Project No.:2017-1-DE02-KA202-004274

NATIONAL REPORT Luxembourg

Intellectual Output 1:
BENCHMARCK SURVEY ON INTEGRATING DIGITAL, CODING AND ROBOTICS SKILLS IN VET SCHOOLS: FROM THEORY TO PRACTICE
February 2017

Women in Digital Initiatives Luxembourg Asbl (WIDE)

This project has been funded with support from the European Commission.
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Content

1. Introduction

According to DESI (Digital Economy and Society Index) studies 2017, Luxembourg ranks 5th out of the 28 EU Member States for DESI. Overall it has improved its performance slightly since the previous year. Luxembourg performs well in connectivity (2nd rank in 2016), both for coverage and subscription (take-up). It records excellent results (2nd rank in 2016) in terms of human capital, whether in use or in digital skills. It achieves very good results for the use of Internet (3rd rank in 2016). On the other hand, it is lagging behind in the integration of digital technologies by companies (22nd rank in 2016). Luxembourg belongs to the high performing cluster of countries of this study (sources: (1)).

Luxembourg began specialising into the financial sector in the 1980s and the 1990s. Previously the country's economy was mainly based on steel (with companies such as Arcelor). Nowadays manufacturing industry remains as a strong pillar but for high-added values activities (including research & development).

Luxembourg has undertaken an ambitious economic diversification strategy in respect of the digital sector. This strategy is multidimensional, embracing education, economy, public services, and grouped under an umbrella initiative called Digital Lëtzebuerg (2)

Changes in the financial industry (regulation end of bank secrecy, new EU regulations) have lead Luxembourg to taking on a new strategy.
For the last few years, it's also been clear that Luxembourg wants to leverage on its historical strengths for further growth; fintech, R&D in industry, top notch infrastructure which has led the Commission to choose Lux for Artificial Hub and High Performance Computing (supercomputer).

Interesting facts about the country

- Minimum wage in Luxembourg is the highest in the EU and 20% of employees earn the minimum social salary.
- Unemployment rate is 5,8%: recently went back to his level before the 2008 crisis.
- Foreigners make up 73% of Luxembourg's workforce. 45% are cross border workers and the remaining are 28% are expats/foreign residents. (5)
- Luxembourg's administrative languages are French, German and Luxembourgish.
- The importance of English is steadily increasing, especially in the business and ICT world.

Brochure on doing business in ICT in Luxembourg:
https://www.luxinnovation.lu/wp-content/uploads/sites/3/2017/11/brochure-ict-oct-2017-2-web.pdf

2. VET-Education of ICT and Robotics in Luxembourg

2.1 Political and educational framework

Current scene in country in robotics

Digital Luxembourg (1), Luxembourg's step towards being a smart nation was launched by PM Bettel and is coordinated by the Ministry of State which directly depends from the Prime Minister. Digital Luxembourg is an inter-ministerial coordination.

Other Ministries might be concerned with robotic and coding education: Ministry of Education and Research, Ministry of Labor, Ministry of Economy and also Ministry of Equal Opportunities.

Policy framework for robotics education

Under the Digital Luxembourg umbrella, digital and education are supported by several ministries in Luxembourg such as: Economy, Finance, Education, Equal opportunity, Labour, all are undertaking actions to move toward a smart nation.
Actions have been taken to encourage robotic education in the formal and non-formal education sectors. A number of non-profit organisations and private initiatives are also active in this field, often supported by Ministries and less often by private companies. Several initiatives have been undertaken to encourage more people, especially youngsters to study technology related studies.

Initiatives in robotic education:

Formal education:

Section technique générale

Focuses mathematics, chemistry, physics, electrotechnics and technology. Languages are important as well. https://www.lte.lu/education/general/technics/

Section technique informatique

Mathematics & languages, programming, teleprocessing, data bases as well as natural sciences and technology. https://www.lte.lu/education/general/technics/

Option Robotique à LRSL in for students in B (maths and I.T. high school classes) http://www.lrsl.lu/departements/informatique
Diplôme Technicien Informatique and DAP Informaticien

Offer a professional qualification in I.T. in 3 and 4 years at the end of high school and includes robotics and programming automates.

