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HACKATHON

HACK + MARATHON

MAY 2021

The organization of a educational HACKATHONS

The Hackathons should include training sessions, workshops apart from developing new tecnologies. PAGE 4

Use of new methodologies and tools

Collaborative learning, practical learning, gamification, flipped classroom. PAGE 10

ESTEAME, IT and Open data challenges

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The guide is focus on using HACKATHONS like an innovative tool to enhance students' motivation towards the study of ESTEAME subjects, improve their basic and transversal skills, art design, skills for the ecological transition and promote gender equality.

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PROLOGUE

This document is a brief description of how to organise a Hackatlon. It's focused on the hackathon project promoted for the members of the European Project EU HACKATHON 2020-1-ES01-KA202-082752. This hackathon will be a programming challenge for vocational training students. The profile of the participants is one of the most important things in which we have to take care, because they are not experts and the project must be more educational than competitive. This guide is not only for the above project, it can be used and adapted for any educational hackathon.

THE ORGANIZATION OF A EDUCATIONAL HACKATHON

Hackathon means programming marathon. The term comes from a combination of the English words “hack” (to program exceptionally) and “marathon” (marathon).

Previous days

In addition to the meetings of the Organizers to define the project and these documents, we have to teach our students, the final participants, in the techniques, languages, soft skills and tools that they will need for the project. All vocational training schools have to follow a coordinated plan in order to include in the regular classes these concepts. In addition, they may need extra classes only for the participants for specific skills. The details of the methodology are in the next documents of this project.

The dissemination in social networks and press must be planned for a good impact. Participants need to be encouraged to share their participation in Hackathon, but in a good way. For this reason, it is necessary to make promotional images, a good hashtag and to provide the right links of the project to the participants. Active profiles must be set up in main social networks and every person involved should share or interact with the post.

It’s necessary to make posters to promote and to guide the participants about the spaces and schedule. These will respect a graphical uniformity and quality.

Infrastructure

A hackathon needs spaces, computers, software and external tools.

Spaces

Each group of participants needs a semi-private space to organize better. The best is a big room with tables for all. They will need a whiteboard and stationery equipment. This space will be occupied for days and have to be for this unique purpose these days.

Computers

Participants could bring their own laptop, but we have to think that they may be students with a low budget and some of them have to travel by plane. The hackathon organization has to provide at least one computer for participant and the needed devices for the challenge. This computer must have an Internet connection and the developer tools needed.

Hardware: Usually for programming there's no need to have a powerful computer unless you have to emulate an Android device, for example. The most reasonable could be a good PC with 4 or more cores, 8GB of RAM and sufficient space in the hard drive.

Software: In order to promote values about free software, the Operating System should be based in GNU/Linux. Ubuntu is a good choice for the dev tools incorporated in it. About the software for programming, the computers should come with some free text editors, terminal, compilers or the specific tool needed for the bases of the challenge. Participants need to feel free to install whatever they need. For this reason, there is no reason for not to give them the administrator password.

Network: There are no special requirements about the network, they will need sufficient Internet speed, it's all.

External Tools

- A cloud service for sharing documentation, Google Drive or Dropbox with shared folders are sufficient.
- They need a place to perform the version control of the code. We recommend GitHub or similar. This place has to be the same for all and they have to share the link to the Jurors as a part of the evaluation.
- As a tool of communication they can use Slack or Discord. Organisation will configure one with different channels.
- Participants can use tools like Trello to organise the project. Jurors can use them for evaluating the organisation of every team.
- If they consider it necessary, organisators can configure a Telegram group to spread messages out of the schedule.
- It depends on the type of project, they could need a VPS, Cloud database or some APIs. Organisators will provide the necessary and the participants can use the free tools available on the internet that they consider.

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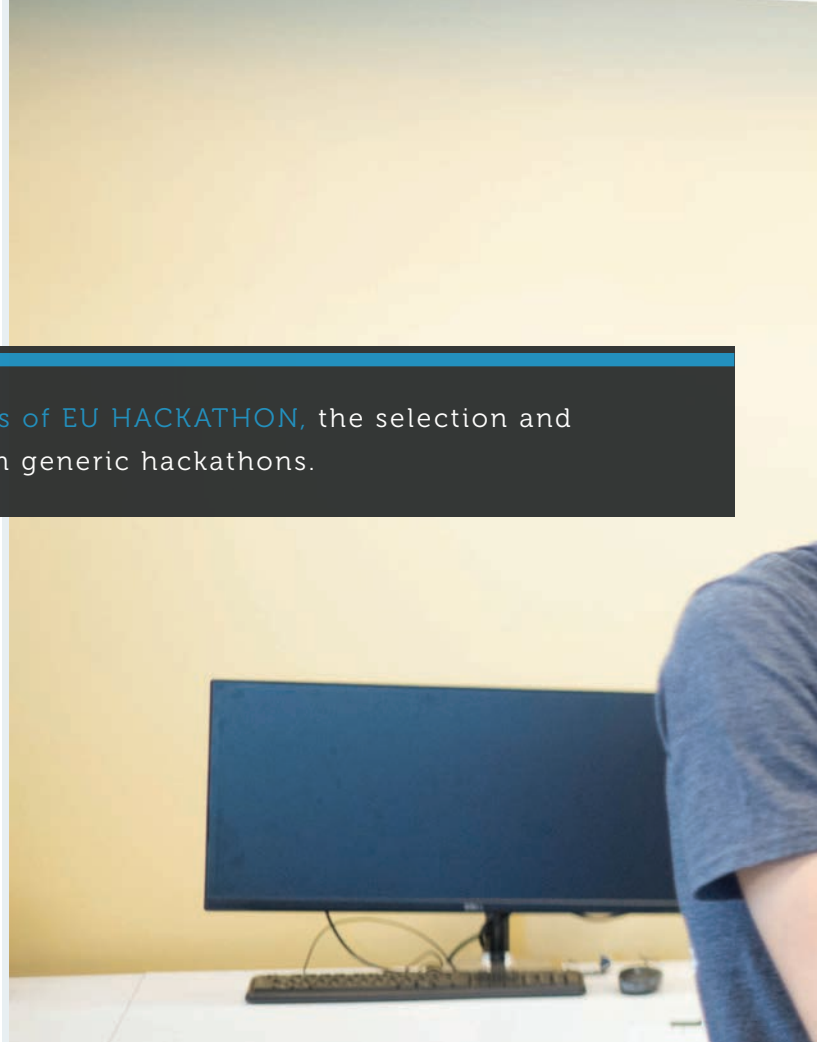
Participants flow



In an educational hackathon with the values of EU HACKATHON, the selection and agrupation of participants are different from generic hackathons.

We have to make multicultural teams and focus on soft skills, transversal and intercultural competences in ESTEAME concepts, gender equality and inclusion.

For these reasons, for an educational hackathon is necessary to make random teams with gender equality.

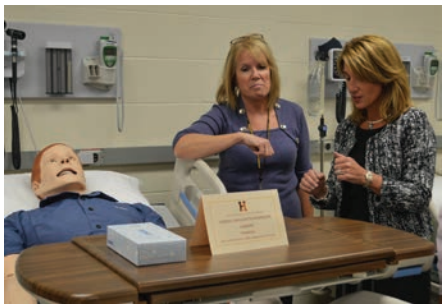
In case of international hackathons, participants will be mixed by country and gender. The organizers have to do a draw respecting these principles.
There is another criteria to consider that is the level of the participants. The teachers of the participants can help the organizers for making more balanced teams respecting the first principles.

A Hackathon is an event and must be more than programming. Before making the teams and talking about the challenge, participants will take part in ice break activities, conferences and city tours. Organizers have to teach them how to use the specific tools for the challenge, the different communication channels and the social networks.

The day of the hackathon, teams will be created. Then, organizers will explain the challenges and participants will start to work on the solution. From this point it's considered a competition, but we must not forget that it's an educational event. Participants can talk with other teams and ask for help from the teachers. Organizers can decide the level of help teachers can provide, but it's important that participants don't get stuck.

Each team has to choose the roles of the group.
For example, frontend or backend developers, graphic designers... it depends on the challenges and the solution.

Hours after the start of the competition, each team has to explain with a short document their idea for the solution. This document will have:
- A cool name for the application and a first sketch of a logo.
- A description of the problem they want to solve.



- A description of the solution they propose.
- A description of the technical architecture of the application.
- The provisional roles of the group.

This is important because jurors can notice if they make last minute changes and the quality of their organization. For the organizers is important because they can make documentation during the event and can publish in social networks the first ideas.

After solving the problem, each team must have:
- A working application that solves the challenge.
- A cool name and logo.
- A way to present their application live. (slides, videos...)
- The code in a public version control platform like Github.
- A brief document with technical considerations about their solution (APIs, protocols, requirements, URLs...) that helps the juror understand the technical stack of the application.
- A business plan.

Evaluation

Jurors have to select the best application. But they have to consider the values of educational hackathons. They have to judge the quality of the final product, the team coordination, the process, the way they solve the problems and the ESTEAME, gender

equality, and inclusion values.

For the evaluation, Jurors will make a shared spreadsheet or similar with all criteria and each member must put their valuation for each team. The weighing of the criteria depends on the challenges and must be defined before the competition.

We can evaluate:

The impact potential: What is the impact to society if the idea is implemented at scale? Does this offer something that hasn't been solved already? If it has been solved, does this offer something different? Can it be scaled to meet thousands or even millions of people?

Technical Complexity & Novelty

Technical complexity does not necessarily mean code. This could be anything, hardware designs, Is this an innovative solution?

Prototype Completion

Is there a ready technical prototype of the solution? If yes, does it work well? Does the prototype present well the idea of the solution? How fast can the prototype be turned into a ready to use product?

Business Plan

It is essential to consider the feasibility, economic and societal value, market knowledge and sustainability of the solution. What resources are needed to implement the solution?

Each of the above criteria have to be separate in multiple points that the jurors agree.

Jurors have to make an individual work and then talk about it with the others. The final decision will take in account the spreadsheet and the posterior joint deliberation.

Some students like the competition and others don't feel good about it. Organizers should be aware of being in an educational competition. All participants should have a prize for the effort and the prize for the winners should be more symbolic than material. There shouldn't be a single award. For example, we can reward originality, teamwork or design.

Spend time on training workshops for beginners.
Educational hackathons should not focus exclusively on developing new technologies, they should include training sessions in the field. Workshops should focus on specific topics.

After the event

It is necessary to spread the conclusions of the hackathon. Organizers have to update the webpage and social networks with photographs, videos, the description of all projects and the winner.

In an educational hackathon, it makes sense to develop free software. The repositories of the projects will remain public and with a free license. It could be interesting to make one static repository with the code of all projects. If it's possible, a working demo of the application will be published and linked to the hackathon webpage.

USE OF NEW METHODOLOGIES AND TOOLS

Collaborative learning, practical learning, gamification, flipped classroom.

Next, the effect of the use of new methodologies, such as gamification, flipped classroom, or collaborative work in an ESTEAME environment is analyzed and the improvements produced both in the process and in the students.

Educational experiences of gamification and collaborative work in ESTEAME. Analysing the benefits of the introduction of gamification in the ESTEAME field, it is appreciated that elements of the games such as points, prizes or badges that lead players to overcome levels once they reach challenges and dares in a competition if they are used in order to achieve teaching objectives, such as, for example, increasing student motivation, improving classroom management, stimulating experiential learning, promoting both the development of creativity and certain skills and, ultimately, improving academic results. They increase motivation reaching a great benefit when introducing gamification in the educational field.

