

ART AND ESP INTEGRATION IN TEACHING UKRAINIAN ENGINEERS

David Pollard

Leeds Beckett University, Leeds, United Kingdom
bearout@hotmail.co.uk

Yuliia Olizko

National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute”, Kyiv, Ukraine
juliukraineKyiv@gmail.com

The article suggests art and ESP integration in a foreign language classroom at technical university. The authors describe five parts of the art and ESP integrated project “Water treatment” developed for teaching chemical engineers ESP at tertiary level. Each part of the project combines art such as poster drawing, writing a poem, creating a brand and making videos with ESP purposes. The results of the pedagogical experiment conducted at the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” (Igor Sikorsky KPI) proved the improvement of professional language, engineering creativity, intellectual engagement and collaboration skills of the students of the experimental group. The answers of the questionnaires conducted among the ESP teachers and students of Igor Sikorsky KPI showed their positive feedback about art and ESP integration. The issues of engineering creativity, active engagement, collaboration and authentic material usage were studied as components of multidisciplinary and multipurpose art and ESP integrated approach. The concluding part of the article outlines the main problems which can occur while integrating art and ESP in Ukraine such as lack of time and materials for exploring art, possible scepticism towards art elements in ESP.

Keywords: ESP; engineering education; ESP and art integration; Ukrainian engineer; project.

Introduction

The use of art in technical education is a popular trend. For example, art elements are present in an interdisciplinary approach which combines Science, Technology, Engineering, Arts, and Mathematics (Boy, 2013; Taylor, 2018; Quigley, & Herro, 2016; Rolling, 2016; Hadinugrahaningsih, Rahmawati, Ridwan, 2017; Allina, 2018) and are used in engineering education (Connor, Karmokar, Whittington, 2015; Sochacka, Guyotte, & Walther, 2016). Art is also integrated into language education: for teaching a science-infused English course (Thurley, 2016); for EFL (the English as a foreign language classroom) (Create to communicate, 2013).

However, scientists mostly concentrate on a particular kind of art EFL teachers can use for their classrooms. Among the most popular kinds are drama (Zhang, Tseng, Hwang, & Chen, 2018; Wasanasomsithi & Janudom, 2009; Wilson, 2008), songs (Albaladejo, Coyle, Larios, 2018; Shayakhmetova Lilia, Shayakhmetova Leysan, Ashrapova, & Zhuravleva, 2017), literature (Luukka, 2019). Art is less common in ESP. Rarely scientists offer innovative art elements in ESP such as digital storytelling for aerospace engineering (Gimeno, 2015); writing about pictures of museums and galleries (Swales, 2016) or teaching economics and fine arts in a creative manner (Onofrei, Precup-Stiegelbauer, & Tirban, 2013).

Sometimes art elements are used while implementing problem-based learning or project-based learning or using information technologies for ESP classroom. Special methodologies involving art are developed for Ukrainian students. For example, interpretation of literature is used for teaching future philologists reading (Kozhedub, 2010); texts of advertisement are used for teaching technical specialists professional dialogues (Kravchuk, 2010); drama techniques – for future teachers to improve their speaking skills (Paustovska, 2010; Datskiv, 2012). However, art is not used enough for teaching Ukrainian engineers English for Specific Purposes (ESP).

In this article, we suggest an integration of art and ESP for Ukrainian engineers as a novel approach that combines different kinds of art and leads to the enhancement of 21st century skills. Each project within this approach can be characterised by variety and new challenges for the students. The surprise element is always present because of the diversity of art involved.

Visual art is usually the first consideration when speaking about incorporating the arts into the language classroom. Painting, drawing, sculptures, photography are examples of visual art. However, we perceive art in a much broader sense. Engineers can use different forms of art to express their ideas effectively. In this research, art can include applied and performing art. Architecture, crafts, design are examples of applied art whereas music, shows, comedies of performing art.

The requirements for art learning and language learning can sometimes coincide, as both require understanding, listening, speaking, writing, reading skills, ability to learn, etc. Integrated art and ESP learning requires a coordination of knowledge and skills and offers a good alternative to comparatively out-

dated methods in teaching when teachers merely convey scientific facts in rote fashion that have to be memorised in order to pass examinations.

