Learn STEM

The Design of the Online Course Innovative Pedagogy for STEM Education

Learn STEM

Innovative STEM learning in schools

The Design of the Online Course Innovative Pedagogy for STEM Education

http://www.learn-STEM.org

Coordinator:
Open University of the Netherlands (OUNL)

Project Partners:
Agora, Roermond (Agora), Kaunas Science and Technology Park (KSTP), Kaunas Simonas Daukantas Progymnasium (KSDP), Association Effebi (Effebi), Technical University of Applied Sciences Wildau (TUASW), Madan Park (Madan), Group of Schools Emidio Navarro (GSEN), Eekhout Academy (Eekhout)

Project number: 2017-1-NL01-KA201-035232

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Please cite as:
< Stracke, C. M., van Dijk, G., Daneniene, J., Kelmelyte, V., Lisdat, F., Wesolowski, A., Barreiros, A., Baltazar, R., Simoens, W., Desutter, J., Lippens, J., Pascoal, A., Rimkevičė, A., Spatafora, M., Cotovanu, A. M., & Spatafora, A. (2020). *Learn STEM. The Design of the Online Course Innovative Pedagogy for STEM Education*.

With the support of the European Commission

Learn STEM

Learn STEM MOOC Week 3

http://www.Learn-STEM.org

Please cite as:
< Stracke, C. M., van Dijk, G., Daneniene, J., Kelmelyte, V., Lisdat, F., Wesolowski, A., Barreiros, A., Baltazar, R., Simoens, W., Desutter, J., Lippens, J., Pascoal, A., Rimkevičė, A., Spatafora, M., Cotovanu, A. M., & Spatafora, A. (2020). *The Learn STEM Online Course: Innovative Pedagogy for STEM Education. Week 3*.

Based on: <Stracke, C. M. (2018). *MOOC Design Template*. [Retrieved from www.mooc-quality.eu]>

Week 3 (from 16th April 2020 to 22nd April 2020)	**Teacher-centred STEM Education**
Responsible: OUNL - Contributors: Agora schools	
Learning objectives: • To reflect the phases for teachers in innovative STEM education • To get to know projects of teacher-centred STEM education • To explore innovative instruments and tools for teacher-centred STEM education	Learning activities: • To read the introductory text • To discover the content and videos • To fulfil the tasks and assignments • To join the live event • To complete the quiz • To check the references if interested in further reading
Topics of this week, the topic experts and their availability: • Phases for teachers in innovative STEM education • Projects of teacher-centred STEM education • Instruments and tools for teacher-centred STEM education • Innovative STEM Projects Scientix and Go-Lab	
Timeplan for this week: • TUESDAY (2020-04-21): Live event starting at 16:00 UTC = 18:00 CEST (in Brussels)	
Tasks and assignments for this week: • Analysing the four phases of teacher-centred STEM education • Discussing three projects of teacher-centred STEM education • Testing innovative instruments and tools for teacher-centred STEM education	

Subsection 1:

Introduction to week 3

Welcome to week 3 of our Learn STEM Online Course!

Week 3 is focusing **Teacher-centred STEM Education!**

Feel invited to watch the **introductory video** for week 3 on the following page.
If you cannot see it in your browser, here is the direct link for the introductory video: **https://bit.ly/LearnSTEM2020_Teachers**

Afterwards, you will find the overview of the **learning objectives and activities** of week 3.

And for each learning activity, we are proposing **learning tasks** that you can complete, also in collaboration with your colleagues and other online learners here.

And do not forget our first live online event on Tuesday, 21st of April 2020, starting at 16:00 UTC = 18:00 CEST (in Brussels):
Here is the link to the **live online event of week 3**: **http://bit.ly/LearnSTEM2020_Week3_Live** (it will open 30 minutes before the live event to allow testing of your connectivity, see all details in the section "Week 3 live online event")

Finally: Have you already completed all learning activities and tasks of the other weeks?
If not, there is still time to do it!

Subsection 2:

Video introducing week 3

Week 3 Teacher-centred STEM education: www.youtube.com/watch?v=j7KORZYOnyQ

Video integrated

Subsection 3:

Overview of Learning objectives and activities of week 3

Unit 1:

Learning objectives of week 3

Our **learning objectives** of week 3 are:

- To reflect the phases for teachers in innovative STEM education
- To get to know projects of teacher-centred STEM education
- To explore innovative instruments and tools for teacher-centred STEM education

These learning objectives are addressed by the learning activities of week 3 that are following on the next page.