In addition to motivation, other aspects are important in VET, such as the development of social and intellectual competences of students and the improvement of both self-confidence and personal satisfaction, due to their direct impact on academic performance.

The experiential experience and meaningful learning is what it is pursued with the use of video games and robotics in education. In addition, although robotics can also be detached from gamification, it is common to use traditional Lego or similar games to promote motivation and facilitate the learning of electronics, mechanics and computer science students, by solving a real technological problem. This new discipline is gradually included in the educational plans of both public and private centers, since the areas of knowledge involved in robotics approaches are part of the secondary school curriculum. This allows the content of

ESTEAME

ESTEAME subjects to be combined by means of the practical creation of programmable robots with different platforms, such as Scratch, Arduino or Lego Mindstorms, which allows promoting creativity and the development of computational thinking.

It is worth commenting on other gamification proposals that aim to gamify classroom management to help improve the classroom environment and, therefore, the general

performance of students.

It should be noted that the overcoming of levels, badges, insignia and medals imply an element of competition that generates controversy in the educational field, but competition is not only beneficial to motivate students to strive to achieve the objectives set, but also which also stimulates participation, encourages teamwork, interpersonal relationships and the acquisition of transversal skills such as effective oral communication, as well as the development of personal skills and social skills that contribute to employability.

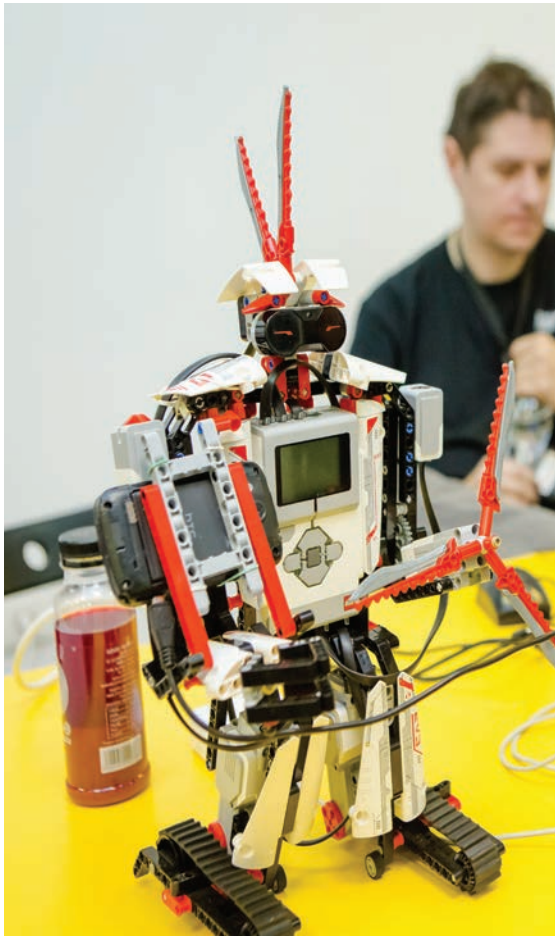
Today's young people, gamers, who dedicate a large part of their leisure to video games, which can be used in education by creating open immersive worlds in which students are experientially integrated into the space and time of the story of the game, which allows students to understand how the world works and learn to respond to everyday problems.

Today's society faces the challenge of training citizens with high knowledge of the scientific and technological field, with the aim of making them protagonists of the future. However, due to the difficulty encountered in understanding the abstract concepts that form the basis of scientific-technological

knowledge, they are unable to relate them to their daily life. Therefore, the ESTEAME movement pursues that the teaching of the subjects of this field, which, traditionally, is carried out compartmentalized, is now carried out in an integrated way in search of a paradigm shift that brings scientific and technological knowledge closer to students

and it creates motivation and curiosity to understand the world around them, as well as prepares them for a technologized society.

In this sense, gamification in the ESTEAME field stimulates student learning by introducing the mechanics of games in non-game contexts: the motivation of the learners grows and, consequently the involvement with their own learning and results academics.
For this, elements such as challenges, competition, obtaining points, rankings, badges, prizes, etc. are used, obtaining benefits, such as the development of competencies, the improvement of classroom management and work collaboratively.
Applying a gamified methodology with a technological component in ESTEAME provides the experiential experience that will allow students to understand and assimilate the contents of the subjects in the field through meaningful learning and active participation Not in vain, the gamified methodologies used by video games or robotics pursue the objectives of ESTEAME teachers related to manipulative and cooperative learning, the approach to solving problems through conjectures or assumptions, the integrated use of technology and the development of critical thinking.
In summary, the potential of gamification in the ESTEAME classroom, especially by including the technological component, lies in providing students with an experiential experience that helps them better understand the curricular content of the different subjects and makes them connect with their own emotions creating interest, curiosity and appreciation for the world in which you live. This positive contribution is reflected in a significant improvement in the development of their capacities, by promoting teamwork and helping them feel motivated, by stimulating their learning and promoting



the development of essential transversal competences that provide students with the necessary tools to face the challenges of today's society, thus deploying their creativity and preparing them for life and to adapt to the social environment that they will encounter in the future and become active citizens committed to the society in which they live.
Analysing Flipped Classroom in ESTEAME environment

Analysing Flipped Classroom in ESTEAME environment

Nowadays, online learning is a vital aspect of education. In the world of online education or distance learning, classes can be asynchronous or synchronous. What does it mean?

While in synchronous learning the student and the instructor are in the same place and at the same time, the tasks being solved by all students simultaneously, asynchronous learning is more flexible than synchronous learning in the sense that teaching is done at a given time (using modern technologies) so that the students have access to it at another time, whenever it is most convenient for them. New learning models such as collaborative work, flipped classroom or gamification have been designed to ensure better adaptation of students to the personal and professional life of the 21st century.

Flipped learning-What is it?

The concept of flipped learning is defined as a reversal of the roles classroom learning and home assignments have. Being an asynchronous learning, in flipped learning students can access the topic prepared by the teacher on their own, at their own pace, by watching videos, listening to podcasts, and reading texts outside of the classroom. Back in the traditional classroom, the role of the instructor is to check the understanding of individual students and to facilitate a deeper interactive discussion between the students that should lead to an immersive learning experi-ence. Even though at first Flipped learning could sound a bit counterintuitive, it has proven to work wonders in improving students' participation and understanding in many classrooms and in different subjects.

Flipped learning in an ESTEAME classroom

Although this type of blended learning seem to work perfectly for singular subjects lessons, the questions is if it can be applied to an ESTEAME classroom since this type of learning (ESTEAME lesson) implies complex concepts, formulas, theories, and problems. Naturally, expecting students to understand the lessons on their own might sound like too far a goal to achieve but, on the contrary, it seems that flipped classroom can work perfectly for an ESTEAME classroom as well. All it needs, of course, is for the material

intended to be taught to be engaging enough to attract the students and they will end up understanding more than we think. Assigning understanding a lesson as homework, classroom time that remains can be used for discussions, debates, problem-solving, and practical experiments. One of the advantages of doing this is that it helps students dive deeper into a lesson, and it helps students set their own learning pace because they can re-watch the video over and over until they grasp the concept.

What does Flipping an ESTEAME classroom imply?

There is no clear answer to this question because flipped classrooms can be implemented in more than one way depending on the nature of the lesson and the teaching style of the instructor. However, some basic coordinates can be established that should be followed in order to achieve flipped learning. In the following lines six basic steps are presented that might give an example of how this type of the lesson can be flipped.

1. GOOD WARM-UPS AND USE OF EXAMPLES

A BORING LECTURE NEVER ATTRACTS STUDENTS, not even those who feel quite motivated. Making a lesson interesting can be challenging but not insurmountable. A good warm-up activity will definitely stir up students' interest in the topic and the use of good examples to illustrate that will maintain this interest at high levels because the exemplifications allow students to make a connection between abstract concepts and the tangible, real world, which they find easier to relate with. For example, a story of two polar bears conversing about the melting of the ice caps can be a good starting point to introduce the topic of global warming. Thus, the students will be more willing to learn and it will be easier for them to grasp the understanding of the concept because they have an example of real animals faced with this situation.

2. VIDEO EDITING APPS

ONE OF MAIN characteristics of flipped classrooms is the use of videos as they facilitate a communication between the instructor and the students in the sense that it is

less impersonal that a written lecture on a learning platform. Video lessons bring the instructor closer to the students, even if it is only virtually. Maintaining the same idea of making the lessons interesting, using different apps to edit the videos so that they become more appealing to the viewers. Visual aids like memes, gifs, infographics and animations can be helpful in understanding the lesson. Besides, students find them funny which helps in making them more interested.

3. DIVERSIFICATION OF LEARNING MATERIAL

Although, as it has been said in the previous paragraph, flipped classroom is basically a video-based blended learning, it does not and it should not reduce to that.

Diversification of the learning material is a key component in flipped lessons as it helps avoid the routine of using the same type of presentation and, as a consequence, risking losing the interest of the students. Video presentations may intermingle with podcasts, blogs or textbooks. Besides succeeding in keeping the students interested, introducing written material or even experiential learning help all the different types of learners absorb information in a way that fits their individual needs. For example, one student might learn best by acting a process out, while another might prefer reading about the topic instead. Knowing how to address the learning needs of the students is an important part of creating meaningful classroom experiences and helping them retain what they learn.

4. SMALL QUIZZES IN CLASS TO CHECK STUDENTS' UNDERSTANDING

IT IS IMPORTANT FOR THE TEACHER TO ASSESS HOW MUCH A STUDENT HAS UNDERSTOOD.

Back in classroom,

conducting a small quiz will give the instructor an idea of the level of understanding of the students. This is a tool that may give the teacher and idea of the position of the students in the advancement of the topic and thus it is a starting point of further activities or more discussions that are detailed or, on the contrary, it tells the teacher if further explanation or more time to study is needed.

5. DISCUSSION, ACTIVITIES, PROBLEM SOLVING AND EXCHANGING IDEAS

The final step of the basics of successful flipped classroom is also the most important one because it involves applying the theoretical concepts that the students have studied on their own, thus providing not only a broader understanding of the subject, but it also leads to an immersive learning experience. No mathematical concept is fully understood if the students do not get to apply that concept in solving a problem or an exercise and this applies to all subjects.

TO CONCLUDE, FLIPPED LEARNING IS A MODERN, complex technology-based teaching method whose aim is to increase students' engagement and learning by allowing them complete readings or watch recorded videos of the lesson in their homes, at their own pace and work on live problem-solving or conducting experiments and having open class discussions during class time. This type of learning can perfectly be applied to ESTEAME classrooms due to its own characteristics, personal pace learning combined with teacher-student real time interaction, using a large variety of teaching materials and methods, thus allowing ESTEAME components to perfectly blend in.

ESTEAME CHALLENGES

Entrepreneurship.
Entrepreneurship stands for the discovery, evaluation and exploitation of opportunities to create something new (new product, production process, service etc.) by mobilizing resources.

The entrepreneurial mindset is actually quite important when it comes to the todays' society: entrepreneurs continuously shift the set paradigms by introducing newness to the consumer markets thereby constantly challenging the status quo. In this sense students who are taught the entrepreneurial ways can become more resilient and resourceful when it comes to future employment and personal growth.

Even though entrepreneurship is highly desirable e.g., many employers ask for an entrepreneurial mindset in a job description, it is not widely taught in schools in any shape or form. From this fact, many challenges are present and will be discussed in the text below.

The challenges include:

How to even start?

More than often the problem resides in not knowing where and to whom should

the students turn to when it comes to learning something which is not a part of the conventional school program. Entrepreneurship, or the entrepreneurial mindset, is something that can be easily trained but only if the right tools for the right groups are used. Since most VET study programs don't include such classes students don't know how to start with their entrepreneurial journeys.

