

Art and IT in a STEAM subject

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STEAM pedagogy is a promising alternative to solve the crises of STEM. In a Hungarian secondary school, a group of inventory teachers of different majors planned and implemented a series of STEAM projects. Their goal is to make research in STEAM didactics and methodology.

In the series of projects, a new school subject is one of the elements: Media-2, which is an optional art subject. The subject is planned on STEAM bases. The model of a healthy human being is the unity his spiritual-emotional-artistic and rational side. In the subject the joy of creation and modern digital techniques form a perfect alloy. In the pilot year the main goal was re-arranging the school's website and focus on how sway-s can best contribute to school-life. The students love the course, it has high reputation.

We report on this work, thus give qualitative proof for STEAM pedagogy.

I. STEM IN CRISES

On 23rd March 2015 President Obama [1.] ascertained the intent of science education like this: “(Science) is more than a school subject, (.....). It is an approach to the world, a critical way to understand and explore and engage in the world, and then have the capacity to change that world....”

Science is included is STEM. We consider STEM as an acronym, a collective field of these studies:

- S is for Science,
- T is for Technology,
- E is for Engineering, and
- M is for Mathematics.

The U.S. Department of Education states [2.]: “In a world that’s becoming increasingly complex, where success is driven not only by what you know, but what you can do with what you know, it’s more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems gather and evaluate evidence, and make sense of information. These are the types of skills that students learn by studying science, technology, engineering, and math—subjects collectively known as STEM.”

The Bureau of Labor Statistics, (in United States Department of Labor) in May 2015 published an article from an economic point of view: “STEM in crisis or STEM surplus? Yes and yes.” [3.]. We learn from the study about employment: the academic sector is generally oversupplied, while the government sector and private

industry have shortages. Also, the geographic location and the discipline of the position affect ease or difficulty. Still, the in article, the researchers assert that “the vitality of the STEM workforce will continue to be a cause for concern”.

Linda Rosen, the Chief Executive Officer of “Change the Equation” points out the following [4.]:

- The truth hurts: the STEM crisis is not a myth.
- In the U.S. even in the years between 2009 and 2012, there were nearly two STEM focused job postings for every unemployed STEM professional.
- Unemployment in STEM was over 4%, while the same value for non-STEM workers is 9.3%.
- STEM workers are paid more than non-STEM workers.
- She refers to estimates that STEM technicians get paid 10% more than non-STEM jobs with similar education requirements.
- She points out that the focus is on the need to make all young people STEM literate: STEM for all!

II. FROM STEM TO STEAM

The main goal of STEM pedagogy is bridging the gap between Science classes and Science adventures. Didactical and methodological solutions of active pedagogy is still a topic well-worth of research.

But what we mean by STEAM can be perceived on Figure 1.



Figure 1. Ingredients of STEAM

STEAM is a new perspective appearing on the palette. In the acronym A stands for Art: arts, skills and reativity are added to the teaching and learning practices.

Is implementing Music, Ballet, Fine Art, Literature, rhymes, P.E., jokes or songs into our classes

worth its time? Many colleagues find they make good use of these, but “relevant and reliable research is urgently needed”, as Professor P. S. Taylor points it out in his article, “*Enriching STEM with the arts to better prepare 21st century citizens*”. [5.]

Can we build on the students’ artistic skills in Science Education? Does STEAM prepare students with higher-order abilities to deal positively and productively life? Professor H. Salmi shares his results in “*How creativity, autonomy and visual reasoning contribute to cognitive learning in a STEAM hands-on inquiry-based math module*” [6.]

III. INTRODUCING MIG

It is a privilege and an obligation to teach or study in Madách Imre Gimnázium, Budapest (MIG - <http://mig.hu/en/>).

The school was founded by Ágoston Trefort (Lorand Eötvös’s uncle) in 1881. The motive was to give high level secondary education for Hungarian boys aged 10-18. It was the first Hungarian state school in Budapest, Hungary.

The list of former students of the school speaks for itself: Imre Kertész (Nobel Prize winner writer), Andy Grove (the father of the microprocessor, founder of Intel), Pál Selényi (experimental physicist), Pál Turán (mathematician), Robert Capa (photographer). The list is very long of well-known singers, artists, painters, comedians, actors and actresses, etc.

Nowadays the school provides co-educated high-level education for students aged 14-19. Based on the results of the institute it is ranked to the from 13th to the 19th place from the 2416 secondary schools. MIG surely deserves the honoring elite school title. However, the best academic results are in literature, drama, history and languages.