Unit 2:

Learning activities of week 3

The week 3 consists of **three learning activities and tasks**:

1. Analysing the four phases for teachers in innovative STEM education
2. Discussing projects of teacher-centred STEM education
3. Testing innovative instruments and tools for teacher-centred STEM education

These learning activities are offered and described in details in the following sub-section together with specific learning tasks.

Subsection 4:

1. Analysing the four phases for teachers in innovative STEM education

Unit 1:

1. Analysing the four phases for teachers in innovative STEM education

In this week, we are focusing on innovative STEM education from the perspective of the teachers. Therefore, we start with an analysis of the four phases for teachers in STEM education.

As you know, the Pedagogical Model Learn STEM comprises three elements as objectives: knowledge, skills and competences. Learners gain STEM knowledge and build STEM skills. Through reflection and repeated training, they build STEM competences based on processes of assimilation and accommodation.

Thus, the learning processes should be interdisciplinary and holistic for innovative STEM education. What is more, it should be processes going through iterative cycles. As you remember, the four phases for the learners are: Discover, Explore, Apply, and Reflect.

Teachers have got a two-fold role: They are designers of STEM education as well as facilitators of STEM education that covers a huge range of potential pedagogical strategies and didactical methodologies. In this week, we concentrate on teacher-centred STEM education in which teachers play a central role in the preparation, realization and teaching.
In addition, the pedagogical model Learn STEM allows flexibility since the teacher can act more as a coach or as a tutor. Accordingly, the design and teaching processes should also not be linear but following iterative improvement cycles.

Analogue to the learners, the four phases for the teachers are:

1. Design
2. Experiment
3. Analyse
4. Rethink

In the first phase "Design" for the teachers, teachers are developing a specific lesson, project or task for innovative STEM education. During the development of the specific lesson, project or task, teachers should always keep in mind and follow the four phases for learners in innovative STEM education. That means: First, select a topic, define appropriate learning objectives and clarify how you as a teacher can raise the motivation of learners by preparing an environment that is attractive for learners to start with their own self-regulated learning on your selected topic. Second, you as a teacher have to enable the learners that they can find out what are the special characteristics of your selected topic of research are and how they can explain them. Third, you as a teacher should encourage your

learners to develop a generalisation of their explanations and adapt it to other fields and topics. Fourth, you as a teacher have to facilitate that your learners can critically think about their experiences and the fitness of their explanations and generalisations leading to a generic review and revision of all learning results in continuous improvement cycles.
In the second phase "Experiment" for the teachers, you as a teacher realize the innovative STEM education that you have developed in the first phase. That can be learner-centred as well teacher-centred STEM education depending on your design. You as a teacher test your own learning design like an experiment.
In the third phase "Analyse" for the teachers, you as a teacher investigate how your "experiment", i. e. your STEM education was: What were strengths and what were weaknesses?
Finally, in the fourth phase "Rethink" for the teachers, you as a teacher critically re-think your learning design and your experiences and the fitness of your explanations and generalisations. Your re-thinking should lead to a generic review and revision of all your learning designs in continuous improvement cycles.

Debate the importance of the four phases for the teachers with your colleagues or with other participants here in the course using the discussion forum: Which phase is more important for you? And do you agree with the need of iterative cycles?

Add discussion: Week 3 - Four phases for teachers

Subsection 5:

2. Discussing projects of teacher-centred STEM education

Unit 1:

Introducing the projects of teacher-centred STEM education

In this sub-section, we want to introduce you to two major projects of teacher-centred STEM education:
We hope that you can find interesting examples and identify practical ideas for your own teacher-centred STEM education.

We are very happy to present the two projects **Go-Labz** and **Scientix** thanks to our close collaboration with them!
Please have a look on the following pages and find out how they can support you and your innovative STEM education.