What if there are no means?

Another problem resides in the fact that todays' society teaches younger generations that financial means are the beginning and the end of any business venture discouraging them to even start with one of their own if they don't have the financial background. Students have to be taught that means come in various shapes and forms: even though financial ones are important, the right knowledge and skills acquired by an individual will lead them to utilize their strengths no matter the situation, which is exactly the entrepreneurial way of conducting oneself.

Who do we look up to?

At the beginning the venture is in the mind of the entrepreneur: the product, production process, service etc. is just an idea. The idea grows and manifests in real life only after a certain time period during which means are utilized and many lessons are learned by the entrepreneur.

Those lessons learned are invaluable to students who are thinking of beginning their entrepreneurial path. However, there is no active connection between students and local entrepreneurs which would enable students to continuously learn in a real time question and answer sessions.

How to change the status quo?

The current way the educational system is set up is not teaching VET students to think outside the box. Firstly, students more than often don't know how to set their own goals in order to accomplish them swiftly by learning throughout the process. The entrepreneurial way encourages setting up **SMART** goals: goals which are Specific – What should be realized?

Measurable – How can I measure my goal

SMART goals: which are Specific, Measurable, Achievable, Realistic and Timebound

Change their S.M.A.R.T. life goals as they go along their employment journey.

achievement?

Achievable – Is the goal challenging, yet achievable for me?

Realistic – Is the goal important for me? and

Timebound-What are important deadlines? Secondly, the usual way of approaching life challenges, and which is greatly represented in schools is the causational way of thinking: e.g., we would start with a recipe to make a dish that we want, going to the store to buy additional produces rather than start with what we have in the fridge and changing the dish as we find new ingredients. In this way we are not bound to a specific goal but rather change our goal as we go along, not being limited by our resources but rather using resources as they come. In the same way VET students should be taught to start their business journeys by asking themselves who they are, what skills do they own, who do they know, what resources they have etc. and change their **S.M.A.R.T.** life goals as they go along their employment journey.

Science

Science is the backbone of many civilizations: because it has developed, new and improved life is possible. It is the pursuit and application of knowledge and understanding of the natural and social world following a methodology based on evidence. Scientific research provides back-up for many of todays' domains of human activity, especially in situations of global significance. Even though scientific subjects are well present in todays' schools e.g., biology and physics, there are still challenges with which VET students are faced with when it comes to fully grasping knowledge taught and which will be discussed in the text below.

The challenges include:

How to master the fear of science?

More than often students have

an unjustifiable fear towards subjects in the scientific field. The problem lies in the conveying of information: facts are presented in a dry and boring way, without real life examples which makes the learning abstract and difficult. The students are sitting down, in a passive state, while the teacher is writing on the blackboard. In this fashion students tend to be discouraged from pursuing further scientific knowledge and settle for the facts they have been presented with and have learned by heart. It is noteworthy to mention that student's attention leans towards the exam grades and not towards acquiring and understanding learned facts.

How to find a scientific link?

The beauty of science which often goes unrecognizable lays in the fact that it has many different domains which give an opportunity for an interested mind to diversify. However, these scientific domains are cut one from the other in the sense that there is no link between the lessons taught in school. When combining multiple scientific fields students could see the potential of knowledge and could make a greater impact than previously possible.

Where is the equipment?

Many of scientific research and experiments don't have the possibility to be conducted in real life school environment. Students read about experiments from their books while consulting the adjacent photographs but without taking part in conducting them themselves. The problem lies in the fact that most schools aren't keeping up with acquiring new scientific equipment while their existing one is out-dated. This leads to students not getting hands-on and being deprived on one of the most interesting ways of scientific learning: learning in the labs.

Where is the staff?

Science has to be taught by qualified teachers who also take part in modifying and approving of the school curriculum. Because that isn't the case in many schools across different scientific teachings, the lessons are poorly structured and the knowledge even more poorly transferred.

The teaching staff is often insufficiently prepared and trained when it comes to the development of new scientific schools' programmes as the programmes need to keep up with the ever-changing scientific breakthroughs.

When combining multiple scientific fields students could see the potential of knowledge and could make a greater Impact

Technology

Technology stands for the manipulation of scientific knowledge in order to change the human environment. mobilizing resources.

Technological advancements are the ones making everyday life easier across various domains of human interest e.g., transportation, communication, energy, construction. New ways of simplifying human activities are on the brink of emerging on a daily level and thereby play a significant role in forming new business opportunities to new coming students. This is why understanding challenges in this field is of crucial importance and will be discussed below.

The challenges include:

How to keep up?

The fact is, technology is ever changing e.g., new ways of communication or transportation are just one click away. However, this fast pace of development can impose a significant problem for students as they are required to constantly adjust their knowledge to the current state of art in the technological world. This is a certain threat which should be dealt with on both fronts: the students have to be taught how to deal with the ever-changing technological advancements while teachers have to be able to convey new knowledge in a way that the past one serves as a base and any future one will not be intimidated by but rather welcomed and easily acquired.

What about the out-dated equipment?

Technology is developing in a fast pace but it seems as if the educational system is more than often not keeping up with it. One of the biggest problems in todays' educational systems is the out-dated technological equipment in classrooms which cannot give sufficient base knowledge for easy transitions between present and future technological advancements. Students are thereby deprived of a wider spectre of technological knowledge they could have and could struggle and possibly miss business opportunities because of their poor technological backgrounds.

What about insufficiently trained teaching staff?

This challenge is connected to the fact that the teaching

staff is also more than often insufficiently professionally trained or reluctant to make as dynamic changes as required which means they don't have the right tools to convey the knowledge to the students in real time school lectures.

What about simplifying technology for both genders?

It should be pointed out that in todays' society male dominance is present when considering technological classes e.g., computer classes. The fact that female students are more reluctant to feel comfortable when solving a computer-based problem points out to a significant issue which should be dealt with. Female students don't take part from an early age in computer-based activities e.g., computer games, hence should be stimulated in a different fashion in order to take more interest in mastering that kind of knowledge.

Engineering
Engineering stands for the manipulation of scientific principles in order to create and build machines, structures and other but also to advance human life across various domains.

There is a certain degree of fear in girls connected to engineering.

It is a field of work which is extremely desirable and fruitful in that it gives numerous opportunities to be further explored. Students who decided to take part in engineering studies develop their skills in different fields and acquire a certain framework of thinking which enables them to adjust to distinct problems at hand finding suitable solutions. This field includes many challenges which should be overcome in order for students to take more part in it.

The challenges include:

What is the gender distribution?

Similarly, to challenges in the field of technology, female students more than often decide to opt for social studies rather than engineering. There is a certain degree of fear in girls connected to engineering which is backed up by professors favouring male students through the course of the lectures. It is an ever-present issue which disables different points of view and thinking processes from coming together and finding a much broader pool of solutions for a given task.

Again, female students have to be stimulated in a different way in order to take part in engineering studies which is of a crucial importance.

Where is the practical part?

Current school curriculums are more than often out-dated and still rely on the passive knowledge distribution via lectures in classrooms.

Students, especially the younger generations, rely on the hands-on and visual stimuli when it comes to learning. This represents a problem for many schools as the equipment for possible experiments is out-dated or non-existent at all. The practical lecture model could create a vertical link between high-school and university studies by conducting

numerous visits of both parties to different facilities on one hand showing the problems with the young generations and on the other showing what the possibilities further on entail.

How to keep up?

Again, similarly to challenges in technology, there is a certain difficulty to keep up with the newness present in engineering studies. Studies have to rely on teaching students not the conventional way of thinking frameworks, learning by heart, but rather how to adapt to new environments and problems by successfully implementing learned principles. This challenge also includes the problem of teachers which have to show constant ingenuity in their teaching methods so the students are more resilient to changes.

How to teach pressing issues?

One of the most pressing issues which todays' society is omnipresent in many daily news, articles and EU's initiatives. Engineering serves as the means with which this issue can be dealt with and therefore a careful approach in lectures to the younger generations has to be taken.

Arts

Arts stands for expressing one's inner self through mediums: music, pictures, sculpting, painting etc. Artistic behaviour in any shape or form enables a person to use and train different parts of their brain, forming new neuropathways which can be used when tackling problems in other fields e.g., science, engineering, technology etc., in order to create a diverse, more creative solution.

Artistic personal development is therefore of a high relevance and its challenges should be further explored as shown in the text below. The challenges include:

How to enable students in finding their artistic side?

Majority of focus when it comes to education, comes to VET education, is put on subjects which are directly correlating with the student's future work preferences.

Artistic behaviour and its further development are thereby put on the backburner more than often as the additional, leisure or extracurricular subjects making the students believe this type of education is somewhat less relevant to their future careers. As previously stated, an innerweb in lectures is ought to be set up so that knowledge and way of regarding certain phenomena's, problems and facts can be trespassed between fields complementing each other and enabling the student to be more diverse in their thinking processes.

How to deal with lack of trained staff/space/time?

Arts classes have to be led by individuals who are sufficiently trained and prepared, which means that more than often external associates are needed. Not only that, but arts classes take up space (special classrooms with props and tools) and need time as artistic line of thought cannot be stimulated in a short time frame.

Mathematics

Mathematical knowledge is the base for all other line of research: it can be found from arts to engineering, in all aspects of human development and life. Since it is the basis of many human functions it is also imperative to be taught in a right way so that students can yield its principals as needed. across various domains.

The challenges include:

What about the fear?

Since mathematics is a line of study which has only one right answer, there is no room for subjectivism. This rigidness together with the set-up examination and grading systems leads numerous young individuals to develop a certain fear towards calculations and fully grasping the mathematical concepts at hand. Current lectures have to be presented with a certain degree of creativity to ease up the students, possibly giving them more autonomy so that a proper way of thinking is generated which will help them with any future mathematical problems.

What about previous knowledge?

Mathematics is one of the studies which has the need to continuously accumulate knowledge: anything learned in the previous school year serves as a base for lectures in the next one. This creates a problem if the students for any given reason e.g., inadequate teacher, have not been given proper lectures. This accumulation of ignorance can lead up to serious problems later on in their respective academic careers and life. Constant supervision of the quality of lectures e.g., questionnaires at the end of the school year, should be taking place in order to insure there are no long-term effects of poor-quality lectures.

What is the meaning of it all?

Since mathematics is more than often abstract, and is taught in such a way, student lack to see he importance of fully understanding certain lectures. They don't see the connection of it all and thereby don't enter open-mindedly into the mathematical problem at hand. Clearer goals of certain lectures have to be stated at the beginning of each one so that the students find the relevance and thereby more openly approach the learning process.

What about the classroom dynamics?

Teachers have to be constantly up to part when concerning the quality and content of their lectures: they have to be trained properly to deliver knowledge to a larger quantity of students in the right way so it 'sticks' with them which requires a continuous creative approach. At the same time the classroom size, or the conventional classroom division could be up for discussion: the number of students disables a dynamic way of conducting classes, where smaller groups are needed in order to let every student get a chance to tackle a mathematical problem at hand and try to solve it.

Since humans are the ones with the potential to modify their behaviour.

Ecology

Ecology is the study of people and organisms, how they relate to each other together with their relation to the environment. Since the interconnection between all living things is undeniable, a certain degree of caution and self-awareness has to be taken into consideration when regarding impact of each.

This is why it is as important to be aware of the challenges pressing the studies of ecology in the current curricular system.

The challenges include:

How to implement it in standard school education?

