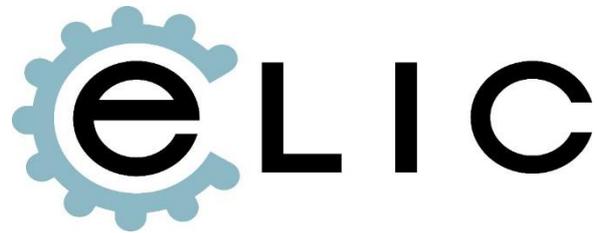




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Engineering Literacy Online - Teachers as Medium for Change

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IO1 – Needs and Gap Report – ELIC Analysis Summary

Austria, Czech Republic, Germany and Italy

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1 Introduction

This report summarizes main parts of Needs and Gap analysis report, which was conducted within ELIC project. The ELIC project is co-funded by the Erasmus+ Programme of the European Union and has the following project number: 2017-1-AT01-KA201-035034. The project focuses on four partner regions - Austria, Czech Republic, Germany and Italy, and all content parts were conducted by the scientific partners with the support of the school partner wherever appropriate.

Analysis part of ELIC project followed defined methodology. The methodology contains elaboration of desk research in particular project partner regions to gather state of the art information, which is accessible for teachers today. Second part are focus group interviews with representatives of main target groups, which brought inputs to the state of the art, needs and possible gaps from the important stakeholders group. The methodology finally results in the needs and gaps analysis on regional and project level.

2 Definition “Engineering Literacy” within the ELIC project

ENGINEERING LITERACY in ELIC stands for interdisciplinary teaching through practical examples that combine natural sciences subjects¹ AND technical sciences input². This increases “functional thinking” among pupils. The link between basic natural sciences knowledge and to how to apply it for solving challenges in different fields becomes visible and makes secondary school pupils more curious, thereby increasing their interest in engineering.

We can transfer/teach this engineering literacy through the creation of practical examples, which involve at least two different areas (one from natural and one from technical sciences e.g. physics and mechanics).

In short, engineering literacy is the elaboration of a combination of natural and technical sciences based on best practice synergies among those topics from different European regions. Once pupils obtain engineering literacy it enables them to create an engineering mind-set and to benefit from the labour market offerings in this field.

An example to understand why engineering literacy is so important and should be improved especially at non-technical school:

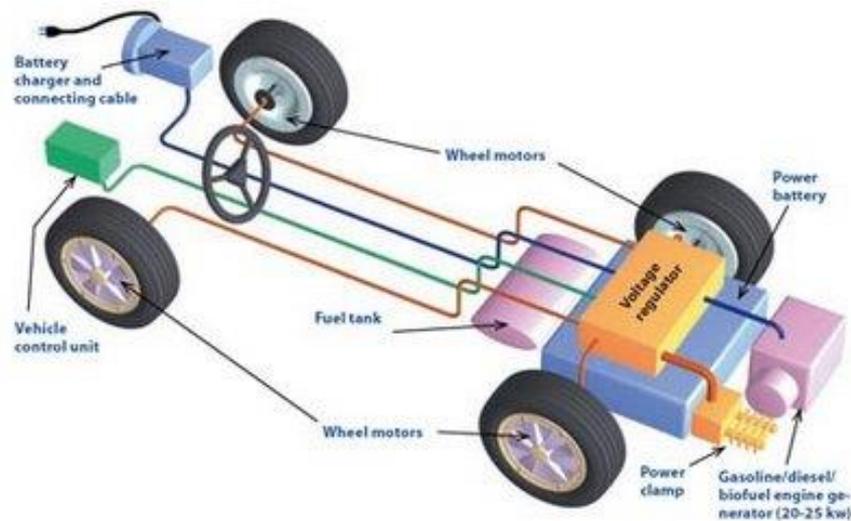


Figure 1 Car environment

¹ Biology, Chemistry, Physics, Mathematic, Computer Sciences in secondary schools

² Biochemistry, Mechanics, Electronics, Software, Renewable Energy

An example are components, interactions and influences on the environment of a car, described in Figure 1: from lithium to software and possible accidents in case of failure it is quickly seen that there is an interdisciplinary nature of several natural sciences subjects and engineering (technical sciences), and its importance in our daily life.

