

STREAM Education - Potential for Engaging Students in Generating Innovative Green Ideas and Development of Transversal Skills

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Abstract - The article presents pedagogical strategies in the design of a STREAM approach-based initiative. The details in the training scenario are examined, the main stages in the design of the individual lessons and the tools for studying the progress of the students are described.

An interdisciplinary Project Based Learning (PBL), in which students are researchers of real problems, creators of authentic content and creative products, is implemented in an innovative high school with foreign language training and additional profiling in the fields of Mathematics, IT and Entrepreneurship. A team of two teachers, participants in a Professional Learning Community (PLC), develop the design of this type of training, change the working conditions and develop a learning environment different from traditional formal learning spaces. Teachers act as mentors and facilitators, engaging 14- and 15-year-old students in the adventure of identifying problems, proposing solutions, and advocating for a position. The focus is on the development and evaluation of transversal skills acquired through the methods of foreign language learning and computer science.

Optional IT learning groups have the potential to free space for extracurricular learning. Organized that way, students acquire and master competencies in the field of computer science. The development shares the details regarding the idea of integrating learning approaches from the two subject areas - computer science and foreign language learning. The assessment and self-assessment tools provided in the development are easy to use and can provide quick feedback to students and teachers and measure the effectiveness of learning and teaching. Some conclusions are drawn and the proposed methodological approaches are commented on, the challenges in the work are described and options for overcoming them are indicated.

Keywords – STEM education, innovative green ideas, educational system, transversal skills

I. INTRODUCTION

Discussions about the development of educational systems are on the agenda in every country and society, and the most important topics discussed are: Do children acquire the necessary knowledge in schools? Which school subjects are related to the real problems outside the classrooms? Can students develop their potential, reveal their talents, discover their strengths, acquire adequate skills necessary for success in the modern world and meeting the challenges of the labour market?

The correct answers to these questions will effectively direct the necessary resources to build an appropriate legal framework of the formal education system in which young

people can acquire qualifications according to the needs of the economy.

The "European Skills Agenda" was developed by the European Commission in 2020 and identifies measures to strengthen sustainable competitiveness, ensure social justice and sustainable growth. According to it, training institutions should focus their efforts on acquiring the right skills in a new work environment with the possibility of flexible transition from one sector of the economy to another. Nicolas Schmidt, Commissioner for Employment and Social Rights, says that upskilling the workforce is the key response to the demands of a rapidly evolving labour market. Twelve "actions" are specified in the Programme, including "EU support for national strategies for upskilling" and "Increasing STEM graduates and promoting entrepreneurial and transversal skills". [1].

STEM training develops abilities in students to apply concepts from Science, Technology, Engineering and Mathematics to solve problems that cannot be solved using only one discipline. Transversal skills aim at solving complex life situations. This type of skills has a supra-subjective character, which is acquired outside the subject limitations. [2]

The current educational model lags behind the demands of society, the economy and the labour market. Progress in the field of education includes the development of state policies, imposes common school strategies, goes through the development of the professional skills of teachers and requires them to take individual actions - the implementation of new approaches in teaching.

The current research focuses on exploring innovative methods, strategies and tools for teaching, learning and assessing progress and builds working models for developing key skills at secondary level.

II. PLACE OF IMPLEMENTATION

Geo Milev English Language School is a secondary municipal school with a language profile and additional profiling in the fields of Mathematics, IT, Entrepreneurship, Biology, Chemistry, History, etc. The school has been part of a state network of innovative schools for five years. During the last three academic years, a partnership has been developed with Angel Kanchev Ruse University. Part of the classes are held in the university laboratories by university lecturers.

A "STEM centre for eco-innovations" has been operating at the school since 2021. It is an integrated

educational environment for the implementation of PBL in the areas of Health and Nature, Technology and Engineering and Sustainable Development. Teachers have permanent attitudes that STEM methods can be transferred to all subject areas and through them non-material skills are taught, since the latter are necessary in order to deal with the challenges of the 21st century - problem solving, logical thinking and critical thinking.