The school is in the center of Budapest, in the imposing original building. (Figure 2.)



Figure 2. MIG in the center of Budapest

IV. STEAM PROJETS IN MIG

MIG gives excellent opportunity for didactical research of STEAM.

There were 2 preliminary STEAM projects giving qualitative proof for didactical research that students and teachers are willing and able to cooperate in new ways.

A) The “Art-pieces of gravity” project in 2018

The topicality of our first STEAM project is the Nobel Prize in physics in 2017. The LIGO experiment proved the existence of the foretold gravitational waves.

Elements of the studies of gravity are in the syllabus, and the information in the media turned our focus to this topic. We promoted an optional task to our students and fellow colleagues two ways:

- personally, in visual art and physics classes
- via the internet, on the school’s website.

It was a great success: more than a hundred course works were handed in. The list proves how creative our students are: a picture-poem, graphics, a design-dress (Figure 3.), poems in English and Hungarian, mandalas, tableaus, oil paintings, and many interesting solutions.



The design-dress inspired by the scientific phenomenon focuses on the different fall of different materials. This is the combined effect of gravity and the characteristics of the materials. It is an exciting composition of the natural colours, the glossy and matte surfaces, the geometrical figures, and the various textures. The ornaments are peculiar, the traditional accessories are reinterpreted.

Figure 3. “Gravity dress” and the designer, Miss Hanna Márkus

From the best pieces we arranged an exhibition in the schools’ social hall.

B) The “Retiring the Grand K” project, 2019

Since 1875 the idea of making a coherent scientific unit system led to birth of the System International (SI) in 1889. This system consists 7 basic quantities and their units derived from the nature. “Le Grand K” is the world standard of kilogram, the SI unit of mass. Le Grand K had been is service for 130 years by 20th May 2019. It is the last one to retire of the 7 world standards. There were the “Avogadro project” and the “Watt/Kibble Balance” project to take over.

The students of applied physics at grade 10 set memory to the occasion on the school’s notice board (13th-27th May 2019). Figure 4. shows it.



Figure 4. Notice board saying farewell to the Grand K

The group of innovative teachers addressed the students for a competition.

Table 1. shows the distribution of course works.

Type of work	no. of works	on display
fine art	17	4
poem	6	2
essay	8	2

Table 1. Number of the course works for the farewell

Fine art works included drawings, paintings, illustrations, tableaux, a figurine and also fashion jewellery.

The exhibition (Figure 5.) in the social hall of the school promoted our project for another two weeks.



Figure 5. Farewell to “Le Grand K” in MIG

V. A NEW SUBJECT: IT & MEDIA

A) Planning and defining the bases of a new subject: terms, conditions, motivation

Based on the success of the previous projects we planned and implemented STEAM pedagogy into a new media subject.

An optional art subject for two years in MIG:

In MIG, students can choose one art subject for their grades 11 and 12. The course they choose is for a two-year-

long period of their studies, the senior years. The actual group is from the members of the four (or five) classes attending the same year, but from different classes: 130-160 students. The course takes one double lesson (90 minutes) each week. There is a range of possibilities, like: theatre, media, radio, dancing and music, visual culture, drama, journalism, etc.

We decided to give a try to a new subject, called Media-2. We introduce our conceptions.

Our model of the student was and is “a healthy human being, in whom the rational and the emotional-creative areas are in a personality defining equilibrium. It not only the model of a healthy human being, the unity of the rational and the spiritual-emotional side, that recalls peripatetic pedagogy. We appointed the role of the teacher also in parallel with the peripatetic model: the teacher is more like a mentor.

The pedagogical model of our work is Dale’s model on active pedagogy. On Figure 5 we highlight the most effective didactical tools in red. “Do a real thing” grabbed our attention, we will explain how we intended to implement the idea in our project.



Figure 5. Dale pyramid of active pedagogy

Our school has just had a new homepage. It is becoming very popular and higher and higher valued. Also, the Department of IT teachers introduced (in close collaboration with the system administrator) a new website of the school including Microsoft Office facilities. It is not easy to take the first steps in the introduction and use. Our purpose was also to help our student get to know more, therefore help their fellow students and possibly even their teachers to make the most of the new possibility.

All in all, our intention is to alloy the joy of creation with modern digital techniques. Ancient pedagogy and brand-new IT make sure that this subject is very peculiar.

B) Contents of the subject, a report on the pilot year

First, we give some information on the pilot year. The course did not have any preludes. We gave our short perspective only. Many applied to the course. The human and technical facilities gave a strict limit to the number of participants. Finally, 19 students were excepted for the course.