Unit 2:

Go-Lab for Inquiry-Based STEM Learning

*Go-Lab stands for **G**lobal **O**nline Science **Lab**s for Inquiry Learning in Schools. Originally started as an EU-funded project, Go-Lab has developed into a global initiative providing the world's largest platform for online laboratories, which is now used by thousands of teachers all over the world. The main goal of Go-Lab is to raise students' interest in scientific topics and careers, by giving them hands-on experience of doing science and helping them develop the necessary skills. In this course module, you will be introduced to the concept of Inquiry-Based Science Education (IBSE) and learn how to easily integrate this approach into your daily teaching with help of the Go-ab Ecosystem.*

1. INTRODUCTION: Inquiry-based learning and the Go-Lab Ecosystem

In this part of the course, you will get acquainted with inquiry-based learning, its main concepts, and pedagogical advantages of this approach. You will be introduced to the Go-Lab Ecosystem, a web-based platform for inquiry learning, it's main components and tools: online laboratories, inquiry learning applications, and Inquiry Learning Spaces (ILSs). You will discover the Go-Lab Sharing Platform (www.golabz.eu) and its tools and get ready to create an own Inquiry Learning Space in the next step. You can find further information to this part under "Additional readings and materials" at the end of the module.

a. **Reading:** Inquiry-based learning and inquiry learning cycle: https://support.golabz.eu/inquiry-based-learning
b. **Video:** Introducing the Go-Lab Ecosystem and its main components: https://youtu.be/hq8MJ73UAXg

c. **Video:** Finding an online lab for your classroom activity: https://youtu.be/XK4ArNX0phU
d. **Activity:** find an online lab suitable for your next class https://www.golabz.eu/labs. Use filters on the right of the page (at www.golabz.eu) to specify the topic, age of your students, and language. If you want to learn more about the filtering option "Big Ideas of Science", have a look at this page.
e. **Activity:** discover inquiry learning apps, which will assist your students in formulating research questions and hypotheses, designing experiments, documenting observations, and drawing conclusions https://www.golabz.eu/apps. Check the different app categories on the right of the page. Open dedicated app pages to check the app information and preview the apps.

2. DESIGN: Create an Inquiry Learning Space (ILS) for your next class

In this part, you will learn how to easily create an Inquiry Learning Space (ILS) and share it with your students. Here we introduce you to the easiest way of ILS-creation: find a ready-to-use ILS in Golabz, copy it, and adapt it for your class. There are alternative ways of ILS-creation, which you can learn about here; however, we recommend to start with the information presented in this MOOC module.

a. **Video**: How to find and copy a ready-to-use ILS: https://youtu.be/-nRrIs4xzjI
b. **Activity:** discover ready-to-use, customizable Inquiry Learning Spaces (ILSs) here: https://www.golabz.eu/spaces. Find an ILS most suitable for your next classroom activity and copy it to the authoring environment Graasp (as shown in the video). You will be asked to create a free account in Graasp by providing your name and e-mail address. Note: the ILS you find in Golabz doesn't have to be 100% suitable for your class; in the next step, you'll be able to adapt it by adding or removing tools and content; it is also possible to change settings of the apps.
c. **Video:** Adding content to an ILS on the example of a text-box; other tools and content items can be added in a similar way: https://youtu.be/pi4O4snrz-s
d. **Activity:** using the ILS you have copied in the previous Activity, design your own scenario by adding and/or removing learning tools and content (e.g. labs, apps, videos, texts, images, etc.). In case of a doubt, have a look at these short-videos explaining how to adapt your ILS. Here you will find some tips on how to design a good ILS. Don't try to create a perfect ILS or use all functions of the Go-Lab Ecosystem (it's quite extensive). This is your first ILS, so try just to cover a small topic for one classroom activity by filling in the inquiry phases with an online lab, a couple of apps and any content of your choice. There is no right or wrong! The ILS should just be simple and assist your students in understanding the topic.

3. EXPERIMENT: Share your ILS with your students

a. **Video:** How to share an ILS with your students: https://youtu.be/am-1jQdmmFU
b. **Activity:** Share your ILS with your students and let them learn with this ILS in the next class or at home. Assist your students during the learning process by

answering their questions and giving feedback. Observe what works well and where they face difficulties. Take notes during the classroom session (or during your remote interaction), so you can analyse your observations in the next step.

4. **ANALYSE: How did your (remote) classroom activity go?**
    a. **Activity:** using your notes from the (remote) classroom session, analyse the strengths and the weaknesses of your approach. What are the advantages of using an ILS compared to frontal instruction? What are the limitations?

5. **RETHINK: What can be improved for the next time?**
    a. **Activity:** Thinking about your ILS, which parts worked well in the class (or in the remote activity)? Which parts caused difficulties by the students? How can it be improved? Document lessons learned for your next ILS designs.