Several Professional Learning Communities (PLCs) are developed in the team with a different focus, which is determined at the start of each academic year, and teachers, according to their own interests and regardless of their own narrow professional expertise, choose the teams in which to be included.

III. THEORETICAL BASIS OF THE PRESENTED SCENARIO

A. Interdisciplinary Training

Interdisciplinary learning is a modern scientific approach that opens up the possibility of studying a given problem from the point of view of multiple scientific perspectives. Interdisciplinary courses are organised around a theme, problem, region, cultural or historical period, institution, figure, or idea. [3]

Multidisciplinary methods are approaches from different scientific fields, for which it is possible to be combined, blended and applied to extract the most useful information on a given scientific problem. Interdisciplinarity is seen as a different, combinative, actionable approach to applying multiple methods.

Karri Holley [4] describes three types of interaction between the different scientific fields.

"Cross-disciplinarity or interdisciplinarity" is the most general term referring to the crossing of boundaries between individual disciplines. Teachers work within their own disciplinary discourse and norms.

In the case of **"multidisciplinary"** knowledge full integration is also missing. This approach is "encyclopaedic". In multidisciplinary research, students accumulate knowledge in the course of a given inquiry, but no effort is made to synthesise these contributions. Students acquire related knowledge about learning content from different disciplines. They can successfully compare topics from different disciplines and find connections between them.

'Interdisciplinarity' is a term referring to the integration of knowledge from multiple disciplines in pursuit of an outcome that is not possible from a single discipline. In this type of training, key skills are built by integrating two or more academic disciplines into a common curriculum.

Interdisciplinary acquired knowledge can be categorised into separate types of knowledge [5]

- Orientation knowledge – helps students to find their own way through different topics: I know what.
- Activity knowledge – helps students to adopt subject-related methods, techniques or strategies: I know how.
- Explanatory knowledge – provides students with arguments that explain why something is the way

it is: I know why.

- Reference knowledge – teaches students where to find additional information on a specific topic: I know where.

Most often, in school practice, two or more teachers with different professional expertise formulate a basic idea, set common goals, and educational activities on individual subjects are planned with a main focus on them. In this approach, project-based learning strategies are applied in full force. Students' participation in academic thematic units develops strategic planning and evaluation skills; introduces them to real situations and engages them in a natural non-violent way to the issues.

B. The acronyms STEM and STREAM

In the world of education, the acronym STEM lists the disciplines of Science, Technology, Engineering and Mathematics. STEM disciplines are important as a central part of human knowledge and a foundation for other subject areas. The STEM-focused curriculum integrates learning tools and methods and prepares students for the adult world. On the other hand, we can consider STEM a basic content-based approach in education, in which the focus is on cognitive development, acquired competences and engagement in the learning process. [6]

The STREAM education model adds more layers to STEM - by including "Arts" and "Reading" in the equation. The Arts challenge and develop creative and innovative thinking and help teach morals, values, ethics and responsibility. Reading as the main element for discovering and interpreting new knowledge, adds another set of activities and tools to the learning process. The focus on Reading or Literacy provides conditions for a holistic learning experience and encourages critical thinking and creativity.

C. PBL pedagogical practice

1) Practice design

Awareness of the learning process implies that learners make independent decisions about choosing the method and environment that best suits them and the ability to adapt them according to their needs to achieve optimal results. Project-based learning is an example of metacognition and self-regulated learning. Pedagogical practice includes the following mandatory steps: clear preliminary formulation of the task; development and activation of a preliminary plan of both the student (team) and the teacher; teacher-student and student-team interactions; progress monitoring; structured assessment and self-assessment; conclusions. [7] The steps are given in figure 1.