One of the highlighted motives is to do a real thing to get the best of best of the effectiveness of active pedagogy. The content of the subject is everything that can be related to the everyday life of the school and digital techniques. These tasks are in the syllabus:

- we take and edit pictures
- we shoot and edit films
- we plan, design and make websites and homepages, etc.

The new website of the school shows what our students can achieve with expert guidance (Figure 6., 7.).



Figure 6. The new homepage of MIG

<http://mig.hu/>

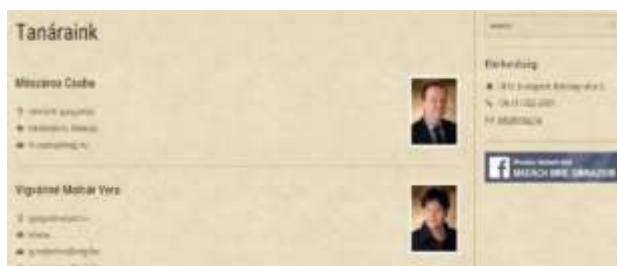


Figure 7. Introducing the staff (on the students' demand)

<http://mig.hu/tanarok/>

Among the students the course is often called “the sway making course”. It shows that sways are very popular in the course and have a praising feedback among the protagonists of the school-life.

Sways are brand new tools in IT. They can be best defined as web-ppts. One of the greatest advantages is that they are platform independent. It means that they can be well used on PCs, laptops, tablets, smart phones, etc.

There are 45 sways giving information about different programs that happened in the academic year of 2018/2019. These are attached to a timeline, as Figure 8. shows.



Figure 8. Sways attached to a timeline

This timeline is on the website:

<http://mig.hu/diaket-2018-2019-tanev/>

We can assume that this part of the project is very productive.

We also present the sways on the previously mentioned STEAM project on Figure 9. and 10.:



Figure 9 Art-pieces of gravity on the timeline



<https://sway.office.com/03GTebW1X6TRCR7?ref=link>



Figure 10. Sites from the sway

We can underline in Figure 11. that also foreign language competences are developed in the course with a sway in English. Hopefully more and more will follow the model.

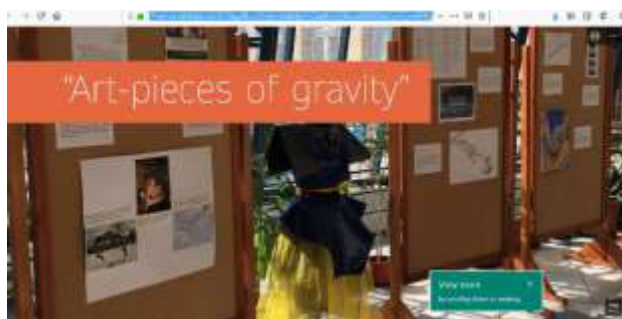


Figure 11. A sway in English promoting STEAM physics

<https://sway.office.com/DjynkOdCF9Amwt2F?ref=Link&fbclid=IwAR1AtppRk-s3J5o6k-6x0sMy0-cCpkElrmCtKkwz68DWb0oCuoYymeW3fg>

The sway is well-prepared if it gives back the atmosphere and events of the occasion it gives information about. The students need to learn how to work in a group to best contribute to the “product”. It is not an easy task to find the strength of each individual participant.

What skills did the students use and develop? Many, but especially these in the teamwork:

- collaborative,
- manual,
- stylizing,
- methodizing,
- artistic,
- systematizing,
- social,
- typing,
- foreign languages,
- and many more.

Surely, the teacher needs to take responsibility what “products” can be displayed on the site. Students need to learn also some critics and based on them to revisit their work to work on it for better.

C) Further plans

We find that Media-2 is a popular course among students. For the new academic year (2019/2020) there were many who chose as their optional subject. Still, the facilities are limited, so only 21 students can take part in the course. This time we wanted to learn how the course works, so planned and began implementing quantitative didactical research. We used multiple choice questions in finding out more about the specific competence (2 out of its 3 aspects). Surely, we used the possibility given by our Microsoft Office.

The pilot group has already reached their grade 12, so new content and new perspectives are present in the second part of the course.

VI. CONCLUSION

We proved that colleagues of different majors can plan and implement STEAM projects in secondary schools.

We proved that secondary school students are eager to participate in STEAM projects, thus combine their knowledge & skills gained in the study of many school-subjects.

We have experienced that exhibitions raise the interest of those students also, who did not prepare a course work.

We can plan our next project in a pedagogical research setting to gain quantitative proof how STEAM projects work.

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