systematic approach for implementation of STEAM education in schools

STEAM READINESS LEVEL FRAMEWORK

Funded by the Erasmus+ Programme of the European Union

This framework should not be understood or used as measurement tool, which indicates absolute absence of quality in lowest points or excellence in highest. We believe that each school is community with certain needs, contexts and might tackle todays and future challenges not with predetermined set of solutions, but with creative and adaptive approach. Thus, we encourage everyone to use this framework as opportunity to self-analyse yourselves in order to better understand your current situation in relation to STEAM implementation.

Change management is difficult process which takes time. Not every culture is keen for radical innovation and change, but we do not find disturbing that education system and each learning community evolves at its own pace. Great achievements are made through incremental improvement, if they are made wisely, timely and coherently. At this point comes this framework, which allows each learning community to analyse and understand the status quo of your own organisation.

For advancement and improvement, you need to choose means based on analysis and you need to have an idea what you can do better. 5 sets of criteria each with 5 levels serves not only as reference point, but also as food for thoughts which might get you on the right track.

For easier understanding, each level has an example showing possible manifestation of STEAM in a school. Yet again, neither examples, nor levels themselves represent ultimate form of STEAM implementation in school. They also are not ready-made solutions for your community, but we hope, that they might work out as catalysators in your improvement process.

Every school should use this tool in accordance with their own institutional mission, national education policy, community ambitions and goals.

5 sets of criteria are as follows: ***S*** *– synthesis of disciplines,* ***T*** *– technology,* ***E*** *– extent,* ***A*** *– applicability and* ***M*** *– mentorship approach.*

Funded by the Erasmus+ Programme of the European Union

S – Synthesis of disciplines. Do we mechanically connect disciplines or focus on showing for students underlying principles beneath separate subjects?

Level 1: Teaching tool – one discipline serves the other as a mean to learn or remember the information more efficiently. One of the subjects is considered less important than the other.

Example: singing the song to memorise the important historical events.

Level 2: Topic connections – one subject area serves to enrich another. The integration exists only if the concepts and goal from both disciplines are addressed.

Example: reading a play about famous historical personality and explaining the way the playwright used the art form to express the human condition.

Level 3: Thematic or content connections – integration of thematic units that comprise genuine areas of study addressing the goals of various disciplines.

Example: integrating math and physics disciplines with Mars as a theme (e.g. calculating differences of various characteristics between Mars and Earth (e.g. temperature, rotation, mass, etc.) and discussing what effect do these differences have.

Level 4: Conceptual connections – integration where concepts and how they are applied to each field are the focus. Using their understanding in one discipline students are more likely to make sense of an unfamiliar, but similar construct in another discipline.

Example: teaching to understand musical piece as a literature story to convey its musical characteristics, for e.g. dynamics according to the idea of the composer.

Level 5: Process connections – integration where process of students engaging with the subject matter – for example – classifying, connecting, sequencing, etc. – is the focus. These processes are common to the various disciplines, thus being aware of how they function in one discipline can enhance students' understanding of how they function in another.

Example: Teaching students to purify different attributes in order to classify practical stuff, e.g. trees, colors, etc. in order to help understand how this works in more abstract cases, e.g. numbers.

Funded by the Erasmus+ Programme of the European Union

T – Technology. Is technology in classroom “fun” or a “game-changer”?

Level 1: Substitution – technology is used with no functional change to tasks given.

Example: students read given article on computers instead of textbooks.

Level 2: Augmentation – technology allows small improvements.

Example: students take a quiz using a Kahoot! instead of using pencil and paper.

Level 3: Adaptation – technology allows to enrich and diversify learning.

Example: students are given task to make the presentation using their chosen tools.

Level 4: Modification – technology allows significant learning process redesign.

Example: students take care of greenhouse through online solutions (measurement, real-time cameras, etc.).

Level 5: Transformation – technology enables learning in previously impossible ways.

Example: students use virtual reality glasses and google maps application to take virtual museum tour.

Funded by the Erasmus+ Programme of the European Union

E – Extent. How “normal” is to integrate on day-to-day practice?

Level 1: Integration of two or more subjects at least once per school year.

Example: Integration of two or more subjects in order to commemorate an important event, such as Earth day.

Level 2: Integration of two or more subjects at least once per semester / trimester.

Example: Preparing a short-term project using knowledge of at least two subjects at the end of the semester / trimester.

Level 3: Integration of two or more subjects at least twice per semester / trimester.

Example: Integration using thematic units for introduction of new theme for several subjects (baroque, classicism, gothic for music, literature, arts) several times per semester / trimester.

Level 4: Integration of two or more subjects at least once per month.

