systematic approach for implementation of STEAM education in schools

GUIDELINES FOR INTEGRATING DIFFERENT SUBJECTS

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INTRODUCTION

Integration of subjects and moving towards more holistic approach to teaching and learning has been something that has been seen as an important shift in schools in recent years. Integration of subjects allows us to cross the lines between different subject-matters and emphasize unifying concepts instead. This document will give you a step by step guideline to think through the integration process both on school and classroom level. You can also find some templates and examples to find inspiration.

First, let's take a look why is it important at all to move towards integration between subjects? School leaders and teachers are saying that integration between subjects is important because:

- In real-life people are solving bigger and complex problems than ever. And schools do not stand separate from real life. We need to prepare our children to tackle those challenges and to do that they need knowledge and skills from different subjects. Integrated studies foster a way of learning that models real life.
- Integration between subjects helps to decrease learning load because students can learn same or very similar themes from different subjects together. Teachers, pupils and parents are often complaining that curriculum is overloaded. Yet, when teachers actually work together and integrate it all becomes more coherent and compact. In addition to that, students actually have time to learn one phenomena or concept more deeply.
- Integration between subjects is often in essence a project-based learning process. This makes learning interesting and practical - students are motivated, they work as a team, use ICT, used learning and teaching methods are engaging, active and similar to real-life context etc. Teachers say that during project-based learning process they have more time to work individually with learners. Also, students can focus more on things that they are interested in, use their past knowledge and be supported in their personal development etc.
- Integration between subjects gives opportunity for students to create their own personal and meaningful learning experiences in different situations. They will remember things better, make real life connections and transfer knowledge more easily to different real life situations.
- Creativity, critical thinking and collaboration are highly valued skills. When it comes to fostering those skills in the classroom integrated studies are extremely effective approach helping students develop multifaceted expertise and grasp the important role interrelationships can play in the real world (edutopia.ee).

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SCHOOL LEVEL - IMPORTANT QUESTIONS FOR THE MANAGEMENT

To start with the integration process in your school it is important first to take time to analyze and plan things on the organizational level. This will support teachers in their work and makes the change sustainable and the whole process more effective.

Questions for discussion on management level:

- **Why do you want to integrate subjects in your school?** What is your reasoning behind it and how does it relate to schools' vision and pedagogical concept?
- **What are the main obstacles that have held you back so far?** What are the issues that need to be addressed and how to do that? This can be time, environment, lack of skills, content, learning tools, resistance from teachers and/or parents etc.

  Some examples how to deal with different challenges:
  - *some schools have time for teachers cooperation every week 1-2 hours. It is time for planning projects and making preparations, sharing experiences and ideas. This requires that this time is consciously planned in teachers workload.*
  - *many schools are organizing visits to other schools so teachers can visit lessons and get new ideas and tips from their colleagues.*
  - *often teachers do not have good examples and materials to start with the integration process and they have to create their own. This needs time and skills. It is useful to create opportunities for teachers to share the materials with colleagues. You can create idea banks, Google Drive folders or paper folders with materials which teachers use together or give to next teacher in the end of the school year.*
  - *it is helpful to think through the learning environment - if possible provide bigger classrooms, opportunities to divide students to work in smaller groups or individually. Usually it is beneficial to have two or more subject teachers in the classroom in the same time so they can share responsibilities.*
- **Who will start the integration process?** Is this the decision and initiative of the management staff or teachers themselves? If this is not teachers' initiative, how do you motivate and encourage teachers to do it?

  Some examples and ideas:
  - *when the decision is made by school leaders it is very important to plan and support the implementation process with care. Changes always bring forth resistance and not all teachers may be on board with the idea at first. It is important to think through how to engage everybody, create shared meaning and vision and provide enough support during the implementation.*

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- *when the idea to integrate subjects is initiated by the teachers they are most likely already motivated to do things differently. In this situation school leaders need to support their initiative and provide all the help, resources, time to support teachers work. This means taking care of some schools level matters: flexible lesson plans or use of space, buying new materials, give permission for having study trips, explaining new approach to parents etc.*

