements of

the labor market and aim to train students at a high professional level or preparing them for higher technical education. A technician diploma certifies the competence of the student to perform the profession (CEDEFOP, 2015).

2.6.5. VET at tertiary level

VET at tertiary level refers to higher technician programs leading to a higher technician certificate (“brevet de technicien supérieur” in Figure 1.) which is awarded to students who complete two years of studies in one of the following fields: (a) applied arts; (b) commerce; (c) health; (d) industry; (e) services; (f) crafts (CEDEFOP, 2015).

2.6.6. Post-secondary education

The master craftsperson qualification (“brevet de maîtrise” in Figure 1.) entitles the holder to become independent in craft industry, open his/her own society and be self-employed. The program must be accomplished within six years.

If required, the full curricula of VET are available (MENEJ, 2015).

2.6.7. Science, Technology, Engineering and Mathematics (STEM) uptake in Luxembourg

This section is dedicated to the following research question: **(1)** What are the statistics of Luxembourg as regards STEM subject uptake from 2010 onwards?

3. STEM uptake in Luxembourg secondary education system

As described in sections 2.2 and 2.3 the Luxembourgish secondary education system structure comprises the classical and the general education which eventually subdivide into numerous tracks. The ministry of education publishes education programs for each school year and the data is all available (MENEJ, 2017). In what concerns STEM uptake in the Luxembourgish secondary education system from 2010 onwards, the data exists while the STEM uptake i.e. the programs at school did only fairly change over the last 8 years. In the context of this research report we found it most important to concentrate on the recent data published from school year 2016/2017.

Overall the STEM uptake drastically depends on the chosen track (Table 1.). Between 7th and 4th grade STEM uptake on average is 7 hours per week. As previously described, students orientate themselves towards a certain track when entering 3rd grade. Thus, over the last 3 years of classical secondary education; STEM uptake drastically varies with the track chosen, ranging everywhere between 0 and 18 hours of STEM courses per week.

| Grade | STEM hours/week |
|--|-----------------|
| 7th grade | 6.5 |
| 6th grade | 6.5 |
| 5th grade | 6 |
| 4th grade | 8 |
| 3rd grade - Languages | 8 |
| 3rd grade - Mathematics & IT | 13 |
| 3rd grade - Natural Sciences | 13 |
| 3rd grade - Economy & Mathematics | 10 |
| 3rd grade -Arts | 9 |
| 3rd grade - Music | 9 |
| 3rd grade - Humanities and social sciences | 8 |
| 2nd grade - Languages | 0 |
| 2nd grade - Mathematics & IT | 16 |
| 2nd grade - Natural Sciences | 16 |
| 2nd grade - Economy & Mathematics | 5 |
| 2nd grade -Arts | 5 |
| 2nd grade - Music | 5 |
| 2nd grade - Humanities and social sciences | 3 |
| 1st grade - Languages | 0 |
| 1st grade - Mathematics & IT | 18 |
| 1st grade - Natural Sciences | 18 |
| 1st grade - Economy & Mathematics | 5 |
| 1st grade -Arts | 3 |
| 1st grade - Music | 3 |
| 1st grade - Humanities and social sciences | 3 |

Table 1. STEM subject uptake in the Luxembourgish classical education system, represented in hours of STEM courses per week. The following courses were included into STEM: mathematics, natural sciences, physics, chemistry, biology and informatics (MENEJ, 2015).

Table 2. summarizes STEM uptake in the general secondary education. Like the classical education system STEM uptake drastically depends on the tracks chosen. While the lower cycles of secondary general education on average teach 7 hours of STEM courses per week, students choose their track after 5th grade, eventually leading to a STEM uptake of 0-20 hours/week.

| Grade | STEM hours/week |
|---|-----------------|
| 7th grade - General | 8 |
| 7th grade - Polyvalent | 6 |
| 6th grade - General | 7 |
| 6th grade - Polyvalent | 7 |
| 6th grade - Modular | 6 |
| 5th grade - General | 9 |
| 5th grade - Polyvalent | 8.5 |
| 5th grade - Professional | 8 |
| 5th grade - Modular | 6 |
| 4th grade - Administration & Commerce | 5 |
| 4th grade - Health and social professions | 16 |
| 4th grade - General | 15 |
| 4th grade - Natural Sciences | 15 |
| 4th grade - Art | 4 |
| 3rd grade - Administration & Commerce | 3 |
| 3rd grade - Health and social professions | 15 |
| 3rd grade - General | 16 |
| 3rd grade - Natural Sciences | 15 |
| 3rd grade - Art | 4 |
| 2nd grade - Administration & Commerce | 4 |
| 2nd grade - Educator | 3 |
| 2nd grade - Social Sciences | 3 |
| 2nd grade - Nurse | 10 |
| 2nd grade - General | 20 |
| 2nd grade - Informatics | 20 |
| 2nd grade - Natural Sciences | 13 |
| 2nd grade - Art | 5 |
| 1st grade - Administration & Commerce | 0 |
| 1st grade - Educator | 2 |
| 1st grade - Social Sciences | 3 |
| 1st grade - Nurse | 3 |
| 1st grade - Health Sciences | 10 |
| 1st grade - General | 19 |
| 1st grade - Informatics | 20 |
| 1st grade - Natural Sciences | 15 |
| 1st grade - Art | 5 |

Table 2. STEM subject uptake in the Luxembourgish general education system, represented in hours of STEM courses per week. The following courses were included into STEM: mathematics, natural sciences, physics, chemistry, biology and informatics (MENEJ, 2015).