Even though ecology is in part covered in the lessons of biology, it hasn't got its own place in the school curricula. Students aren't aware to the full extend what is their correlation on a much deeper level to their environment and aren't learning about it sufficiently enough through their existing courses. Ecology should be represented to a greater extend in one of two ways: taking parts of existing biology lessons which could be transferred to additional knowledge or creating an individual subject which would stress the importance of ecological phenomena and research through a different kind of class lectures.

What does the E.U. say about it?

The interconnection between life on this planet and the impact it has on its respective environment is shown through the European Union's Green Deal initiative: an initiative which calls for a change. Since humans are the ones with the potential to modify their behaviour in order to make that positive change it is imperative to make the students aware of what their contribution to the greater scheme of things could be.

Are we learning about recycling potential?

Even though recycling bins have been put up in schools throughout international school systems there is still uncertainty and ignorance present in young individuals as to what recycling (or upcycling) actually means and what is their role in that system. Further workshops together with additional integration of set notions in the curricula should be added.

Are there enough practical lessons (or means for them)?

Practical lessons have proven fruitful when concerning lectures which can be displayed in a physical form rather than taught through books and notes. Students learn better when given the chance of hands-on experimenting or while visiting institutions which could provide a different view to lessons taught in classrooms. However, practical lessons entice a certain degree of additional financial resources which are more than often difficult to obtain for many schools.

This is why external partners to the schools should be prompted to take part in enriching existing curricula.

IT CHALLENGES

In this day and age it is crucial to understand and effectively use at least the basics of information technology: especially when an unexpected situation such as a global pandemic arises. This has proven that without the adequate knowledge on how to transmit information using the internet, it is impossible to thrive in any situation given and even the littlest of problems can seems significant.

The It is therefore advisable to pin point the shortages which are present in this area in the educational system so that they can be dealth with on various levels: individual, school wise or even city or country wise so that actions can be taken and the students are the ones which can benefit the most.

What is IT?

Information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data.[1] This means that young individuals have the opportunity of reaching much greater scope of data and knowledge but have to learn how to effectively and safely use those to their advantage.

1 "TechTarget," 2000-2021. [Online]. Available: https://searchdatacenter.techtarget.com/definition/IT.

The current IT challenges include the following:
Adequate staffing knowledge: a considerable factor in educational staffing IT capabilities comes from their respective schools financial backgrounds or lack thereof.

Many schools requier their teacher to be up to date in their IT knowledge so that their students can always be informed and ready to tackle internet based novelties such as new computer programmes, ways of communicating and sharing ideas, reading and filtrating relevant information they find or other.The problem stems when there is a disbalance in the requirements set upon the teachers by the ever changing IT sector and the budget the schools have for that education. The teachers more than often requiere workshops with relevant parties and have to take upon themselves to learn how to efficiently use those novelties in order to be able to teach them back in their classrooms. This often leads to unsatisfied staff as they aren't sufficiently paid for these activities upon which much depends on. This is why it is important to try and figure out a way of making the IT program sustainable in the way that it can survive and develop with a limited budget the schools could provide: the staff is educated enough through specialized workshops and isn't feeling overwhelmed by the requirements set upon them as they are adequately paid and recognized.

Cost of up-to-part technology: similar to the staffing problem, the cost of up to part technology oftentimes presents a significant hurdle which many schools cannot seem to pass. The equipment the staff and students should use and learn on is outdated and serves just as a mean to master the basics which are not sufficient if higher future life standards in terms of job oportunities are to be met. One of the possible solution for this stumbling block could be interstructural cooperation between local IT based organizations and schools; both of which can benefit greately. The IT organizations could become project partners of the school, enticing knowledge and equipment interchange while the school could help leveling up the IT organizations business by introducing it to now a much greater audience including those of local decent such as students and

their parents, friends and family or even international partners.

Students' online safety: using IT means students have the opportunity to reach a much wider set of data which can help them develop their careers through their extensive knowledge. However, much in this life has two sides, enticing both the negative and the positive, and the IT sector is no different. Students wellbeing has to be monitored while they emerge in the novelties set upon them to ensure they are using them to their benefit and are protected against external negative stimuli which are now present to a much greater extend.

Proper usage of knowledge and resources: as mentioned before, IT represents a window into a much broader pool of knowledge which oftentimes has the necessity to be verified. Students need to learn how to use data found effectively and to a proper utilization in order to make the right connection between learning new data and encoding it into their future life usage. This challenge is similar to the one connceted to the students general safety: there is a requirement to check and verify IT novelties which could be done by the staff which teaches the students in the first place on how to use those.

Furthermore, what could be interesting to point out is the fact that the IT sector is continuously evolving. There are breakthroughs from one decade to the other which also meant behavioural and knowledge based changes stemming from respective users. One of the computer scientist of todays' age who has made significant changes through their working lifetime in the IT sector with a few books as a result, is Judea Pearl and his book 'The Book of Why'. This is an interesting read to say the least: the author explains what the computers of today are lacking and what will be the next steps when it comes to new IT breakthroughs all the while comparing them to a human being thought process. This is why it is advisable to any young individual to take upon themselves to read through the pages and try and figure out their own take on it! One of the students of the Faculty of Mechanical Engineering and Naval Architecture in Zagreb, has done exactly that and their thoughts could be found on the next few pages.

Interstructural cooperation between local IT based organizations and schools.

"THE BOOK OF WHY" BY JUDEA PEARL

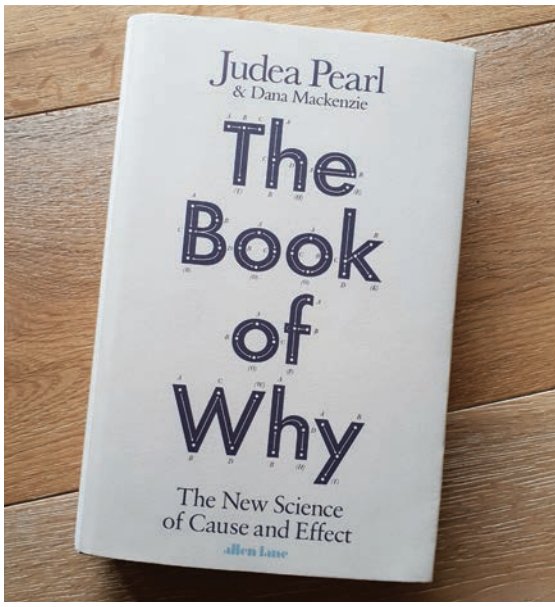
What I find really interesting is the fact that every question we ever wanted answered, every mind-boggling problem we have come across or phenomena we took interest in can be explained by employing the clusters of data which are around us.

It is the fact that we either see and, probably more importantly, understand those cluster and make appropriate connections between them, which will enable us becoming causal scientist of our time. I know this might sound a bit far-fetched, but the idea I would like to portray is that only after knowing how to yield knowledge will we be able to perform leaps in scientific, AI and other forms of research and this is something I believe Judea Pearl wanted to communicate through his book, 'The Book of Why'[1].

The book has presented me with several notions which I considered most stimulating: orientated and the causational ladder and how each ladder could be connected to a specific part of our reality. After reading the book I've come to the conclusion that finding, and even more, proving causational relationships has been the pivoting point of many scientific debates e.g., does the usage of a specific drug cause changes in a person's state of health or is it that other factors, like genetics, receiving good news, basking the sunshine etc., play the leading role. Furthermore, another problem lays in the fact of proving the hypothesis with unambiguous results especially in cases where ethic structures have to be taken into consideration. Safe to say, these problematics lead us into being prone to make correlational relationships much more easily and more often as there is no need for substantial proof, it is just the matter of 'what you see is what you get'. However, I believe that causational and correlational relationships shouldn't be taken lightly: as I've stated before we are surrounded by clusters of data for which we are trying to find the connections and while it is fun to make assumptions whether there is indeed a correlation between the rising of global average temperature and number of pirates in the sea's or the number of freshly imported lemons from Mexico to the USA with the total USA highway

1 J. Pearl, "The Book of Why," May,2018

How can it be that machine learning is so popular in many areas?



fatality rate (see BuzzFeed News) there are situations where differentiating between correlational and causational effects play a crucial role. One of the examples is the domain of health research and employing new ways of curing currently known diseases e.g., if you were to state that the acidity and not the vitamin C content of fruits is the cause for successful scurvy (vitamin C deficiency) treatment, then similar correlations might follow such to say that soft drinks which are acidic have the same potential in curing this disease and should be drunk in high amounts. Hence, the importance in distinguishing which factors

actually contribute to a certain effect (causation) and which factors simply change one with regards to the other (correlation) has to be taken into consideration more determinately. The other notion which I've found interesting is the concept of the ladder of causation where one of each rung of the ladder determines how the observer of the data understands them and acknowledges the underlying reasoning. There are three rungs of the ladder depicting corresponding activities: 1st seeing, 2nd doing and 3rd imagining. Current human beings sit well on the 3rd one by employing their ability to imagine different realities as opposed to the ones happening, employing backward reasoning or in other words counterfactuals. I believe that it is here where the tough philosophical questions reside e.g., how would today's society look like had historical events played out differently? The 2nd rung depicts the operation of doing in the sense of actively trying to find a novel result while performing a change on a variable seemingly connected to it. I've noticed this is something many students do across various tasks e.g., have you ever encountered a problem while doing your physics homework where the task asks of you to re-perform a calculation only to check what would happen if you double the mass of an object in friction force calculation? The 1st ladder depicts the notion of passive observation with the potential to correspondingly change the understanding of underlying connection between the data. This rung is the one where today's AI system reside on which renders them lacking in the creativity of formation of causational effects. However, despite this flaw they still play a significant role in todays' society proving indispensable across various domains of human action.

A question is imposed: how can it be that machine learning is so popular in many areas even if the techniques most used don't check for causality at all? Todays' machine learning tends to rely on data: the more data you feed the machine the higher the effectiveness of its computational methods in the sense of obtaining a correlational relationship rather than a causation one. This renders them incapable of producing decision making results: machines cannot provide an answer when the situation moves away from the extensive, initial data input. However, despite these shortcomings machine learning has proved itself being useful in occasions where input-output data