B.T.S Informatique (2 years post secondary school diploma, equivalent to 2 years of University (similar to French B.T.S) in Information Technology exist since 10 years.

In addition, in fall 2018 a number of new BTS will be added: Internet of things and Cloud computing which are the closed options for students wanting to study robotics and coding at a higher technician level.
Source: http://www.lifelong-learning.lu/Detail/Article/Accueil/liste-des-bts/fr

Section I and FutureHub

Engineer in robotics is mentioned as one of the jobs that the section I (classic) offers access to. Robots are one of the tools students will be able to use in the section I. No directly mention though whether there are actual robotics classes.

http://www.men.public.lu/catalogue-publications/secondaire/informations-generales-offre-scolaire/section-I/fr.pdf

FutureHub is a label for Lycées offering excellence facilities to study I.T
http://portal.education.lu/futurehub/ At the moment, 3 lycées in Luxembourg are FuturHub

Uni.lu
Automation & Robotics Research Group focuses in two main research directions: Autonomous Vehicles and Robots and Distributed and Networked Automation and Control
https://wwwen.uni.lu/snt/research/automation_robotics_research_group
http://www.luxembourg.public.lu/fr/actualites/2017/06/12-robocup/index.html

Non-formal and extra curriculum education:

BeeCreative

Launched in 2015, BEE CREATIVE is an initiative of the Luxembourg government to prepare young people in the Grand Duchy for the challenges of the digital future.
BeeCreative offers Makerspace facilities. Well equipped maker spaces are available around the country in high schools, free of charge, for all youngsters to experience and use tools such as 3D printers, laser cutters. They can be access by students, on a voluntary basis after school. The makerspace are supervised and also offer workshops with coaches.
Mainly the initiative has two goals:
- To allow young people to know how to create using technical tools and new media
- To promote young people's creativity, talents and entrepreneurship in the context of new information and communication technologies
BEE CREATIVE is jointly coordinated by the SNJ (snj.lu) and the SCRIPT (script.lu).

Luxembourg Tech School for (future) Tech Leaders
Luxtechschool.lu
For young people in school education or VET:
Extra curriculum for students in order to equip them with relevant knowledge to become digital leaders, the content taught is directly applied to the business world: video games, A.I, big data, space ressources …).
Currently available for 9 lycées in Luxembourg (including 2 techniques)

The RoboTEC project explores the ways in which 11 – 12 year old students build and program LEGO MINDSTORMS robots. During three weeks in June, the RoboTEC SUD workshop welcomes classes from Luxembourg fundamental school for a 4 to 6 hour exploration activity. The goal is to stimulate kids' interest in technology, ICT, robots and basic programming by proposing playful, creative and inquiry-based

learning tasks. The project exists for several years and is supported by Fond National de la Recherche.

Science Center (opened in 2017)

Robots are part of the exhibition. It's likely that there are some activities regarding robots. Nothing mentioned on the website though.
http://www.science-center.lu
Activities are open for schools and general public.