It is important that the ELIC project developed its own understanding/definition of engineering literacy to create a common understanding and make sure that the project's outcomes and goals are reached. The definition created is based on the consortium's understanding of engineering literacy. Further, literature and external experts were consulted to create a final version of the definition to make sure that the definition not only reflects the view of the ELIC consortium but also the one of external experts in engineering and education.

3 Needs and Gaps summary at project level

This section presents a summary of needs and gaps which were identified in the individual project partner regions and summarised in individual reports.

The comparison of individual needs and gaps analysis at regional level brought following findings of needs:

Table 1 Needs identified at the project level

No.	Needs
1.	<p>Need for engineering teaching materials, which can be implemented into teaching with no or little adaptation. Need for focus on hot and emerging topics in engineering such as:</p> <ul style="list-style-type: none"> • Electromobility vs. combustion engine <ul style="list-style-type: none"> ○ How do cars work? What are the most important parts of the combustion engine? What are other types of engine? ○ Autonomous driving – how will the mobility of the future change? • Robotics – how are robots changing business strategies? • Etc.
2.	<p>Need for cross subject/interdisciplinary collaboration. STEM subjects and others such as English, where a collaborative collaboration could lead to the improvement of students in STEM subjects and such cooperation could also improve the practice of students and would offer laboratories the common use.</p>
3.	<p>Need for a more systematic further education of teachers, which allows teachers to have the latest state of the art in their education topics. It is important mainly in the engineering domain, which is rapidly evolving and teachers need to stay in touch with the latest knowledge to transmit up-to-date knowledge to their pupils.</p>
4.	<p>Need for actual/up-to-date national teaching plans and frameworks. There is a big need in all participating countries that teaching plans are more adapted to current developments als industry needs.</p>

The comparison of individual needs and gaps analysis at regional level brought following findings of gaps:

Table 2 Gaps identified at the project level

No.		
1.	Gap	Quality of offered trainings actually on the market
	Current Status	<ul style="list-style-type: none"> • Trainings offered to STEM teachers are available to a high degree, still quality of content is often questionable as well as the output provided • There is a lack of training implementation with experts, very little information on didactical concepts for engineering topics, questionable increase of knowledge. • The content of the courses is uncoordinated, incomplete, far from covering all topics of "technical literacy", they are just individual actions
	Desired Status	<ul style="list-style-type: none"> • Training for teachers in high quality, focusing on quality rules • Course content based on cooperation with experts and provide real expels from universities and industry • Teaching materials which can be implemented in lectures with little adaptations
2.	Gap	Not clear aiming of trainings – teacher/pupil
	Current Status	<ul style="list-style-type: none"> • It is vaguely defined what kind of education is suitable especially for teachers and what kind of learning would be beneficial for joint action of teachers and students
	Desired Status	<ul style="list-style-type: none"> • Have a training that is applicable for the teachers and also defined what is directly applicable for pupils
3.	Gap	Course structure – not suitable for direct implementation to courses
	Current Status	<ul style="list-style-type: none"> • Short and well prepared course training material for a 2h class (experiments, teaching material etc.). • Not only the content, but also the form of offered courses and further education should be varied to cover the different needs and expectations of teachers and to adapt to current teaching standards, e.g. online courses for individual study, experience multi-day courses, common courses for teachers and students, etc.
	Desired Status	<ul style="list-style-type: none"> • Related to the Need no. 1

		<ul style="list-style-type: none"> • Availability of teachers' training materials for the implementation in STEM subjects with little or no adaptation
4.	Gap	Teachers career plan
	Current Status	<ul style="list-style-type: none"> • Teachers are not enough supported to participate in further education (either financially or in terms of study or time), they do this on the basis of their own professional and individual motivation.
	Desired Status	<ul style="list-style-type: none"> • Related to the Need no. 3 • Support systematic teachers education with a training that is EU-recognised with international certificate <ul style="list-style-type: none"> ○ At project level, we are not able to aim on national or regional levels of systematic teach education, but it can be coherent support
5.	Gap	Interdisciplinary projects with university and industry
	Current Status	<ul style="list-style-type: none"> • There are already some individual cooperation between secondary schools and university or industry
	Desired Status	<ul style="list-style-type: none"> • Related to the Need no. 4 • Interdisciplinary projects with university and industry could be initialized for state-of-the-art teaching • It allows cooperation on the latest project in the industry and university and getting the latest trends to the teaching of pupils • It can be also in the form of well-defined examples from the industry and the university, where teachers and pupils at secondary schools can see the use of individual STEM subjects
6.	Gap	Cross subject/interdisciplinary collaboration
	Current Status	<ul style="list-style-type: none"> • Engineering implemented not only in STEM subjects but also in other subjects such as languages. It was identified that among the STEM teachers there is a high motivation to collaborate with other subjects in order to create the awareness and motivation among pupils and teachers to deal with engineering aspects
	Desired Status	<ul style="list-style-type: none"> • Related to the Need no. 2 • Collaborative teaching of STEM subjects also with other subjects to present the interdisciplinary of particular topic, as the majority of nowadays engineering topics requires interdisciplinary view on it.