Figure 1. Design assessment and PBL

The established practices in the educational sphere are related to the placement of assessments at the end of the training of the relevant topic on a specific educational content. Evaluating a group student project implemented in the context of interdisciplinary PBL requires a different approach. [8]

In PBL, students perform a long-term set of tasks and it is logical that they are assessed with different methods and objectives that build a common assessment framework. In general, several types of assessments can be applied:

- Formative (to improve the individual activities in project implementation);
- Integrative (to reveal the direct connections between knowledge and learning);
- Summative (to measure the results achieved). [9]

According to Thuy Thu Vu [10], in order to be useful for student learning, the practical tasks subject to assessment should have the following strengths:

- The direct link between assessment and learning activities should be clearly visible;
- Students should be involved in the evaluation process;
- Teachers should provide clear, quality and timely feedback;
- On the other hand, the evaluation should be: clear, authentic, engaging. It should support students to draw their conclusions for further learning.

Teachers of various subjects require students to present as a result of a school project some digital product - video, presentation, text document, website, e-book, etc. The idea is good if the assignment is clearly formulated with details on the requirements for the form and content of the final product, and the evaluation criteria are clearly presented in advance, at the start of work on the project. Teachers without professional expertise in the field of IT cannot be armed with such knowledge, therefore working in a team of teachers is appropriate.

D. The outcomes in the context of IT

From the point of view of IT education, the digital products developed by the students as a result of the implementation of an educational project must have the following characteristics (Figure. 1):

Purpose /Aim/: The end product of PBL should check the level of understanding and provide opportunities to practise and apply knowledge and skills.

Effectiveness: The end product of PBL should increase opportunities for students to learn and demonstrate knowledge.

Personal attitude: The end product of PBL should offer students choice, be personable, and create a personal connection between students and the learning content.

Competencies: Students should be able to realise the end product of PBL independently and have a sense of improved skills after doing it.

Aesthetic aspect: Teachers should present such requirements that the students' task is attractive and motivates the students to complete it.

Quality criteria: Students need to be presented with a full set of feedback tools and standard requirements for digital products.

E. The outcomes in the context of ELT

From the point of view of English language learning, the products developed by the students as a result of the implementation of a learning project must have the following characteristics:

Purpose/Goal - reflect important aspects of acquiring language competences - working with written information and developing skills for analysis, synthesis and interpretation, as well as critical thinking.

Effectiveness - that the end product engages students' attention and directs them to creative expression and motivation to use aspects of applied arts to learn learning content.

Personal attitude - the project should reflect elements of the students' personal value system and approach the application of solutions in real-life situations.

Competencies - end products to demonstrate cultural competence and develop creative skills, abstract and non-standard thinking, ability to recognise and deal with moral dilemmas and conflicts.

Aesthetic aspect - the project should meet the needs of the students and take into account their interests and personal goals by improving the interaction between peers.

Quality criteria - the product must contribute to the improvement of language education and communication skills by providing students with opportunities for self-reflection, feedback and peer assessment tools.

When teachers work together to improve their practice, students learn more. Teaching must be transformed from a solitary activity into a process involving professionals sharing common attitudes and ideas for improvement. Steps in this direction make schools efficient, teachers satisfied and students successful. [7]

F. Professional Learning Communities (PLCs)

Professional Learning Communities (PLCs) have been entering education since recent decades and have nothing to do with teacher qualification courses. They provide an environment that encourages professional development, collaboration and innovation. The innovative concept in schools fundamentally changes the way educational services are provided to children and adolescents - through the dynamics in the goals it sets, through the mechanisms it works with, through the way the results are reported. [10]

Arguably, the difference between cooperation in professional learning communities and cooperation in other cooperative spheres is significant. [11]

School teams are created with a specific purpose, most often at the beginning of each school year. Teachers with different professional expertise work together to develop a space to improve student outcomes. Teacher effectiveness researchers share compelling evidence that when educators work as a team with their colleagues, they change school environments and policies, making improvements in their teaching that benefit both teachers and their students. According to Kathleen Fulton and Ted Britton, "great teaching is a team sport." [12]

According to researchers, school communities are effective because of a common system of interventions to support students with difficulties, regardless of the personal characteristics of the specific teacher.[13]