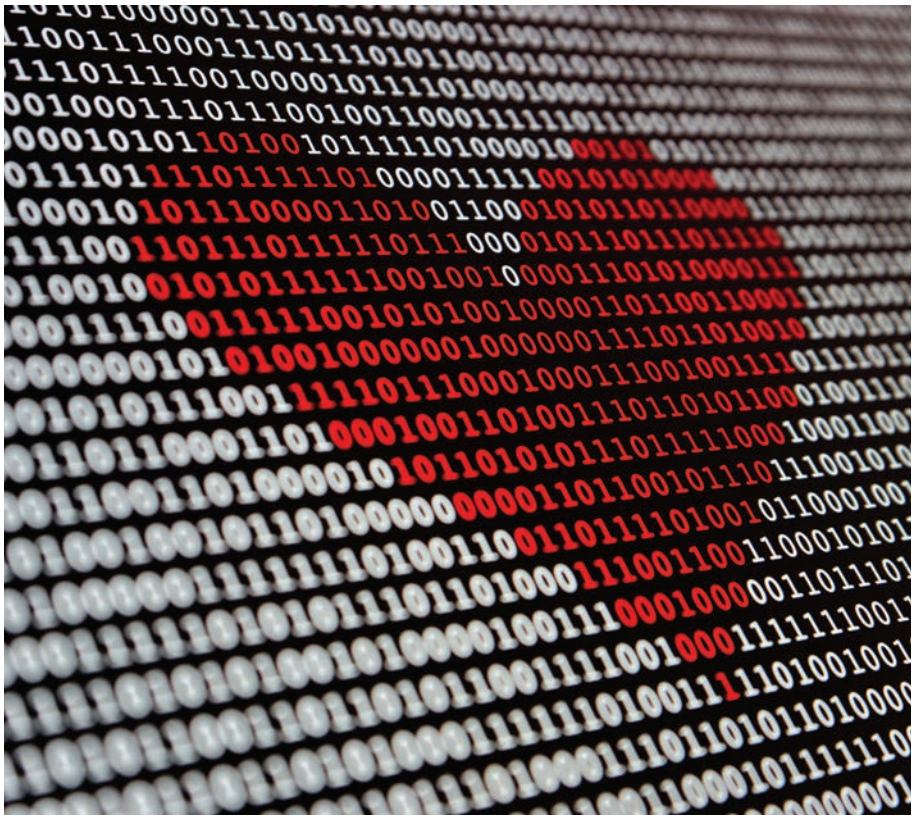
correlation is necessary and sufficient for further conclusions. Take for example, calculations of determining heating losses of a building and therefore heating needs of residents of that building. The calculations start by putting, amongst other, the lowest outside temperature which is standard for that area in a program called Integra CAD. The final result will tell you what kind of heating losses a building has during winter (or heating gains during summer with vice versa initial temperature input) and to get that result you didn't have to make one causational relationship! You didn't have to argue why the outside temperature is of that specific value or what caused it, to get the necessary result of heating losses during winter which plays a significant role in todays' heating comforts of residents in buildings. Same

patterns of data correlation sufficiency can be seen across other domains e.g., in object (face) recognition where the machine has to simply correlate attributes of a picture to given initial data, in predicting stock prices where previous trends play a significant role or in marketing when it is important to map market growth predictions where correlation between product attributes and customer needs are enough. I believe that, to an extent, we should pose the leading question of this paragraph differently: how come that even though such breakthroughs in machine learning have been achieved it still doesn't seem to hold a candle to a future where machine learning manages to master the causality domain? It isn't to say that a future with fully comprehensible machines isn't the one we should strive for however, should it be as advocated as the author has set upon? I believe that there is a flip side to the situation and should be regarded with caution: if we do manage to produce fully functional machine learning in terms of causality who is to say that the underlying result we obtain is the one we can trust?

After reading "The Book of Why" I have started to reflect about the correlational and causational relationships which shape my everyday life: what and how did I do up to this point and how each of my actions played a certain role in defining my current stated of art. I would like to note that I believe that the author had the intention to make us more aware that we are beings which in many terms lack the ability to formulate causational relationships and which are, to great extent, the ones which will evidently lead the machine learning revolution of tomorrow. Nevertheless, everything started with a simple 'why' so let's keep on asking ourselves exactly that question in formulating our future (both with and without regards to AI)!

We are beings without the ability to formulate causational relationships.

OPEN DATA CHALLENGES



What is Open Data? Open Data is a philosophy and practice that seeks to make certain data freely available to everyone, without copyright restrictions, patents or other control mechanisms. Data should be published raw, well structured, and in familiar formats that facilitate reuse.

The public sector produces a wide variety of interesting information for citizens and companies, such as social, economic, geographical, statistical, meteorological or tourist information and information on companies and education. This information has characteristics that make it particularly attractive for the digital content sector, as it is complete, reliable and of high quality.

Many organisations will make their data available (publish it) via their own website or through a portal. The opening of public sector data allows any person or organization to build on them a new idea that results in new data, knowledge, improve processes, add value to existing ones or even create new services.

Open Data Challenge provides an opportunity for creating innovative solutions to use, create, and/or collect data in a way to improve existing problems. As Open Data availability increases globally so the opportunity to build practical, accurate,

Tool to create a practical solution that will allow better utilization.

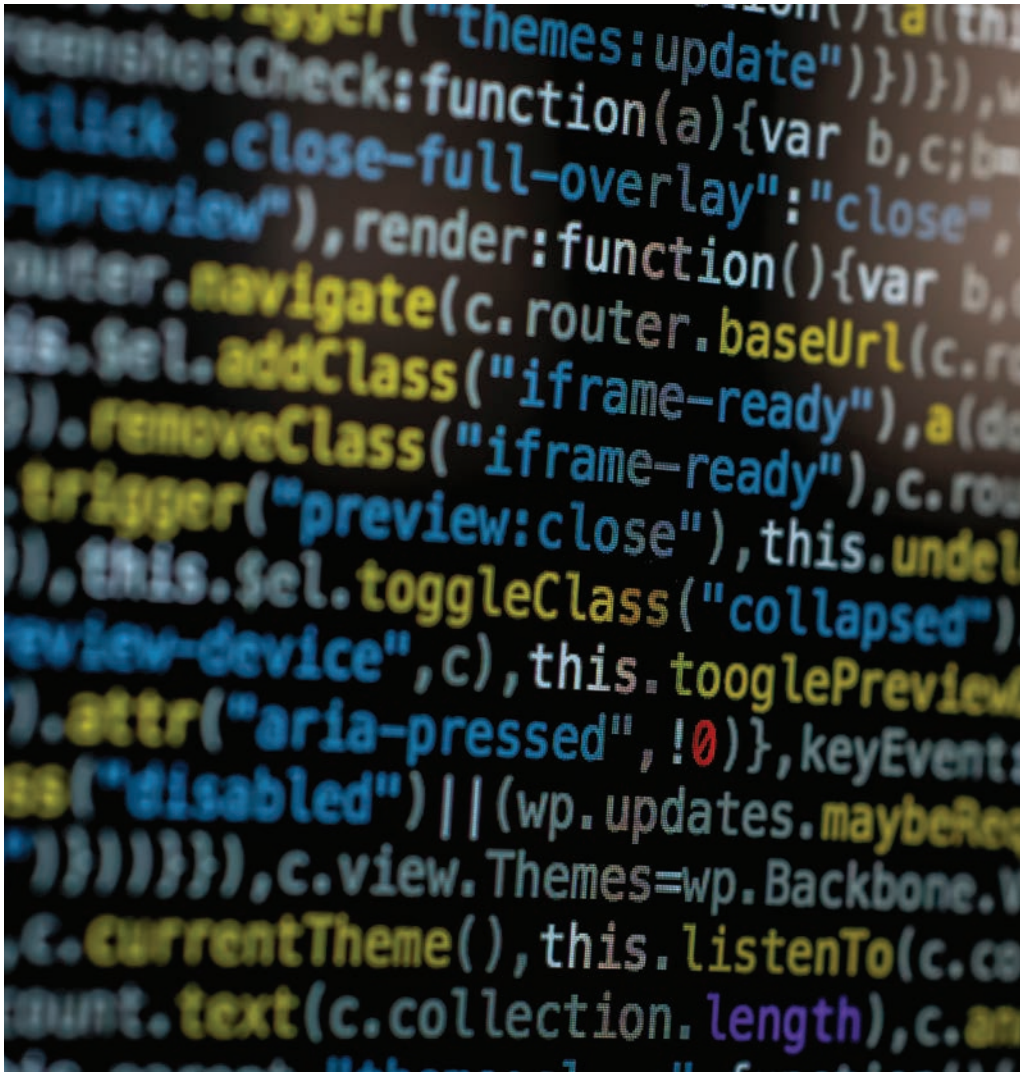
and data driven solutions also grows.

What are benefits of using Open Data Challenges?

Open Data Challenges is a tool to create a practical solution that will allow better utilization, collection, and/or make more accessible data to ultimately improve existing problems. Also, by using Open Data we can improve community's actions and knowledge to create a better solution and its support.

For Vet teachers and students, it represents a resource to achieve open teachings and education-related data programs. It has potential to improve educational processes and engagement with communities working in the area under study, and with others who have yet to see the potential of Open Data for educational purposes.

Its aim is to encourage development of innovative solutions for presented



problem challenges. Achieving this can be especially valuable to a VET teacher who is approaching a new field or subject for the first time and needs to find material for a curriculum or lesson.

Teachers, organizations and generally people who use Open Data information can achieve specific outcomes:

- increase collaboration and efficiency
- improve decision making
- reduce duplication of work
- increase openness and build trust
- drive new ideas and innovation
- increase value of research data
- raise awareness of problems and possible solutions.

LEARNING OF CONTENT BASED ON HANDS-ON EXPERIENCES

As definition, can be used the one from the Association for Experiential Education (https://www.aee.org/): "Experiential education is a philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities."

Experience	Curriculum integration	Students outcomes	Reflection
+ Direct, hands-on involvement + Meaningful and substantial + Linked to curriculum	+ Learning outcomes (competencies) + Assessment + Reconnect experience to program	+ Skills, knowledge and attributes + Capacity to contribute	+ Ongoing and meaningful

Key aspects of hands-on learning

Hands-on experience at school

Examples of Hands-On Learning Hands-on (also called experiential learning) can be activities like making an analog clock from a paper plate, brass fastener, and two strips of paper in the shape of arrows.

Students make the clock face, then learn how to tell time. Or students can use money to count change and learn addition and subtraction. Students can use art to facilitate their learning, such as drawing a map, writing a skit to describe a historical event, or writing a short biographical poem about an historical figure. And of course, the iconic volcano from papier-mâché with erupting lava of vinegar and soda is applicable for learning geology, 3-D art, and a little chemistry.

Looking at the results

Students learn better when they can relate to a subject, when it is personally meaningful. Learning happens when the brain is engaged in making connections and creating familiar patterns. Hands-on learning engages students of all ages in multiple modes of learning: kinesthetic, problem solving, and trial and error. These all build patterns in students' thinking about how persons, places, or events relate to each other.

This type of learning changes the role of the teacher from information dispenser to co-explorer of

knowledge. Evaluation of student learning is richer because students get to show what they've learned. Learning by doing provides better results over time as students move through school and on to their careers.

Develops skills and a lifelong love of learning

When students learn in this way, they gain valuable skills—critical thinking, communication, collaboration, and creativity—what we sometimes call the 4 C's of 21st century education. But in reality, these skills have proven essential for all generations. Because when students learn from doing something and are motivated to explore and discover new things, they more readily develop a lifelong love of learning.

Top benefits of a Hands-on Learning approach in vocational and technical education – Future impact in the workplace

Hands-on training is the acquisition of knowledge, skills and competencies needed in the workplace. There are a number of definite benefits that can be realized in learning in a hands-on.

More program material is retained

Student experience a huge increase in the amount of information that they retain when given the opportunity to practice what they are learning in the form of

hands-on training. Studies have shown that when students sit and listen intently but passively in a lecture-style environment, they retain 20 percent of the presented information. When they are given the opportunity to practice what they have just learned, that percentage increases to 75 percent.

Simulated learning is an engaging environment

When students are given the ability to learn in a practical hands-on environment, they are very often engaged, stimulated and want to learn as much as possible. The student's appetite for learning increases and they are more willing to listen and pay attention if they have a more practical or life like task to complete. Students also become more empowered in their own learning situation.

A hands-on learning environment develops critical thinking skills

A student's critical thinking skills increase in a hands-on learning environment. This occurs since students must make decisions on what to do next to receive the outcome they are striving to obtain. They no longer have to rely on memory and attention as they sit in a lecture environment. These critical thinking skills remain with a student as opposed to material that is simply memorized for a test and much of the material often forgotten after the exam. Critical thinking skills are very important to the workplace as every situation that an employee encounters cannot be learned from a book.

Real-world experience and knowledge from an instructor can go a long way

Students who learn in a hands-on environment can also have an instructor nearby who have real-world experience and knowledge and can help and give guidance to them if they have difficulty with a task that they are trying to complete. This expert advice can help them perform the task correctly and safely which is very critical in the workplace.