Unit 3:

Scientix - the community for science education

Scientix promotes and supports a Europe-wide collaboration among STEM (science, technology, engineering and maths) teachers, education researchers, policymakers and other STEM education professionals.
The main stakeholders of Scientix are teachers, researchers and project managers in STEM education, and policymakers. Each of these groups can benefit from Scientix activities and events.
In its first stage (2009-2012), the project built an online portal to collect and present European STEM education projects and their results, and organised several teacher workshops. The main networking event was the Scientix conference, held in May 2011 in Brussels.
The goal of the second phase of the Scientix project (2013 – 2015) was to expand this community to the national level. Through a network of National Contact Points (NCPs), Scientix reached out to national teacher communities, and contributed to the development of national strategies for wider uptake of inquiry-based and other innovative approaches to science and maths education.
This activity is continued in the third stage of Scientix (2016-2019), which is funded by the Horizon 2020 programme of the European Union for research and innovation. Scientix was originally born at the initiative of the European Commission and has, since its inception, been coordinated by European Schoolnet, a Brussels-based consortium of thirty ministries of education, which is a driving factor for innovation in teaching and learning and fosters pan-European collaboration of schools and teachers.
If you need more information, contact either the Scientix National Contact Point in your country or the Scientix central office at European Schoolnet.

You can find more materials from Scientix in our shared online folder "Materials" (**https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv**).

Unit 4:

Our task for you

Our task for you:
Which projects do you know or have you already explored and tested with your pupils?

Think about your own learner-centred projects that you have developed or used in your STEM education: What are good examples from your teacher-centred STEM education? Which learning tasks were most interesting for your pupils?
Please select good teacher-centred projects with interesting samples of learning activities and tasks from your teacher-centred STEM education.
Or describe them using our Case template from week 1.

Please upload and share them into the shared folder "Week 3 – Good practice examples and cases" that you can also find here: https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv
Share your views and discuss them with your colleagues or with other participants here in the course using the discussion forum (see below).

Add discussion: Week 3 - Discussing teacher-centred projects

Subsection 6:

3. Testing innovative instruments and tools for teacher-centred STEM education

Unit 1:

Our tools for beginners and experts in online learning

In this sub-section, we want to introduce you to several innovative instruments and tools of teacher-centred STEM education:
All innovative instruments and tools are openly and freely available and can used without any costs (you only need internet access).
Some of them are offering the full access and all functionalities for free, most of them require your registration first and a few of them offer a version for teachers and educational purposes with limited functionalities but for free, too.
We hope that you can find and explore innovative instruments and tools for your own practice and teacher-centred STEM education.

To start with, we present you two tools for beginners and experts of online learning:

1. The **Quality Checklist** is designed for teachers (as well as for learners) who are novices in online learning: You can find simple questions how to design your first online course (and as a learner you can find out which online course is appropriate for me).
2. The **Quality Criteria** are developed for teachers (as well as for learners) who are already experienced in online learning: You can explore all potential options and check how to improve your existing or future online courses (and as a learner you can check which functionalities are most relevant for me).

You can find both tools (the Quality Checklist and the Quality Criteria) in the shared folder "Week 3 – Good practice examples and cases": https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv
For both tools, there are also one-page introductions with a simple summary.
Feel free to share both tools and their summaries with your colleagues and friends thanks to their open and free licenses.

Which tool is more relevant and helpful for you?
What are your findings if you compare these two tools?
And how can you use them in your own teacher-centred STEM education?

In the following pages, you can find more innovative instruments and tools for teacher-centred STEM education that are waiting for your exploration and analysis.

Our task for you:

When you have explored, analysed and compared our innovative instruments and tools for teacher-centred STEM education, think about your own good practice examples and cases and your instruments and tools that you use for teacher-centred STEM education. Please upload and share them into the shared folder "Week 3 – Good practice examples and cases" that you can also find here: https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv

Afterwards, please give feedback for at least one innovative instruments or tools for teacher-centred STEM education that your peers and colleagues have uploaded and shared with you in the folder. Remember to refer to the name of the innovative instruments or tools. Share your views and discuss them with your colleagues or with other participants here in the course using the discussion forum.

Finally: If you want, you can share your findings from the analysis of our own innovative instruments and tools for teacher-centred STEM education in the discussion forum, too.