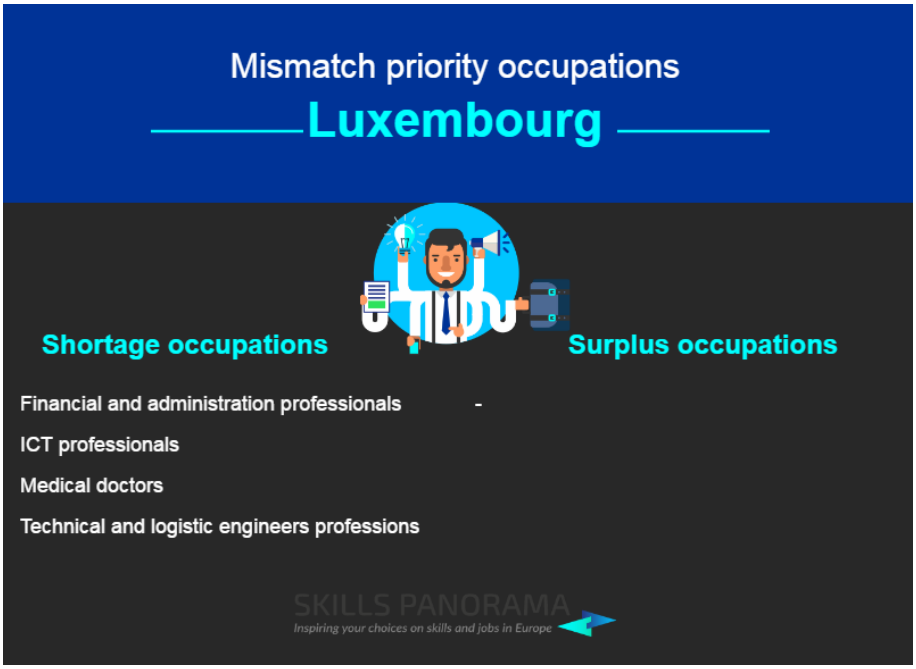
First Global Robotics Competition

Luxembourg was one of 164 participants in the First Global Robotics Competition (2017). The team consisted of 7 high school students and 2 co-mentors.
http://first.global/in-the-news/luxembourg-joined-the-first-global-robotics-competition/
http://lge.lu/2017/05/luxembourg-tech-school-for-future-digital-leaders-inscriptions-jusquau-02-06/
https://www.ltam.lu/index.php?portal=19&page=1668

Continued education :

To address the great mismatch in the field of ICT, the ADEM (Ministry of Labour) launched a new training in 2016 with the support of European Social Funds. Unemployed people with no specific background can follow an intensive 3 months and ½ training to retrain into the profession of junior developer. 90 persons were trained in the first 2 years of the scheme, including several young people coming from VET education and did not succeed in University.

2.2 Needs of the Labour Market in the Sector of ICT and Robotics



Source: Skills panorama study, Cedefop, 10.2016

Luxembourg is the one the most ICT centric countries in Europe, meaning has a percentage of ICT specialists above EU average, with 4.6% (1)
The ADEM (public employment services) shows that 1400 jobs were declared in ICT field in 2017 which represent the largest job category. Many of these vacancies are reported unfilled and 6 out of 10 are judges hard to fill by employer (8)
However, at the same time the country has one of the lowest percentage of students in STEM compared to other EU countries (13) and according to Eurostat studies 2015 (educ_grad5).
According to OCDE, Vocational programmes at the upper secondary level are well developed in Luxembourg. Among 15-19 year-olds, 36% are enrolled in vocational programmes, compared with only 27% in general programmes. On average across OECD countries these rates are reversed, with 37% of teenagers in that age group attending general upper secondary programmes and 25% of them vocational ones. (7). However 5% of students in universities and other higher education institutions studied in the fields of engineering, manufacturing and construction in Luxembourg, one-third of the OECD average (14%). (7)

Furthermore, an important part of ICT professionals is trained abroad, meaning that the country is not only dependent on residents leaving the country to study but also in need of qualified personnel moving to the country in order to meet the needs of the industry in Luxembourg.

Luxembourg does not offer all required training by employers and I.T. and engineering studies are not popular amongst local students.

Additionally there is a shortage of VET specialists (8), which creates a problem as the current offer does not meet the increasing demands of the labour market.
There is especially a mismatch between the demand of private sector and VET specialist available on the labour market, as many VET and University graduate choose to work for the State as civil servant. As working for the State offer well paid jobs and high security, the Luxembourg government has difficulties to recruit I.T. specialist with the rights skills and the national languages.
The demand for high skills is increasing in the industry and science related occupation. There is an important demand for qualified staff “intermediary and specialist in science and industry (22.500 jobs in 2015, 5,7% of total jobs) according to Cedefop study (8).

Robotics, from industry to bank … and space

Industry using intensively robot, with companies such as Japanese firm Fanuc which made massive investments in robotics in Luxembourg.
The importance of robotics is also increasingly important in the financial sector, especially because of Robotic Process Automation where robot can take over repetitive tasks in the financial / banking sector.