IV. STRATEGIES FOR ASSESSING PROGRESS

The model of perception of new knowledge, the way of learning and understanding and mastering skills are individual characteristics of the personality. According to the authors K. Shoylekova and B. Ivanova, teachers in each age group should choose teaching and assessment tools tailored to the student's characteristics. Teachers have the freedom and responsibility to apply critically and properly any form of teaching and assessment, to evaluate pedagogical practice and to revise their strategies. [15, 16]

In the conditions of STREAM education, the focus in determining the progress of students should be meaningfully redirected to transversal competences, to ensure the growing independence of the learner and to create conditions for the transfer of knowledge and skills from one learning area to another.

According to Rosemary Hipkins from New Zealand Council for Educational Research [18] they are traditionally comparative in nature and measure skills before and after training as well as actual achievements. They are authentic and meaningful if they are directly related to students' abilities and learning objectives. The evaluations prove the level of performance therefore they are necessarily related to previously announced criteria. It is best to have more than one author of tasks and criteria.

In cross-curricular learning, the tasks students perform are often interdisciplinary in nature. Learning challenges then require problem formulation skills and creativity and innovative ideas to solve it. Academic success is a process, and students must practice, persevere, and overcome obstacles. They should be challenged to use personal experiences, to transfer tools between subject areas, to develop their learning skills, leading them to meta knowledge. [17, 18]

Meta skills are universal and transversal skills that can help in professional and personal development. Rigorous professional expertise in a particular field of knowledge is no guarantee of success. It is often necessary to choose a new professional career, and meta skills expand the possibilities of realisation and open the door to progress.

According to Knight [19] it is essential to take into account the following features and characteristics of the evaluations:

- Estimates are provisional judgments based on current evidence;
- When designing PBL, the criteria for determining the quality of the achieved results should be specified;
- It is important for students to make sense of their development and what else they need to know and can do, to carry out critical self-reflection.

Knight also describes complex competencies, sometimes described as "soft" skills. These are competencies that are often difficult to define, cannot be measured in a quantitative way, and usually develop over a considerable period of time. These are often included in the qualities desired by an employer: teamwork skills, emotional intelligence, verbal communication, customer service skills, self-management, time management, confidence and efficiency.

V. A TRAINING SCENARIO IN ELS

The training scenario presented is an example of the common practice of three teachers of IT, English language and Philosophy. A total of 100 students in the 8th grade - first year of high school level, studying English for 18 hours per week, philosophy - 1 hour and IT - two hours per week are included.

The pedagogical scenario is realized in a total of 30 hours, and at least 5 of them are realized in the STEM centre of the school, in a room with workplaces for each student, equipped with a standard computer configuration.

Therefore, the focus of this study is the set of non-standard tools and methods for impact assessment developed by the team of teachers. They are under development and implementation. By the end of June, all classes will be held and the results of the practice will be summarized.

Big idea: Through teamwork to create electronic products (animations, presentations, collages, videos, etc.) to present ideas for solving global problems. Students should be encouraged to use their imaginations and create fictional characters with supernatural powers to help humanity.

Standards and intended outcomes

Students should acquire transversal skills: to argue and defend their personal position in various communication situations; to investigate a cognitive problem working in a small group; to make efforts to build a sense of empathy and trust in the community (group) through cooperation and constructive communication; to carry out individual and group studies, using a variety of information sources, achieve and present specific results; to present information to the public in a structured manner, following a predetermined regulation and using various visualisation tools and technologies.

Students should expand their digital literacy: the ability to use digital technologies, devices and social networks, find, organize, process, evaluate and information in an appropriate way; to observe and apply specific security rules, as well as norms related to the ethical and legal use of information; to choose and justify their choice of specialised software for creating web pages, digital images, sound and video information.

Students should expand their language skills and acquire a performance culture related to time management, English presentation, body language and confident public speaking. Students learn to work with diverse sources of information to analyse and synthesise in order to extract essential elements and linguistic units. The goal is to form a basic culture of the personality: moral, legal, aesthetic, physical, labour culture, of communication; developing creative skills and independent thinking of students.