Add discussion: Week 3 - Discussing instruments and tools

Unit 2:

Important warning for you as teacher

All instruments and tools that we are presenting here are free to use.
But always remember and reflect when setting up online learning opportunities and environments: Free to use does NOT mean that it is completely for free! You have always to pay a price, in particular if the instruments and tools or services are provided by (private) companies and enterprises with their specific business interests.

Thus, always carefully think about the information that you want to publish or use online! The human right on privacy also includes (online) data protection and you as a teacher have got a special responsibility for your pupils. Unfortunately, there are no precise global laws until now that would define and simplify the legal situation worldwide.

In Europe, the European Union has approved and adopted a law, the General Data Protection Regulation (short: GDPR), see this permanent link:
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02016R0679-20160504
Therefore, all citizens (including you as a teacher) and all organisation (including all companies) in Europe have to respect and follow this law that is very complex and difficult as the whole topic is very complex and difficult.

Private companies such as Microsoft and Google are claiming to follow the GDPR but they handling it in different ways (Microsoft is signing GDPR contracts with organisations while Google rejects it). Most important is that these companies can change their terms and conditions form one day to another and that includes the free usage as well as the handling

of privacy, personal and protected data. In consequence, it is your best care for your pupils that you do not rely on their good will but that they always ensure that private, personal and protected data are not used and not published online (including names, birthdays but also figures, videos, etc.) without given consent by the pupils and their parents.

Our strong recommendation: Do not use any real names in any online instruments and tools or online environments and tasks. And also avoid any personal numbers or IDs that could identify a specific person. Think about nicknames or simply use the numbers of your class register (a random numbering would even be better).

Please always keep these important issues on privacy and data protection in mind and act accordingly, thank you!

Unit 3:

Complex environments

First, some complex environments that you and your pupils can use for many different types and purposes including online meetings, sharing of documents and tasks (and collaboratively working on them), online discussions and chatting. We recommend Microsoft Teams at the moment as it is designed in particular for educational purposes and (online as well as classroom) teaching (and the handling of privacy and data protection by Microsoft is currently more transparent):

Microsoft Teams:
https://www.microsoft.com/en-us/education/products/teams
Microsoft Office 365 Education:
https://www.microsoft.com/en-us/education/products/office
Microsoft Remote learning:
https://www.microsoft.com/en-us/education/remote-learning

Google G Suite for Education:
https://edu.google.com
Google Docs:
https://docs.google.com

Unit 4:

Creating websites

Here, some online services that allow you to create your own websites:

Of course, the complex environments are also containing such services, see:

Microsoft Teams:
https://www.microsoft.com/en-us/education/products/teams

Google Sites:
https://sites.google.com/new

Next to those, you can also benefit from more advanced and specialised services:

Wordpress is THE standard for websites but not easy to install:
https://wordpress.org
It can be worth to consider a third-party service (website hosting) that includes set-up and maintenance of your websites

A simple way to start with your own website:
https://www.wix.com

An alternative for the collection and aggregation of different sources on a topic selected by you:
https://scoop.it

Or alternatively, you can simply use one of the online boards that we have already presented in week 2:

A very simple board without fancy features:
http://board.net

A stylish board with many options:
http://padlet.com (what we have also used in our live event in week 1)

And a simple collaborative whiteboard:
https://bitpaper.io

Unit 5:

Collection of other tools

Here, a collection of other recommended tools (but there are many more of course):

A very powerful tool for creating, combining and re-using any types of content (including interactive), strongly recommended:
https://h5p.org

An online tool for your (and your pupils') collaboration, communication and documentation:
https://trello.com

A free software for creating your own recordings and live streamings, recommended:
https://obsproject.com
(You can position your cursor above the start button, then prepare yourself in the camera, click on the start button while keeping watching into the camera, start speaking and click again on the same button to finish the recording)

A platform with great and many license-free photos:
https://pixabay.com

Another platform with license-free photos, not that big:
https://unsplash.com

Voting with your pupils on any devices (online and offline):
https://kahoot.com

Another voting and assessment tool:
https://socrative.com

And one more voting and testing tool:
https://www.sli.do

Adding quizzes, voting and tests to your videos:
https://vizia.co

Convert any video into your own lesson:
https://edpuzzle.com

Unit 6:

Kind reminder on our task for you

Finally, a kind reminder on our task for you:

When you have explored, analysed and compared our innovative instruments and tools for learner-centred STEM education, think about your own good practice examples and cases and your instruments and tools that you use for learner-centred STEM education. Please share and upload them into the shared folder "Week 3 – Good practice examples and cases" that you can also find here: https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv

Afterwards, please give feedback for at least one innovative instruments or tools for learner-centred STEM education that your peers and colleagues have uploaded and shared with you in the folder. Remember to refer to the name of the innovative instruments or

tools. Share your views and discuss them with your colleagues or with other participants here in the course using the discussion forum (see the first page of this sub-section before our presentation of all instruments and tools or go directly to the discussion forum).