Use of materials and equipment used on the job

One of the benefits of a hands-on learning environment is that students will get a feel for materials and equipment that is commonly used in the workplace. This is particularly good if the student is working with equipment and tools.

Stimulant and learn as much as possible.

Types of hands-on learning and related activities in University: a glossary from University of Victoria, Canada

Clinic – Provides practice-based work experience under the supervision of an experienced registered or licensed professional. Unlike practica, which require practice-based work for discipline-specific professional licensure or certification, clinics provide practice-based work experience, but these work experience hours are not required for professional certification.

Community Service Learning – Integrates voluntary, unpaid community service that addresses community needs into a credit-bearing course with an explicit educational framework that includes student reflection on the volunteer experience. Reflection enhances understanding of civic engagement and builds connections between the experience and course content. Typically, the first four weeks of the course are spent in the classroom learning relevant theory. The following seven weeks are spent doing 30-40 hours of volunteer service. The final two weeks are again spent in the classroom and include reflection and relation of the experience back to theory.

Consulting project – Involves student interactions working with a client or organization in order to identify and analyze issues or opportunities within the organization and develop a solution or strategy for moving forward.

Co-op – Consists of alternating academic terms and paid work terms, where work terms provide experience in a workplace setting related to the student's field of study. The number of required work terms varies by program; however, the time spent in work terms must be at least 30% of the time spent in academic study.

Course-based – Incorporates intensive hands-on learning into the academic classroom setting. This hands-on learning can occur in various ways, including engagement with primary source documents and artifacts, participation in simulations or community-based interactions with members of the external community who come into the classroom as guest speakers or presenters. While other types of experiential education may also utilize in-class activities, coursebased

experiences include in-class activities not captured within the scope of these other categories.

Creative or physical practice – Enables skill development in a particular area through intensive practice-based experiences that rely heavily on student participation in and experimentation with course concepts. These courses develop various skills in areas of art, music, theatre, creative writing, dance and physical activities (such as soccer, swimming, softball, etc.).

Creative performance or exhibit – Involves an individual or team-produced dramatic, artistic, or musical performance, exhibit, or display that is presented to an audience consisting of members other than or in addition to the course instructor and classmates. Creative

performances, unlike creative projects, involve student interactions with members of the external community. This performance constitutes a central component of the course.

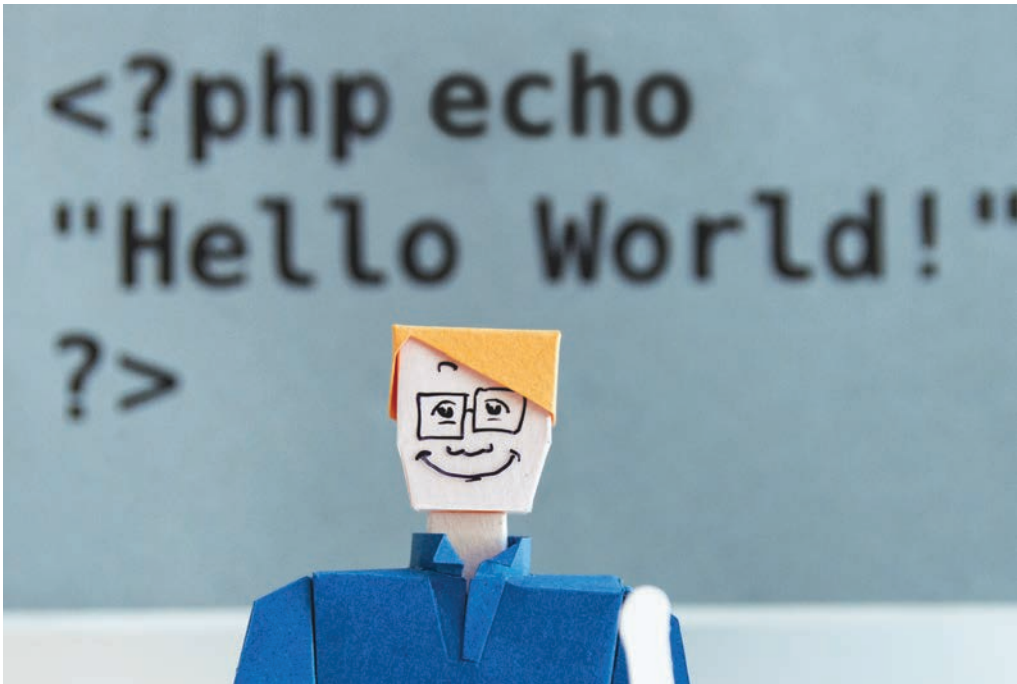
Creative or design project – Involves an individual or team-produced project as a central component of the course. Projects provide experience in the design process, from identifying needs or problems and determining solutions to prototyping and testing designs. These projects take many forms: artistic, dramatic, or musical projects, graphic design projects or engineering design projects, for example.

Field experience – Requires time spent on course-related experiences and assignments in settings other than the typical academic classroom (which includes the lecture hall, laboratory and seminar or workshop setting). Field experiences may be directed or mediated by the instructor and include a range of time-intensive endeavours that require varying levels of student interaction. For example, field experiences include short-term field trips, fieldwork and observational activities such as classroom observations or attending a performance. Field experiences may or may not involve student interaction with members of the external community. Note that as distinctive types of experience, field schools and field placements are classified separately from other field experiences.

Field placement – Provides students with an intensive work experience in a setting relevant to their field of study. Field placements need not require supervision of a registered or licensed professional and the completed work experience hours are not required for professional certification. Field placements account for work-integrated educational experiences not encompassed by other forms, such as co-op, clinic, practicum and internship.

Field school – Takes students out of the typical academic classroom (which includes the lecture hall, laboratory and seminar or workshop setting) and into the field for hands-on study or application of course concepts in a context relevant environment. Field schools offer an intensive, immersive experience and are often at least three weeks in duration.

Internship – Offers a discipline-specific, supervised, structured, full-time work experience or practice placement of substantial duration. Internships may



occur in the middle of an academic program or after all academic coursework has been completed but prior to graduation. Internships can be of any length, but are typically four, eight, or twelve months long.

Lab – Provides hands-on application of course concepts in a controlled environment, including activities such as observing, measuring, testing and experimenting. Labs are often scientific or technological in nature; however, other types of labs also exist, such as language labs in the humanities. A lab is a distinct course component, separate from a lecture, seminar or workshop.

Practicum – Involves work experience under the supervision of an experienced registered or licensed professional in any discipline that requires practice-based work experience for professional licensure or certification. Practica are generally unpaid, and, as the work is done in a supervised setting, students do not have their own workload/caseload.

Professional or technical skill development – Offers intensive, hands-on experience in the development of professional or technical skills, providing discipline-specific preparation for academic or professional careers. This includes, for example, career education and preparation courses, courses that prepare academics to teach in a university setting or discipline-specific writing courses (other than creative writing courses) in areas like legal, scientific or technical writing.

Publication or conference presentation – Includes presenting an original paper in a formal academic conference or colloquium setting, publishing an original work and/or contributing to a publication in an editorial capacity.

Research project – Involves, as a major course component, a process of substantial discovery, synthesis and/or application of information to solving a particular problem in an original way. The research process can be undertaken independently or in teams. The application of research may be community-based. Although consulting, creative or design projects may involve research, these are seen as distinctive types of experiential education and are classified separately.

Study abroad or exchange – Entails participation in at least one term of coursework at an international institution. While "exchange" indicates that both the international institution and UVic send and receive students to and from each other, "study abroad" does not indicate a reciprocal agreement, and UVic acts as a sending institution only (not also as a receiving institution).

Work experience – Intersperses one or two paid work terms into an academic program, where work terms provide experience in a workplace setting related to the student's field of study. Work experience is a modified, smaller-scale version of co-op.

METHODOLOGY FOR TEACHING ESTEAME IN VET SCHOOLS USING HACKATHONS

"As a melting pot of creativity, ideas, and skills, hackathons have helped in building some of the coolest apps of our times. Hackathons offer the opportunity to meet like-minded people, mentors, and potential investors. This makes it easy for participants to test and validate their product. The hackathon environment has led challenges to the invention of many successful business ideas. Hackathons have helped solve pressing issues and business worldwide."

https:// dzone.com/articles/6-hackathonideas-that-turned-into-milliondollar

Nowadays, technology is changing our society at a dizzying pace. Because of this, labor demands are constantly evolving and the need to find workers with a diverse technological skill set is ever growing. What we are currently experiencing is a skills revolution.

The learning processes used to educate the young minds of today must adapt in order to promote a series of skills and knowledge that encourages students to learn to innovate, use their imaginations and solve problems.

The main objective of the innovative ESTEAME learning system is to strengthen students' personal and social abilities in order to familiarize students with the new demands of the labor field and create better opportunities with their futures in mind. It aims to guarantee the development of transversal knowledge, in which the contents of each of these branches is not taught or learned in isolation, but rather is imparted in an interdisciplinary way that ensures contextualized and meaningful learning.

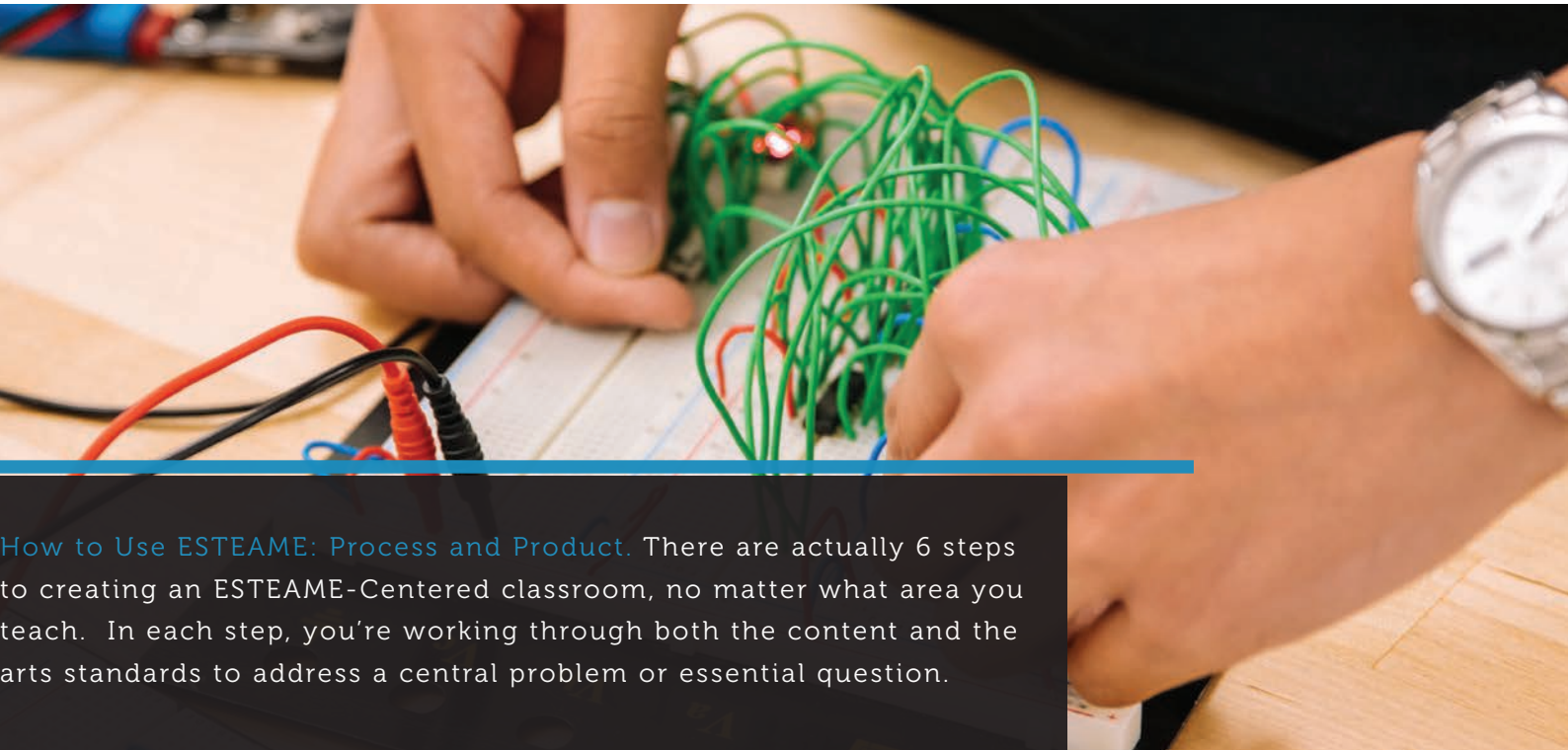
ESTEAME learning helps students observe, investigate, innovate, develop curiosity and their imaginations, ask questions, ponder how things work and solve the problems that they face on a daily basis.