Students to develop cultural competence and skills of expression through creativity by developing creativity and emphasising the distribution of tasks in a team and integrated construction of the four language skills: listening, speaking, reading and writing through understanding and composing oral and written messages, understanding and expressing thoughts, facts, opinions, feelings and attitudes both orally and in writing in

predictable and familiar situations; use of auxiliary materials and technique.

The roles of participants in educational activities

Teachers: mainly constructors/designers of the assignment (instructions, schedule of activities, evaluation criteria) and facilitators of the process.

Students: Researchers of the topics involved, active and engaged partners in the learning process, creators of creative and authentic final products.

Progress research and impact assessment is implemented with original and adapted tools - ongoing and at the end of the project, when the results are presented at the ELS open days in the last days of June.

A short feedback session at the end of an activity is an excellent way to emphasize the learning objectives and conclude that students are ready to move on to the next stage. This way, they understand what they did and why, and are better able to apply their knowledge and related skills to future activities. Time invested in feedback increases student understanding and increases their self-efficacy, which will lead to better learning outcomes.

After the lesson, teachers also do a short self-assessment. They comment orally on how far the lesson objectives have been achieved. If they are not satisfied with the goals achieved, the teachers determine what needs to be done differently. It is possible that one student needs more help or another needs a greater challenge. It is a quick, informal method of assessing the impact of teaching on learning.

Allowing students to comment on the work of others in class is likely to cause anxiety and lead to arguments. Students can be sometimes biased or superficial in their judgments. These problems can be avoided by careful planning and a teacher-developed assessment framework (rubric). Clear and understandable training objectives are needed at the very beginning of the activity. Students need to understand the criteria by which they are required to give feedback. It is good to create a pattern of how feedback should be provided. The teacher monitors the process carefully and mediates as needed until the students grasp the concept. Once students are aware of the ground rules, goals, and gain some experience, peer feedback can become a very effective tool.

The summative assessment includes a report on the work performed, an assessment by criteria for final products, rubrics, and a ticket for self-reflection.

It is important to understand that there are no easy routes to valuating results. However, this should not stop attempts to evaluate the impact of the teacher as a leader of the learning process.

VI. CONCLUSION

The activities presented in this study develop a variety of key transversal skills, use diverse tools, and aim to spark students' interest and increase students' motivation. Learning activities are implemented in a modern educational environment and by applying new methods of work: independent study, teamwork and general discussions and presentations.

Over the coming weeks, students will answer a series

of surveys, participate in discussions, and provide feedback. The details are yet to be considered, but some conclusions can be drawn.

- The assessment of achievements in the implementation of a learning project includes feedback mechanisms - formal and informal, direct and indirect, individual and collective. Valuation can be conducted at different times and with different technological and methodological means.
- During the implementation of a learning project, a set of skills related to various key competences is developed. In interdisciplinary projects, teachers work together to develop checklists to reflect each student's skills in different areas. The teaching team develops joint criteria for the evaluation of a final product realised in the conditions of PBL.
- In the conditions of long-term implementation of a school project, students move from a one-time application of knowledge to using skills to perform significant tasks. Students make wider connections and learn multiple skills.

Schools like ELS bridge gaps in national policies by giving teachers the freedom to plan, implement and draw on innovative pedagogical practices across all subject areas. Most often, an innovative approach is thought about and planned in small groups of like-minded colleagues who design PBL together.

While we wait for policymakers to reform curricula, we can focus on learning in existing grades and build our lessons beyond the core concepts in middle schools. We can look for ways to provide training resources and engage teachers from different subject areas to apply STEM in their practice. In schools, STEM disciplines and methods can be used as a powerful educational tool to promote critical thinking, problem solving and creativity. Self-assessment skills are a key contributor to broadening one's worldview and deepening one's ability to learn, develop and perform ideas.

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