And remember: If you want, you can share your findings from the analysis of our own innovative instruments and tools for learner-centred STEM education in the discussion forum, too.

Subsection 7:

Live online event

Our live online event in week 3 is on Tuesday,21st of April 2020, starting at 16:00 UTC = 18:00 CEST (Brussels):

We are very pleased to announce that we will welcome external experts from two major projects for innovative science education:

- **Diana Dikke** from **Go-Labz**: https://www.golabz.eu
- **Agueda Gras-Velazquez** from **Scientix**: http://www.scientix.eu

Both projects are also introduced in this week 3 and they will discuss with you how to benefit from their results and tools.

Here is the link: **http://bit.ly/LearnSTEM2020_Week3_Live** (it will open 30 minutes before the live event to allow testing of your connectivity)

Please allow to use your microphone and camera (if you want to be visible) when joining the meeting. All browsers should work (but not in all former versions), best results are currently with Google Chrome.
Due to changes of winter and summer times in many time zones, we had to change/correct the timing relations, we hope that the following are currently correct (please note that time zones will change only on next weekend, therefore it is not valid for all weeks):
16:00 UTC (Coordinated Universal Time) = 09:00am PDT (California) = 11:00am **CDT** (Mexico capital) = 11:00am EST (Columbia & Peru) = 12:00am EDT (NYC) = 12:00 AST (Bolivia) = 13:00 ART (Buenos Aires) = 13:00 BRT (Brasilia) = 17:00 WEST (London) = 18:00 CEST (Brussels) = 18:00 CAT (South Africa) = 19:00 EEST (Athens) = 19:00 MSK (Moscow) = 19:00 EAT (Nairobi) = 21:00 PKT (Islamabad) = 21:30 IST (New Delhi) = 23:00 ICT (Bangkok/Jakarta) = 00:00am+1 CST (Beijing) = 01:00am+1 JST (Tokyo) = 03:00am+1 **EADT** (Sydney) = 05:00am+1 **NZDT** (Wellington).
You can check your own timezone using the following online services:
https://www.thetimezoneconverter.com/?t=18%3A00&tz=Brussels&

And here is **the recording of our live online event in week 3:**
http://bit.ly/LearnSTEM2020_Week3_Recording (will be published afterwards)
Thank you very much for your contributions!

Subsection 8:

Materials of week 3 and further reading

You can find all materials of week 3 in our shared online folders (**https://surfdrive.surf.nl/files/index.php/s/rnMYuH1kh8gBiPv**):

In folder "Week 3 – Good practice examples and cases":

Stracke, C. M., Tan, E., Texeira, A., Pinto, M., Vassiliadis, B., Kameas, A., Sgouropoulou, C., & Vidal, G. (2018). *Design and Quality of Online Courses. The Checklist for Beginners*. Online available at www.mooc-quality.eu/online-courses-checklist-beginners

Stracke, C. M., Tan, E., Texeira, A., Pinto, M., Vassiliadis, B., Kameas, A., Sgouropoulou, C., & Vidal, G. (2018). *Design and Quality of Online Courses. The Quality Criteria for Experts*. Online available at www.mooc-quality.eu/online-courses-quality-criteria-experts

Stracke, C. M. (2020). *Design and Quality of Online Courses. The Checklist for Beginners in brief*. Online available at: www.mooc-quality.eu/online-courses-checklist-beginners-brief

Stracke, C. M. (2020). *Design and Quality of Online Courses. The Quality Criteria for Experts in brief*. Online available at: www.mooc-quality.eu/online-courses-quality-criteria-experts-brief

In folder "Week 3 – Literature":

Stracke, C. M., van Dijk, G., Fasen, J., Lisdat, F., & Simoens, W. (2020). A Holistic Pedagogical Model for STEM learning and education inside and outside the classroom. In *HCI International 2020 Conference Proceedings. Springer Lecture Notes in Computer Science (LNCS)*. (accepted, in print).
You are most welcome to add your preferred and recommended literature to this shared folder!