- **Who is in charge of this project among management staff and/or teachers?** Teachers should not be left alone during this process. They need support from the beginning till the end. As mentioned before, giving your full support to your team is essential to have great results, effective cooperation and dedicated teachers.
- **What kind of prior knowledge and experience do teachers have?** What are their strengths and also weaknesses? It is important to know your team and make sure that everybody's can contribute based on their strengths.
- **How do you decide what should be the output/aim of the learning journey?**
- **To what extent and in what class will the integration of subjects be implemented? Why?** You can have one integrated module or project per year, one shared lesson, integrated syllabi, general studies etc.
- **Is the teaching process flexible when it is necessary?** Who helps to rearrange the timetable or subject topics if needed? Is it possible to do studies in field and organize learning process elsewhere than in a conventional classroom? Do teachers have an overlapping time for working together? Is it possible that two teachers work in the same time in the classroom?
- **Can you visit other schools and talk to school leaders who have been practicing integration between different subjects already and can share their experiences?** It is even better if you will be able to follow the learning process for a longer time. Teachers like practical tips and they trust their colleagues. This also helps to get ideas that can be afterwards implemented at your school. Things cannot be copied but can be adopted and done in a similar way. It saves time and often ensures positive experience.

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CLASS(ROOM) LEVEL. STEP BY STEP GUIDE FOR TEACHERS

1. **Think about the topic**. It would be good to write down and then share your thoughts with other teachers: what are the attitudes, knowledge and skills that a student needs to learn in your subject to be able to succeed?
   Time: 15-20 minutes (for presentations take 2-3 minutes for each person)
2. **Read your subject national syllabus.** Same subject teachers can do it together. Do you see opportunities for integration? Write down on a separate paper all different options that you have. It's good to be as specific as possible. All thoughts are good, do not choose between them, just write every thought on the paper.
   Time: 30 to 45 minutes
3. **Read through some strategic documents or research articles and discuss these with colleagues** (and parents, pupils). It is important to see wider perspective. For example: PISA, TALIS, European or national strategy/policy or developmental plan, visions for future, etc.
4. **Read at least 1-2 other national subject syllabuses which you do not teach yourself.** Same subject teachers can do it together. Do you see opportunities for integration with different subjects? Highlight if something coincides with your subject. Write down on a separate paper all different ways for integration. It's good to be as specific as possible. All thoughts are good, do not choose between them, just write every thought on the paper.
   Time: 30 to 45 minutes
   Brainstorming: Use post-it papers. 7 minutes individually, 3 minutes together. Theme: Give ideas for integration between subjects! All ideas are good, at first do not criticize! Be creative! 1 post-it and 1 idea! The layout of post-it papers are not important! Make sure that everyone offers ideas.
5. **Introduce your ideas to other teachers.** Do you have overlapping ideas? Note: If you have any new thoughts/ideas during the presentation write them down, maybe you will need them later.
   Time: For each person / group, minimum 5 minutes
6. **Based on presented ideas create new teams.** Good, if there are at least 3 different subject teachers in one group. Elementary school teachers could be grouped together with subject teachers, that are also involved in teaching their students.
   Time: about 10 minutes
7. **Choose a common topic that overlaps in different subjects.** Or for example, write down topics that are addressed during particular time period (for example October). Is it possible to be flexible with the order that topics are allocated?

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8. **Read together the general part of the national curriculum** (general competences, cross-curricular topics). Find links to the selected topic.
   Time: minimum 20-30 minutes
9. **Make cooperation agreements with teachers.** This may seem pointless in the beginning but in reality, it is extremely important to establish communication agreements and share your expectations before potential problems arise. People and their work cultures are different. So, it's very important for communication to work!
   Time: minimum 30-40 minutes

Some possible aspects of cooperation agreements in the team

- Who is involved with the module? What is the role of each team member?
- What are the strengths, knowledge and preferences of each team member?
- How and how often does the team interact with the module?
- How are external experts, advisers and helpers used in the module?
- How are decisions made?
- How are changes made to the module?
- How are disagreements resolved?

10. **Choose which type of integration option / level you will be using.**
    Time: minimum 15 minutes. If this is done step by step it may take up to several hours, depending on how in depth things are discussed. If the group agrees you can fill level 1 first, then level 2 and 3 in order to get more perspectives.

Level I / Option 1: Topic-based (multidisciplinary)

Common topic is chosen. Different subjects address that topic. There are no common tasks in different subjects. Each teacher can do whatever he/she wants and how he/she wants (there should be no restrictions). There can be situation that other teachers do not know exactly what others are doing or how deeply they deal with that theme.