The main characteristic of this learning system is practical training, during which students learn and work in a real way through experimentation. Teachers provide students with the necessary tools they need in order to obtain autonomy and use their own knowledge in a profitable and enriching way.

To carry out this methodology, digital competence, teamwork and decision-making processes need to be integrated into each subject's curriculum. In addition, an important concept within the ESTEAME model is to combine learning concepts with game-like practices.

Unlike STEAM, ESTEAME includes the components of environment and (gender) equality. These aspects are of vital importance nowadays and students should be exposed to them as early as possible in their education.

STEM
STEAM
ESTEAME



How to Use ESTEAME: Process and Product. There are actually 6 steps to creating an ESTEAME-Centered classroom, no matter what area you teach. In each step, you're working through both the content and the arts standards to address a central problem or essential question.

What's great about this process is that you can as easily use it to help plan for a lesson as you can to facilitate the actual learning process in your ESTEAME classroom. Let's take a look at each step.

1. FOCUS

In this step, we're selecting 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 STEAM and the environmental and equality content areas you've chosen.

2. DETAIL

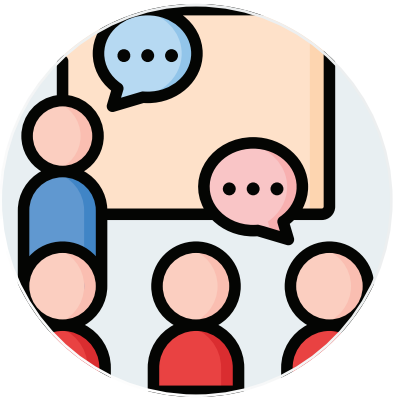
During the detail phase, you're looking for the elements that are contributing to the problem or question. When you're observing the correlations to other areas or why the problem exists, you begin to unearth a lot of key background information, skills or processes that students already have to address 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 both analyze the gaps your students may have in a skill or process and to teach those skills or processes explicitly.

4. APPLICATION

This is where the fun happens! After students have dived deep into a problem or question and have analyzed current solutions as well as what still needs addressed, they can begin to create their own solution or composition to the problem. This is where they use the skills, processes and knowledge that were 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 how to give and receive input.

6. LINK

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

Hackathons are an ideal solution to teaching ESTEAME subjects in VET classes because they are fast-paced events where competitors work in teams to go from an idea to working products within a single day or a weekend and demonstrate their creation to a live audience of peers. Due to the "fun" and informal nature of such events, they make for excellent informal learning platforms that attract a diverse spectrum of students, especially those typically uninterested in traditional classroom settings. Despite the competitive nature of such events, a significant amount of peer-learning – students teaching can be observed. The students involved can learn new skills easily because there is little pressure from the teacher and the maximum amount of freedom to collaborate with the other students. Due to the gamified format of the events, students were heavily motivated to learn new skills due to practical applicability and peer effects, rather than merely academic metrics. The hackathons can be continued as long-term projects.

Hackathons can be considered long and extended group work activities where students are given a lot of liberty to choose their ways of working while the coordinating teacher or teachers monitor and act as a resource.

Hackathon Structure. The basic hackathon structure can be adapted for use in both meetups and un-conferences. A well-run hackathon involves a series of easily replicated steps, yet each one is a unique experience based on the contributions of participants. The essential elements include:

- A PURPOSE
- PRE-EVENT PREPARATIONS
- PROJECT PITCH PHASE
- MIXING AND RECRUITING PHASE
- PROJECT DEVELOPMENT PHASE
- PROJECT PRESENTATIONS
- JUDGING, RECOGNITION EVENT, AND CLOSING STATEMENTS

Steps in organizing a hackathon. Step 1: Organize and plan the hackathon - Decide on team sizes that will ensure success.Decide which students will be on each team. Be sure students have the necessary skills they need for doing the required tasks.

Step 2: Introduce a teamwork rationale for the hackathon (Why are we working in teams?)

Help students consider the value in working together.

Step 3: Establish a purpose for the hackathon (What is our purpose?)

Clarify the function of the student teams.
Define the goal and outcomes for teamwork.
Verify that students understand the lesson's purpose and ask them to explain to you what their team is expected to accomplish.

Step 4: Establish teamwork procedures (How will we do the work?)

Guide teams in setting norms.
Giving students experience with interaction skills through multiple teaming experiences will build more successful teamwork during the ESTEAME lesson activities.
Use self-assessments to help students improve teamwork skills.

Step 5: Monitor teamwork

Regularly monitor teams and provide productive feedback.

Step 6: Check teamwork progress

Regularly collect student feedback on how effectively groups are working.
Leave enough time at the end of the activity to debrief.

Roles of the teacher.

Of the many innovations that surround hackathons and how people use them, the role of "the teacher" does not exist in the same way as in the traditional classroom.

It is clear that hackathons provide teachers with a powerful platform with which to observe their students in action. Unlike traditional assignments, a hackathon is all about students bringing their ideas, their questions, and their curiosity, energy, and hard work together with others in order to produce something together within an artificially compressed time period. This does not mean that teachers or organizers sit idly by. The reality is quite the contrary. Organizers and teachers are often in motion monitoring, responding to emergencies, and offering guidance when asked. And, more often than not, they are actively observing. Like an athletic coach, they are in position to calibrate students and teams in response to the evidence they are provided during the hackathon. They deal with personal issues as they come up, which may very well surface again later in the school term. When approached for assistance, they can identify the competence of the student teams at a fundamental level.
The hackathon structure provides a strong scaffold with which to push responsibility for performance out to the participants. As an informed observer during this process, the teacher might very well benefit the most of any participant. Further examinations should be encouraged to bring forward how teacher observations can translate in terms of classroom activities and result in a more engaged and proficient learning experience.

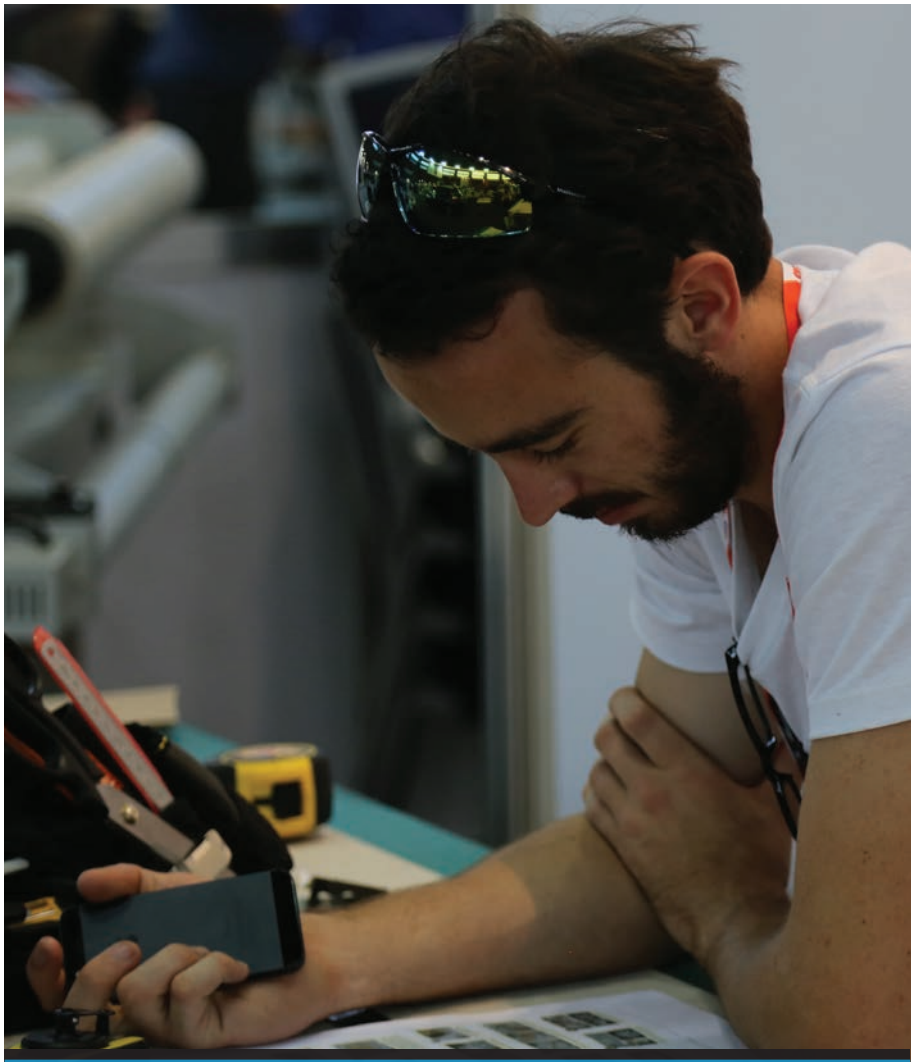
Importance of hackathons for teachers

Hackathons are seen as a venue where teachers can observe their students in action, allowing them to understand their interests and capacity and what is meaningful to them. As a result, course design could be influenced by these observations that can bring topics worthy of inclusion in the course syllabus.

Importance of hackathons for students

Students enjoy the hackathon experience in which they considered themselves to be immersed. They also feel very engaged and excited throughout the hackathon. Learning is one of the most important aspects, hackathons being an opportunity to put into practice what they learn in the class-room but with a more realistic application. The aspect of learning by doing is very evident since students tended to agree that they learn more in the hackathon and practical classes than in theoretical ones.
The social interactions made possible by the hackathon allow the exchange of knowledge as well as establishing or reinforcing personal bonds with peers. Besides being important for team work, collocation was also important for knowledge exchanges that happened among students in the same space.

USING HACKATHONS



Hackathons expose students to new directions of study and opportunity. In addition, the skills practiced during hackathons can be mastered through repeated experience.

Finding projects or experiments worthy of team formation, developing an understanding of what makes teams work well, identifying the skillsets of team members, focusing and re-framing projects to meet a deadline, and developing persuasive project presentations are skills worthy not only of a classroom but will also be useful throughout students' post-academic careers. By using hackathons in their teaching, the teachers can identify competencies as well as early warning signs, so that appropriate actions can draw out students for the full class term. The potential for students and teachers alike to come into some alignment at the beginning of a class might prove to be the biggest immediate benefit. Once this kind of alignment is achieved, more traditional classroom activities just might take on new meaning for students. Students who have discovered an interest or competency through a hackathon seem willing to "deep dive." It may well be that the artificial pressure of a hackathon causes participants to test their limits and challenges them to increase their capacity. If this is indeed the case, then everyone benefits.