In folder "Week 3 – Materials":

Our slides with the content of the week 3 for your download

You are most welcome to add your preferred and recommended materials to this shared folder!

And some recommendations for further reading:

De Jong, T., Linn, M. C., & Zacharia, Z. C. (2013). Physical and virtual laboratories in science and engineering education. *Science, 340*(6130), 305-308. View

De Jong, T. (2019). Moving towards engaged learning in STEM domains; there is no simple answer but clearly a road ahead. *Journal of Computer Assisted Learning, 35*, 153-167. View

Video (introductory): What is Inquiry-Based Science Education (by Ton de Jong): https://support.golabz.eu/go-lab-inquiry-based-science-education

Video (advanced): How to include a live stream in an ILS (by Casper de Jong): https://www.youtube.com/watch?v=sVtfajOaLEo. This feature is especially useful if you have to teach remotely. You can include live streaming (similar to teleconference or video call tools like Skype) into your ILS, so you can broadcast your video to the students. The feature is more suitable for advanced users, but you can simply try it out with help of the video.

And finally, enjoy the following quiz at the end of week 3!

Subsection 9:

Your quiz in week 3

Each week ends with a quiz:
Do not take it too seriously, it is not an exam but more entertainment to test what you can remember.
Therefore, we will offer you different types of quizzes in each week to explore their differences and advantages.

Here in week 3, we are using again the built-in quiz from the open edX platform, enjoy!

1. For teachers, teacher-centred STEM education is ...
   A. labour-intensive
   B. relieving
   C. leisure time

2. For learners, teacher-centred STEM education is ...
   A. expensive
   B. boring
   C. standard

3. The four phases for teachers in innovative STEM education are ...
   A. design, experiment, analyse, rethink
   B. discover, explore, apply, reflect, improve
   C. experiment, analyse, rethink

4. Go-Lab stands for...
   A. Great Offline Science Laughs
   B. Global Online Science Labs
   C. Green Online Science Laboratories

5. Scientix is ...
   A. the community for science education
   B. the cooperation for science experiments
   C. the communication of science laboratories

About Learn STEM, the European Alliance for Innovative STEM learning in schools:

We need innovative and better school education in Science, Technology, Engineering and Mathematics (STEM) as key sectors for our future life, work and society. The European Alliance **Learn STEM** focuses their interrelation and integration in cross-disciplinary and reflective STEM education and pedagogical methodologies. Main goal of **Learn STEM** is to improve the quality and efficiency of STEM learning in secondary schools. Consequently, **Learn STEM** is increasing the pupils' interest in STEM and building STEM competences. Therefore, **Learn STEM** designs and provides pedagogical methods and tools for secondary schools to explore and solve real life questions. Thus, **Learn STEM** supports and contributes to the key objective of the European Education and Training 2020 Strategy (ET 2020) that fewer than 15% of 15-year-olds should be under-skilled in reading, mathematics and science.

Moreover, the **Learn STEM** project also addresses the need to enhance knowledge of and about science as a precondition to prepare Europe's population to be actively engaged, responsible citizens as well as conversant with the complex challenges facing society. In the PISA study 2015, most students expressed a broad interest in science topics and recognised the important role that science plays in their world; but only a minority reported their participation in science activities. In addition, teachers still declare they need more professional development linked to tailoring, diversifying, and innovating teaching practices. Thus, **Learn STEM** is strengthening secondary schools' capacity to develop skills in subjects such as science, technology, engineering and mathematics through innovative and interactive pedagogical methods and approaches. Therefore, **Learn STEM** designs and provides practical instruments and online tools for secondary schools and their teachers and pupils to explore and solve real life questions.

Under the leadership of the coordinator Dr. Christian M. Stracke from the Open University of the Netherlands, **Learn STEM** brings together nine Partners from six European countries. They are collaborating for innovative STEM education and have developed the **Learn STEM** Pedagogical Model, the Inquiry learning package, a teacher training programme and an online course. These instruments are tested, evaluated and continuously improved in close cooperation with hundreds of STEM experts and school teachers. All **Learn STEM** results and achievements are openly and freely available on the **Learn STEM** website online:

http://www.Learn-STEM.org

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