Example: Students carry out a continuous project (e. g. Designing a Low Energy Home: Heating and Cooling) by using knowledge of several subjects and have repetitive sessions dedicated to this theme.

Level 5: Integration of two or more subjects on weekly basis.

Example: Content and Language Integrated Learning (CLIL).

Funded by the Erasmus+ Programme of the European Union

A – Applicability. Do we solve theoretical problems with very basic understanding how it might be applied in real life or do we encourage students to tackle relatable, everyday life issues?

Level 1 – Students solve theoretical tasks, teachers provide examples of practical application

Example: Students apply Pythagorean theorem to solve the task given by the teacher.

Level 2 – Students solve theoretical tasks and provide examples of practical application

Example: Students make inference about which matter will float on water by calculating density of these matters and then provide examples how they can use this information in life (application is rather theoretical and artificial).

Level 3 – Students solve theoretical tasks which is applicable in real-life context (they can relate)

Example: Students use their knowledge to plan the budget of an upcoming school event.

Level 4 – Students solve real practical cases

Example: Students prepare a business plan to redesign the chosen product to be more environmentally-friendly, that includes market analysis, product design and marketing campaign.

Level 5 – Students solve practical problems related to their individual experience and real-life context (idea comes from them)

Example: Designing and testing the app that helps to improve healthy lifestyle and visualise the progress.

Funded by the Erasmus+ Programme of the European Union

M – Mentorship approach. How free student is to make decisions about his/her own learning?

Level 1: Interactive demonstration – teacher shows the construction of correct scientific conclusions, supplementing it with questions for students.

Example: the teacher conducts the scientific demonstrations and manages the experimental apparatus, but asks questions to the students, asking for predictions about what may happen by operating in a certain way and asking for explanations of what has been observed.

Level 2: Guided discovery – students carry out given task previously introduced by the teacher.

Example: laboratory activity conducted under the guidance of a worksheets given by the teacher and containing instructions for conducting the experiments.

Level 3: Guided inquiry – students work on tasks identified by the teacher based on well-defined goals with no predetermined response or result. However, students are provided with hints and instructions on how to operate with given tools, and the teacher can guide activities through questions and problems to be posed while developing activities.

Example: laboratory activity with concrete goals, for e.g. "Find this ...", "Determine that ...".

Level 4: Bounded Inquiry – students plan and conduct the task identified by teacher with little or no guidance from the teacher and limited preparation.

Example: The research problem to be solved through laboratory activity is provided by the teacher, but the students are responsible for designing and conducting the work, collecting data and building descriptions and explanations of what it is observed.

Level 5: Open Inquiry – students develop their own research questions and design and assemble their experimental apparatus.

Example: For the task, "Set up a study aimed at sound analysis or speech recognition" students can choose to compare high and low tones, male and female voices, sounds produced by musical instruments, noises, etc.

Funded by the Erasmus+ Programme of the European Union

References:

Clotilde, B. M., & Andrea, C. (2016). Clil & ibse methodologies in a chemistry learning unit. European Journal of Research and Reflection in Educational Sciences, 4(8), 1–12. URL:https://www.unifg.it/sites/default/files/allegatiparagrafo/06-07-2017/bruno_cecchetti_clil_and_ibse_methodologies_in_a_chemistry_learning_unit.pdf

Dr. Puentedura R. SAMR model. URL: https://sites.google.com/a/msad60.org/technology-is-learning/samr-model

European Commission. (2007). A Renewed Pedagogy for the Future of Europe, 1–29. URL:https://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-on-science-education_en.pdf

Heick, T (2017). 5 Levels Of Technology Integration In Curriculum. URL: https://www.teachthought.com/technology/5-levels-of-technology-integration-in-curriculum/

Risinger, C. F. (2010). Using Online Field Trips and Tours in Social Studies. Social Education, 74(3), 137–138. Retrieved from URL:https://www.socialstudies.org/system/files/publications/articles/se_7403137.pdf

The Technology Integration Matrix. Florida Center for Instructional Technology at the University of South Florida, College of Education. URL:http://mytechmatrix.org.

Trebor Scholz, R. (2013). Learning Through Digital Media: Experiments in Technology and Pedagogy. IDC, 325. URL:https://clalliance.org/wp-content/uploads/files/Learning_Through_Digital_Media.pdf

Wiggins, R. A. (2001). Interdisciplinary curriculum: Music educator concerns. Music Educators Journal, 87(5), 40–44. https://doi.org/10.2307/3399707

Wolpert-Gawron H. (2014). 8 Ways to Use Music in the Language Arts Classroom. URL: https://www.edutopia.org/blog/using-music-strategies-language-arts-classroom-heather-wolpert-gawron

Funded by the Erasmus+ Programme of the European Union