In the meantime, space is also a strategic sector. Luxembourg is the home of SES (satellites) and is also the first country to have laws regarding space mining rights.
The initiatives spaceresources.lu launched by the government to promote opportunities and attract investment in this field (9). Therefore recently, Luxembourg has become the Head Quarter of some space mining startups.

Employment possibility in Luxembourg in the field of I.T. and robotics :

V.E.T (secondary or higher education such as diplome technicien and B.T.S)

Computer technicians (software / hardware)
Network technicians
Maintenance and facilities technicians
Junior software development
Technical sales
1st / 2nd level help desk
DataCenter technicians
Automation programmers (domotic …)

Bachelor / Master / Phd Level:

Software developer (high demand)
ICT teachers / trainers

ICT specialists in the financial sector or servicing the financial sector
ICT specialists for the industry
ICT specialists / consultants in the field of cybersecurity / RPA
ICT project managers
Technical sales and account management
Research (new units in AI at University of Lux and LIST)
R & D engineers
Data specialists
Startup entrepreneurs (spinoff financing from FNR)
Business analysts

Sources and further readings:

(1)http://www.gouvernement.lu/4103901/20-digital-letzebuerg)(http://www.digital-luxembourg.public.lu/en/actualites/about/index.php)

(2)ec.europa.eu/newsroom/document.cfm?doc_id=43026
ec.europa.eu/newsroom/document.cfm?doc_id=44320

(3)(http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Minimum_wages,_July_2017_(PPS_per_month)_YB18_I.png)

(4)Source:http://www.adem.public.lu/fr/publications/adem/2017/Chiffres-cles-dec-2017/Chiffres-Cles-ADEM-Decembre-2017.pdf)

(5)http://www.luxembourg.public.lu/en/publications/l/luxembourg-2018/infographies_2018_EN.pdf)

(6)http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Number_of_students_graduating_from_tertiary_education_in_science,_mathematics,_computing,_engineering,_manufacturing_and_construction,_2015_(number_per_1_000_inhabitants_aged_20-29_years)_YB17.png

(7) http://gpseducation.oecd.org/Content/EAGCountryNotes/LUX.pdf

(8) Skills panorma Cedefop
http://skillspanorama.cedefop.europa.eu/en/analytical_highlights/luxembourg-mismatch-priority-occupations

(9)http://www.spaceresources.public.lu/en.htmlSpace(http://www.spaceresources.public.lu/content/dam/spaceresources/press-release/2017/2017_07_13%20PressRelease_Law_Space_Resources_EN.pdf).

(10)http://delano.lu/d/detail/news/6-10-ict-jobs-hard-fill/151912

(11)http://ec.europa.eu/eurostat/documents/2995521/8115850/9-18072017-AP-FR.pdf/95970ced-06b5-4e71-b656-3cc87aa9f8f1

(12)http://paperjam.lu/dossier/2017/04/technologies/#/page-142605 on RPA

(13)http://paperjam.lu/news/fanuc-et-ses-robots-ancres-au-luxembourg

(14)http://www.adem.public.lu/fr/marche-emploi-luxembourg/faits-et-chiffres/statistiques/adem/Chiffres_cles_offres_declarees/index.html

3. Survey on Robotics

3.1 Sampling and Method

Teachers :

The survey was conducted from 10th February till 28th in Luxembourg, by email, using the respondent to complete an online form. The survey has been send sent to 15 teachers and headmasters that we are in contact with, inviting them to share with colleagues interested in the topic.

13 teachers replied online.

77% of respondents were male

15% under 30, 25% between 30 till 40

25% between 41-50

85% of respondents teach in Upper High School (Classes supérieures du Lycée).

Mostly teachers in STEM with a few answers from languages teachers

Students :

The survey for student was carried out in February, from 10th till 28th february.
The survey was shared by email via our network of teachers in Luxembourg and within our girlsindigital.lu group

We are able to gather 26 answers from students.

¾ of respondents were male, ¼ female

76% are between 16 and 20 year old and 85% in upper secondary school (classes supérieures du lycée)

3.2 Results

Teachers :

Answers show a lower confidence in robotics, coding, physics lab and electronics.