Analysis of competence descriptors for chemical engineers used at “Igor Sikorsky Kyiv Polytechnic Institute” (Igor Sikorsky KPI) confirmed the necessity of art integration. For example, one of the studying outcomes of a bachelor of chemical engineering is an ability to use a creative approach and flexibility in different professional situations and generate new ideas (Educational programme, 2016, p. 5). We agree with Belski that “Engineering creativity is the ability to generate novel solution ideas for open-ended problems, ideas that are not obvious to experts in a particular engineering discipline and that are considered by them as potentially useful” (2017).

The necessity of the integration of art in engineering education is also caused by an increasing number of collaborations between engineering and humanities (Baron et al., 2017). The scale of engineering nowadays is far beyond the technical area and has an impact on many other sciences.

Consequently, the role of an engineer is changing. Engineers are now employed in a wider range of activities within the private, public and academic sectors. Thus, an essential part of the role of an engineer is in participation at cross-organisational meetings, negotiations, membership of interdisciplinary teams and socialising with customers and suppliers. Employers hire engineers who can produce novel problem solutions. This requirement is especially important for chief positions. According to “The engineer of 2020” report by National Academy of Engineering (2004) among the skills of the future engineers mentioned in the report are science and practical ingenuity, creativity, business and management skills, leadership, dynamism, agility, resilience, analytical skills, professionalism, and flexibility. These factors must be taken into account while designing ESP studying materials as working only with the specialised technical content of a particular sub-discipline of a branch of engineering will not provide the necessary skills of an engineer mentioned above. Engineers should be broadly trained and more aware of the social, ecological and cultural situation in their country and abroad.

We consider integration of art and ESP to be an efficient approach to deal with the mentioned challenges and needs of engineers. Art elements can be of great assistance if they correspond to the ESP syllabus modules and reflect current scientific trends. Designing ESP and art integrated projects for engineers that include appropriate professional, social, cultural contexts is a new challenge for ESP teachers.

The aim of the article is to examine the implementation of an art and ESP integrated approach at tertiary level in Ukraine. The following objectives are stated: 1) to design art and ESP integrated project and analyse the benefits and potential problems of the approach; 2) to validate the efficiency of art and ESP integration at the chemical department of the National Technical University of Ukraine Igor Sikorsky KPI.

It is hypothesised that the implementation of multidisciplinary art and ESP project for teaching Ukrainian engineers is an effective way to improve students’ professional language, creative and collaboration skills and increase learners’ engagement.

Methods

It was made a critical examination of the literature related to engineering education and art elements in learning; analysis of educational programmes and ESP syllabus topics for chemical engineering in order to develop art and ESP integrated project; observations; project planning and structuring; questionnaire of the ESP teachers of Igor Sikorsky KPI; a pedagogical experiment with the students.

In order to confirm the effectiveness of the approach, a pedagogical experiment was conducted at Igor Sikorsky KPI. 29 first-year students of the chemical technology department took part in the experiment in 2018-2019 academic year. They participated in the ESP integrated project that included classwork and individual work.

In the first stage, all students had an initial assessment of their language based on adapted for Ukrainian students criteria (Table 1). They were asked to choose and answer one of the open-ended questions. For example, *How chemical engineering can be used to protect the environment?*, *What are the problems that you think chemical engineers have not yet solved?* Levels of performance used for assessment are described in the table. The maximum point for each criterion was five (Table 1). To assess initial collaboration skills students were asked to work in small groups and share their ideas concerning the questions they were asked earlier in order to group ideas, choose and present the best ones in their opinion.