FROM COMPETITION TO COOPERATION. EFFECTIVE ORGANIZATION OF LOCAL, REGIONAL, NATIONAL AND TRANSNATIONAL COOPERATION TO PROMOTE THE ESTEAME KNOWLEDGE

According to the dictionary, we can define the word cooperation: Act or effect of cooperating; Association between two species that, although expendable, brings advantages to both, collaboration. Regarding the word competition: Act or effect of competing; Simultaneous search for two or more individuals, for a victory, an advantage, a prize; Fight challenge, dispute or rivalry.

Cooperation, apparently, is associated with "us", while competition is associated with "me". Both "cooperation" and "competition" have a set of beliefs and rules that determine how they are presented and how they institute forms of life.

There are 5 collaborative forces

The concept of cooperation transfigures into relationships of mutual respect, having a posture of tolerance towards coexistence and differences, thus having a constant negotiation process. In order for cooperation to exist, there must be common goals, activities and joint and organized actions providing advantages for all, thus recognizing that the human being depends, in a certain way, on others to compete. Cooperation is not only a non-competitive situation, but also a situation where we have to be very clear that I will only be successful if the other is also successful and vice versa. Regarding competitiveness, there is a willingness to fight for satisfaction when making comparisons with some standard of superiority in the presence of evaluators. Basically, competitiveness is a performance-oriented behavior in a competitive context, with social evaluation as a key component.

A competitive person simply likes to compete and look for competitive situations. Victory orientation is the focus on interpersonal comparison and competition victory. It is more important to outdo other competitors than to improve your own standards. Goal orientation is the focus on personal performance standards. The goal is to improve your own performance, not to win the competition.

Help "idea launchers" grow

When a student joins a "challenger", it is possible to develop services and products together that benefit both sides.

Develop products to solve the problem

Think proactively! Assess the possibilities of updating and improving your products / knowledge. Don't think about what other students can do, make the necessary changes so that a new product is the most original, the most effective.

Involve "idea launchers" in our process to innovate

Create communication channels with the "idea launchers" so that they, at the very least, confirm whether the path they are going to take is right or wrong.

Team strength

Think collaboratively in order to obtain better product quality. Two heads are better than one.

Occurrence of other teams

Don't think of your competitor as a threat. Become his ally.

Coopetition is the strategy that combines the characteristics of cooperation and competition.

COOPERATION FOR INNOVATION AND COMPETITIVENESS

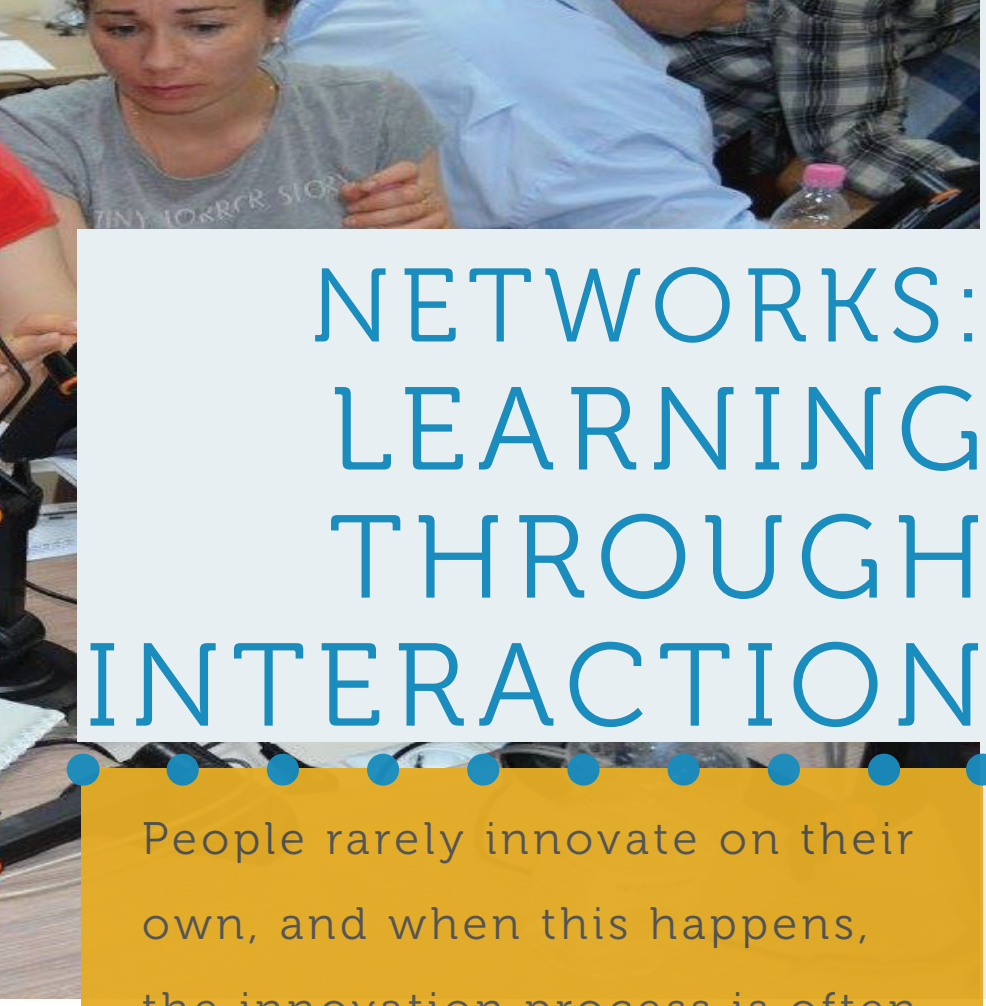
Innovation is a key factor for competitiveness. Innovation is understood as an interactive learning process, involving a variety of diverse skills and knowledge.

Innovation results from the creation of new knowledge or from the recombination of existing knowledge and solutions. These processes can result from individual actions.

However, they are strongly stimulated when they imply the crossing of worldviews of several individuals, resulting from group discussions and (multidisciplinary) initiatives.

It is generally accepted that the processes of knowledge creation and recombination and the resulting innovation become more efficient when actors / individuals, coming from completely different areas (for example, from different industrial sectors and functional groups), share their experiences and knowledge. Consequently, cooperation between actors from various organizations, with different views and different activities, is seen as an important factor in stimulating innovation in its various forms: product, process and organizational innovation.

This concept introduces a broader and more comprehensive view of innovation, understood as a technical and social process, but also as an interactive learning process between organizations and the environment in which they operate. As a result, a greater number of individuals and organizations that interact frequently are included in the process of creating innovation and also in the development of a variety of regions, industrial sectors and innovative companies. The systemic and interactive approach to innovation is well represented in inter-organizational cooperation networks.



NETWORKS: LEARNING THROUGH INTERACTION

People rarely innovate on their own, and when this happens, the innovation process is often considered ineffective and unsustainable.

More promising solutions are based on the development of interaction mechanisms

with other organizations, in order to acquire, create and share information, knowledge and other resources. Cooperation networks encourage the development of interactive innovation processes. Conditions are created to bring people and institutions together, to create and share knowledge and, consequently, to develop the learning processes inherent in the consolidation of the capacity for innovation. Participation in cooperation networks can stimulate and reinforce innovative attitudes, since the actors have access to a broader set of information and knowledge and face a greater circumstantial diversity. From a strategic point of view, cooperation must be understood as a permanent activity and, as such, be part of the operational and decision-making processes.

It is common to find innovative cooperation networks along the clusters between schools, since they share elements such as: labor, regional culture, institutions, regulations, etc., and this support medium or space is traditionally used to share the information and knowledge indispensable for innovation.It is considered that an efficient means should bring together:

a) internal coherence - that is, the existence of a multiplicity of activities and a strong interrelationship between them; the combination of competition and cooperation, based on trust and the widespread recognition that cooperation is positive in the long run; the existence of a local institutional base that supports institutions in their processes, providing relevant and appropriate information

and skills, etc.
b) the ability to establish external networks - that is, the existence of links between schools and other local, regional, national and transnational schools. It is generally accepted that the consolidation and development of an ESTEAM cluster is closely related to the creation of links with other schools / institutions and depends on behaviors based on imitation. Through this web, knowledge is quickly disseminated in the cluster. This process is strongly dependent on the efficiency of the support medium. When some schools in the cluster demonstrate innovative and original behaviors that lead to an increase in their competitiveness, it is logical to assume that this behavior will be transmitted and subsequently imitated by other schools in the same cluster. This imitation process can lead, in the long run, to the consolidation of the cluster and to a generalized increase in competitiveness and, consequently, to regional development. Multisectoral networks, between different types of schools / institutions that include different actors, are particularly effective in promoting regional development. These networks are more complex and do not usually arise spontaneously.

Bring new ideas to the classroom

Collaboration through participation in Hackathons is a great way to hear new ideas from other partner institutions to use in the classroom. It is also an opportunity for colleagues to start sharing and collaborating.

Collaborate abroad

One of the most interesting collaborations could be working with schools abroad. Even without the resources to travel.

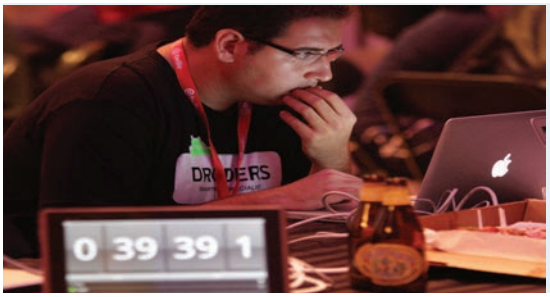
Collaborate locally

Working with local or even regional schools allows you to be aware of local / regional issues. Make sure that all schools / institutions understand the benefits of collaboration.

It is corporate social responsibility to raise the bar, not only within your own school / institution, but within the community you serve.

Competition can be healthy and can lead to higher standards across the region, which will benefit everyone.

When everyone is working together, collaboration can be a real success. It is often quite difficult to justify the impact in the short and long term, but in the short term it is quite evident.



Working with the local community

The local community can play a big role in collaboration. Schools need to look for opportunities to work with the local community and local businesses.

There is no perfect guideline to follow for successful collaboration, but by supporting each other, the benefits can be endless for schools to improve their learning and professional development experiences, and provide better progress for students.

7 steps to a successful Hackathon

1. Find partners with a common vision and goals

Looking for partners with the same vision and goals is essential. This does not mean that we are similar, we may even be adverse, but with the same mission.

2. Remember that leadership matters

Not authoritarian leadership, but shared leadership.

3. Be creative with money and donations

Consider asking companies to provide equipment and other non-monetary resources.

4. Get it in writing

It is important that all institutions and people involved agree on the learning objectives, expectations and time commitment for each type of partnership. What skills and knowledge students should obtain. What is expected from the results of the Hackathon.

5. Establish ongoing supervision and communication

Even a signed contract is no guarantee of success. Partners need to establish regular communication. Progress reports may be the solution.

6. Make a long-term commitment

You can bet that the directors of the institutions and the teachers will get involved in the partnership, but with a strong commitment from the whole community of the different partner institutions, it is possible to continue the collaboration.

7. Be patient - It doesn't happen overnight

Building effective and lasting partnerships takes time. So, instead of trying to go it alone, seek support from a respected community leader - a member of the school board, the municipality or an association - and ask for help to spread the idea / project to align with possible partners.

HACKATHON

Erasmus