		<ul style="list-style-type: none"> Project style of teaching, where the topic is discussed on particular project from different point of view of individual STEM and other subjects
7.	Gap	Voluntary project classes
	Current Status	<ul style="list-style-type: none"> There are already voluntary project classes
	Desired Status	<ul style="list-style-type: none"> Voluntary project classes with resulting project works do exist and could be used for such studies. The interesting point is that the mark will influence the final A-level certificate

3.1 Objectives of ELIC project based on Needs and Gap analysis

ELIC project objectives shall lead to the closure of identified gaps and fulfilment of discussed needs, that we are able to cover. These objectives will be fulfilled in the following work of ELIC project, which aims on development and implementation of new training for teachers as primary target group and pupils and secondary target group. The aim is to increase engineering literacy.

Table 3 Objectives of ELIC project based on Needs and Gaps analysis

No.		
1.	Objective	Availability of teachers' training materials for the implementation in STEM subjects with little or no adaptation.
	Related needs and gaps	Needs: <ul style="list-style-type: none"> No. 1 Gaps: <ul style="list-style-type: none"> No. 2, 3
2.	Objective	MOOC training materials are made available to the target group of secondary STEM teachers and all other interested target groups. MOOC can generate interest among teachers but also among pupils as a secondary target group
	Related needs and gaps	Needs: <ul style="list-style-type: none"> No. 1 Gaps: <ul style="list-style-type: none"> No. 2, 3

3.	Objective	Training materials focus on combining theory and hands-on practice. It means variety of slides, or example description, how to reproduce it in the class
	Related needs and gaps	Needs: <ul style="list-style-type: none"> • No. 2 Gaps: <ul style="list-style-type: none"> • No. 6
4.	Objective	Online training under ECQA, which allows to obtain international certificates.
	Related needs and gaps	Gaps: <ul style="list-style-type: none"> • No. 4
5.	Objective	Training under ECQA quality rules and procedures.
	Related needs and gaps	Gaps: <ul style="list-style-type: none"> • No. 1
6.	Objective	Provide real industry or university examples from the latest and emerging engineering topics
	Related needs and gaps	Needs: <ul style="list-style-type: none"> • No. 3 Gaps: <ul style="list-style-type: none"> • No. 5
7.	Objective	Focus on hot and emerging topics in engineering such as: <ul style="list-style-type: none"> • Electromobility vs. combustion engine • How do cars work? What are the most important parts of the combustion engine? What are other types of engine? • Autonomous driving – how will the mobility of the future change? Robotics – how are robots changing business strategies?
	Related needs and gaps	Needs: <ul style="list-style-type: none"> • No. 1

4 Conclusion

The analysis, which consists of desk research, focus group interviews and needs and gap analysis, identified and addressed the main needs and gaps in particular the project partner's regions, in Austria, Czech Republic, Germany and Italy. These results are described in individual partner region reports. Overall results are described in Needs and Gaps report.

This report is summarizing the main needs and gaps at project level, and definition of ELIC project objectives.

The paper presents basic definition of engineering literacy, which stands for interdisciplinary teaching through practical examples that combine natural sciences subjects and technical sciences input. It is the main backbone of ELIC project.

The needs and gaps analysis as it was conducted at project level, presented summarisation of needs and gaps identified. The main needs were, the need of more comprehensive overview of all subjects, not only the STEM ones is common. Teachers are motivated to collaborate with other subjects in order to apprehend more comprehensive overview and try to understand the engineering aspects in a whole package. There is also a need for courses for teachers with the aim to interdisciplinary. It could show teachers practical implementation of individual STEM subjects and empower them share and describe these examples to pupils at the secondary schools.

The needs and gaps served as the basis for objectives definition, which define main objectives to be followed in the development of the new ELIC training.