Example: The topic is medieval time, that is thought in 7th grade. During history lessons students learn about medieval European cities. During music lessons students learn about medieval and church music. Medieval literature is the topic of Estonian language classes and during math lessons teacher talks about medieval units of measurement etc.

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Level II / Option 2: Interdisciplinary

Common topic is chosen. Different subjects address that topic. There are common tasks in different subjects. Other teachers do know exactly what others are doing or how deeply they deal with that theme.

They plan together learning process and tasks. Not only every subject knowledge-based outcomes are important, but also concepts and skills. Mostly these tasks are not real-life context based (but just task: make poster or map).

Example: In 5th grade science pupils learn food chains. So, in art lesson pupils draw different animals and plants. In science lesson pupils use drawings to make different food chains.

Example: In 6th grade history pupils learn about ancient Greek, in literature lesson pupils read ancient Greek mythology, in art lesson and music they also learn same theme. They have common bigger tasks.

Level III / Option 3: Transdisciplinary

Substantive, practical and vital output, generally in the form of project learning. Generally, students work in groups. Important are general competences and the necessary skills for the future work. However, the learning outcomes of different subjects are also acquired.

Example: 9th grade students create within two months a student company, whose products (for example, made of chocolate) are sold to the school community on the Christmas fair. During the fair students have to introduce their products in various foreign languages (for example, Russian, German, English) and in their own language (Estonian). For this they have to design advertisements and write brochures for product promotion or make a video (this is done during mother tongue and foreign language lessons).

During mathematics lesson students learn how to create a budget (including, for example, learning to understand how to calculate labor costs). Work and technology studies in cooperation with art and computer science classes will help to design and manufacture packages for the product. During art lesson students create logos for their company. In cooking class, they learn how to make chocolate and try different recipes. During chemistry classes they make experiments with chocolate (cocoa). Geography, civic education classes (fair trade, human rights) and English lessons (documentary about child labor) contribute to learning about cocoa route from Africa to Europe and issues related to that. A visiting/quest teacher (entrepreneur) will introduce his profession to the pupils. In addition, there are lessons directly linked to creation of a student company (for example team building, target

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group selection, product related polls, product selection, company name selection, summarizing and feedback etc.)

11. **Discuss with subject teachers and answer key questions**

Key questions before starting to work with the module:

- Why is this module needed?
- What is the content of the module? (short description)
- What is the purpose / goals of the module?
- What is the expected result?
- What is not included in this module, even if it is easy to do?
- What kind of module is this? (e.g. exploratory, design, expressive, combination, etc.)
- What is the motivation to get started?
- When will the activities of the module take place? (time frame)
- Where does the module take place? In what rooms? In what learning environments?
- What tools are needed to successfully complete the module? (e.g. equipment, tools, materials, financial resources, technology, online tools, books, human resources, etc.)
- How is the module evaluated? (module quality and outcome, learning outcomes, effectiveness of project methods)
- What are the risks associated with the module? (events or factors that may slow down or affect the module)

12. **If you are using an interdisciplinary or transdisciplinary approach, then think together how to assess students' achievements.** This is especially important for common tasks as students (and also teachers) must receive feedback on learning outcomes. Students should also be given the opportunity to make their own assessment as it supports the learning process. When it is possible then students should be included in the creation of evaluation criteria and these criteria must be presented along with the goals in the beginning of the module.

In addition to creating an action plan, before starting studies/module students must understand what exactly is being measured in their performance and what are the criteria for good performance. To answer these questions it is appropriate to use assessment rubrics (for examples look here).

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The assessment rubric must clearly and comprehensively describe the expected learning outcomes and be understandable to both students and parents. Students should be included in creation of this. The rubric helps students concentrate on informed learning, supports them during learning process and is student self-assessment and peer assessment tool. The rubric gives learner tools that can help them achieve better learning outcomes.

5 steps for using assessment rubric

1. Instruct students to use self-assessment rubric during their assignments. When students do their work remind them to follow the evaluation model.
2. Give students opportunity to evaluate performance of a co-learner.
3. Give feedback based on rubrics and then allow to improve their performance.
4. Allow students to make self-assessment using rubric after completing his or her task.
5. Assess performance based on the assessment rubric.

13. **Summary and feedback.** What went well? What should be changed? Ask feedback from students. What can be different next time. What they thought was useful and interesting.

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