3.2. STEM uptake at University

To determine STEM uptake at University, we used data from the Luxembourgish institution CEDIES who allocate scholarships to Luxembourg residents. Between 2012 and 2017 the average STEM uptake at university corresponded to 16 %, where STEM included the following domains: IT, Engineering, Mathematics and Natural Sciences with on average twice more men than women choosing STEM in higher education.

4. Promotion of STE(A)M careers in Luxembourg

This section refers to the question: What are the current policies in Luxembourg regards promotion of STEAM careers? Are there any initiatives to promote those types of careers? In Luxembourg the following institutions promote STE(A)M while only a few promote the underlying careers in a direct manner:

- 1) **The Luxembourg Science Center** sparks interest in science and technology in the public and youngsters in particular. We have recently started to promote also the underlying careers. We started to work with researchers and engineers from Luxembourg's research institutions and industry to eventually present their latest research and developments during our shows. In collaboration with the Chamber of Trades and Skilled Crafts, we recently organized a workshop series to promote various VET professions to high school students. We offered hands-on workshops highlighting the career of: chef, carpenter, mechatronic engineer, 3D-designer, electrician, welder. Each workshop was held by a professional of the respective fields. The promotion of STEAM careers and professional vocations through vocational workshops will play an important primary role in the second phase of the Luxembourg Science Center project.
- 2) **The Scienceteens Lab** offers youngsters hands-on experience in a real research lab.
- 3) **Bee-Creative Makerspaces** are creative and interactive spaces that offer youngsters the possibility to work with various technologies and new media.

- 4) **Technoport S.A** is a fabrication lab rendering accessible 3D printers, lasers, industrial robots to the public to stimulate their creativity.
- 5) **Museum of National History** organizes STEM-oriented activities for kids and youngsters.
- 6) **Tudor museum** is an interactive museum about electricity.
- 7) **Wëssens-Atelier** seeks to motivate kids and youngsters to become interested in science and technology and eventually orientate themselves towards these domains. They also offer industry and enterprise visits.
- 8) **Déi kleng Fuerscher a.s.b.l.** explore daily scientific phenomena with kids and actively involve them in scientific experiments.
- 9) **PINS a.s.b.l.** promotes science while offering interactive and playful labs.
- 10) **Syndicat PRO-SUD** seeks to generate interest in sciences, research and technologies in kids and youngsters.
- 11) **Luxkids Lab** offers hands-on science to kids
- 12) **Vitarium** an interactive museum about milk production
- 13) **Sennesräisch** interactive exhibition to discover the 5 senses

Other projects that aim at promoting STE(A)M in Luxembourg are f.ex. Gender4STEM which is also funded under the ERASMUS + scheme. This project aims at developing an education online platform and raising awareness teaching material to eventually be used by secondary school teachers. The goal of the project is to identify existing stereotypes, spark greater interest in STEM disciplines among girls and help to generate a better gender balance in STEM-careers (Gender4STEM, 2015).

Other projects aim at promoting careers and profession in the VET context. HANDSUP f.ex. was launched by the Chamber of Trades and Skilled Crafts and is currently promoting careers related to various crafts in Luxembourg (*Handsup*, 2018). Hello Future is another project that seeks to promote various types of careers including STEM (Biohealth, Construction, Ecoinnovation, Materials, Automotive, ICT, Logistics & Maritime, Space). This project presents these careers at their homepage and eventually creates a direct link to Luxembourg's industry. At their homepage several possibilities for internships in participating institutions are directly advertised.

5. STEAM carriers in Luxembourg

5.1. STEAM employments in Luxembourg

This section refers to the research questions: Is there a list of employment opportunities which can be pursued in STEAM? Is there data available establishing what is the skills set which are currently missing in specific STEAM jobs? Which are the jobs being demand is bigger than supply, and vice versa? Which VET careers are difficult to attract people? What affects uptake of certain careers, versus others? (e.g. gender issues, stereotypes and so on)

Unfortunately for many of these questions no information was available. There seems to be a certain information lack about STE(A)M careers in Luxembourg.

Although this would be of enormous utility, there is no comprehensive list of the various employment opportunities that exist in and around Luxembourg in the STE(A)M field. There is the initiative of Hello Future (*Hello Future*, 2018) who do publish a set of STE(A)M jobs and consequently link information about the careers with local companies that offer internships.

There is however no information about STE(A)M careers that are in high demand. We have contacted ADEM the Luxembourgish employments office, who have established a list of those careers most frequently required by employers in Luxembourg. IT Engineering and Development ranks second with 151 open position in June 2018 (ADEM, 2018). Which job are currently in low demand could not be determined.

To tackle the question that we could not answer in our report, we have launched a survey that we have send to our sponsors and collaborating institutions in industry, research and development. Unfortunately, we have not yet gotten responses, but we hand in the results of the survey once we have received feedback.

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