The survey shows that school in Luxembourg are well-equipped with ICT, nearly all teachers reports having access to computer for teachers, students are well as internet available at school.
However lowest rate of equipment when it come to robotic lab and robotics kids (less than ⅓ of respondents).

10 respondents out 13 said that robotics are taught are part of the curriculum but not the regular one.
Respondent mention extra-curriculum / after school activities and 4 mention existence to robotics clubs or society within school.

The majority of teacher has followed Office training as well as programming. On the other hand only 3 teachers followed trainings of robotic skills.

As for demand for training, there is not a clear category which seems to be more popular. Respondent seems to be mildly interested in all suggested coding and robotic training, with a higher demand noted for robot controller and robot structure.

On the IFEN catalogue (national teacher training institute) we have not found any robotic related training. It seems that interested teachers look for the online resources to access new trainings on these subject.

Students :

14 out 26 respondents judge their robotics skills poor which is the category were students have the lowest confident.
In physics and maths, half of the student say that their skills are at least “good”.

Levels of confidence/experience in various ICT and robotics fields do not vary between genders, as on average each student pointed four of subjects out of 11 as the ones they have ‘poor’ knowledge about. Students have significantly the highest confidence in Physics, while the lowest in Robotics, Mechanics and Electronics.

24/26 respondents said that they already followed a web programming training;

This is due of the type of students who answered, mainly in I.T. VET classes).. Majority of students has never participated in any type of Robotics skills training. Moreover, Robotics is not perceived as particularly attractive by students - they are the least interested in learning any Robotics skills out of all fields asked.

The highest attention is put on coding skills such as: Internet and networks, Programming language e.g. Pascal, C/C++, Java, Python, Boo, Ruby, PHP..., and Programming methods, which is consistent with most research done on this issue. It is worth noting that this is also the area of training the students were the most exposed to.

Overall, students had some contact with ICT, usually programming languages, and this is the field they feel the highest need to learn more about. As for robotics, the demand does seem not so high, maybe because students were not introduced to this topic. Each category in robotics rate from not interested to somehow interested.

On their personal time, 12 students out 26 list at least one occupation related to I.T. and computer (coding, 3d printing) and 5 mentioned consuming content such as watching series and playing video games. 8 define personal interest around I.T. and coding.

4 students report an interest in working in I.T. One mention being an entrepreneurs and 2 mentioned stability as a priority and one money has a priority. 2 mentioned they had no idea.

A majority mentioned receiving robotics trainings with 20 reported they were taught about robot structure and 20 about robot algorithms.
As for other trainings, summer school in robotics and 3d printing were mentioned once each.

Students show a general high interest for:

- Programming languages such as JavaScript, CSS and PHP and c++, Phyton,ruby
- Databases
- Internet and network

4. Conclusion

As one of the most ICT centric country in Europe, Luxembourg places a premium on digital by developing multidimensional strategies which embrace education, economy, public services, and grouped under the Digital Luxembourg's umbrella.

In order to move toward a smart nation, actions to encourage the robotic education have been taken in formal and informal education with the help of non-profit and private organizations often supported by the Government.

ICT sector represents the largest job category in the country. However as an important part of ICT professional is trained abroad, the country is dependent on residents leaving the country to study but also in need of qualified people moving to Luxembourg. Meaning that the country does not offer the necessary training required by employers.

The importance of robotic and the demand of high-skilled staff are increasing in sectors like industry, science, banking or even space.
However the current offer does not meet the increasing demands of the labour market especially because of a shortage of VET specialists who prefer to work as civil servants instead of in private sector.

We can see, according to the survey on robotics among teachers and students, a lower confidence in robotics for both of these categories especially concerning students for whom Robotic is not perceived as particularly attractive.

Moreover schools are well-equipped with ICT but not when it comes to to robotic lab and robotics kids.
Teachers look for the online resources usually to access new technologies on these subject.
Whereas digital skills demands are not really high for student maybe because they are not sufficiently initiated into Robotic topics .
However students seems to had more contact with ICT with a particular interest for Internet, network, programming languages and databases.

This project has been funded with support from the European Commission.
This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.