Table 1

Measured criteria

Criteria	Levels of performance which correspond to the number of points students could get				
	1	2	3	4	5
Language	No command of structure, numerous grammatical and spelling errors	Limited command of structure, frequent grammatical and spelling errors	Some command of structure, some errors in grammar and spelling	Considerable command of structure, few errors in grammar and spelling	Extensive command of structure, no errors in grammar and spelling
Engineering creativity	No creativity is used, poor understanding of the material	Show little creativity and originality, some understanding of the material	A few original ideas and good understanding of the material	Show deep understanding of the material and original and thoughtful ideas	Think from a new perspective, a lot of new original ideas
Intellectual engagement (Schlechty, 2002)	Diverted attention – no commitment. The student refuses to do the work, acts in ways to disrupt others, or substitutes tasks to which he or she is committed.	No attention – no commitment. The student is disengaged from the task and doesn't attempt to comply with its demands. The student doesn't participate.	Low attention – low commitment. The student is willing to expand whatever effort is needed to avoid negative consequences. The emphasis is on meeting the minimum requirements. The student will learn at low and superficial levels.	High attention-low commitment. The task has little inherent or direct value to the student, but the student associates it with the outcomes or results that do have value to the student (such as grades). Student will not retain what is learned.	High attention-high commitment. The student associates the task with a result or product that has meaning and value for the student. The student will persist in the face of difficulty and will learn at high and profound levels
Collaboration skills (Frey, Lohmeier, Lee, & Tollefson, 2006)	Little communication within group; loosely defined roles; all decisions are made independently	Provide information to each other; Somewhat defined roles; all decisions are made independently	Share information and resources; defined roles; frequent communication; some shared decision making	Share ideas; share resources; frequent and prioritised communication; all members have a vote in decision making	Members belong to one system; frequent communication characterised by mutual trust; consensus is reached on all decisions

To assess students' language they were also asked to write an essay on *the advantages and disadvantages of work of a chemical engineer?*. As a result, only 30% of students reached B2 level whereas 70% achieved B1 level within the CEFR. For evaluating professional skills the students were suggested to describe the work of water filters and explain the terms of students' specific field (*sustainability, turbidity, contaminant indicator, secondary filtration, aeration, flocculation*). So, we came to a conclusion that the specialist content knowledge should be much improved.

After completing art and ESP integrated project students were reassessed with the help of the same criteria (Table 1) and the analysis of the results of experimental research with the help of mathematical method was carried out.

Results

The offered project can supplement regular coursework and can be incorporated in the ESP syllabus of engineers without deviating from it. Depending on the language proficiency level of the group, psychological features, interests and needs, a teacher can use the project for his/her ESP classrooms. Each part integrates art and ESP in a creative way (Table 2).

Table 2

Art and ESP integrated project – “Water treatment”

	Art elements used
Part 1	Preparing quizzes on interesting facts about water. Preparation of a poster showing steps of a typical water treatment process
Part 2	Visiting and sharing ideas about online international exhibition <i>The water hub</i> . Choosing the most impressive photo showing the water global crises and delivering 2-3-minute speeches about water scarcity, sanitation and hygiene problems evolved; reading and writing a poem in mini groups.
Part 3	Conducting experiments to demonstrate water properties; preparation of a mind map to show technologies used by chemical engineers to purify water, their advantages and disadvantages.
Part 4	Creating a water treatment company, drawing its brand, creating portfolio, mottos and logos.
Part 5	Making English video to advertise the company.

By the end of the project, students will understand the process of water treatment, use professional vocabulary to compare and contrast water treatment technologies, create video to advertise the company.

Water treatment project

Part 1.

Aim: understanding the process of water treatment.

Creative skills: creative thinking, imagination, personal expression.

ESP skills: listening, speaking, reading, writing about the process of water treatment.

Functional language: asking questions, giving opinions.

Description. Answer the quiz on interesting water facts. In your mini group prepare a 15-question quiz about water. Deliver it to students from other group. Take the quiz of the other group and vote for the most interesting question. In mini groups prepare a big poster exploring drinking water treatment. Act out to present your poster.

Part 2.

Aim: understanding the importance of high water quality.

Creative skills: artistry, creative thinking, personal expression, imagination.

ESP skills: listening, speaking, reading, writing about water global crises.

Functional language: delivering a speech, asking questions.

Description. Six thousand children die every day because of the lack of potable water. Deliver a 2-3-minute speech about the importance of maintaining high water quality, contamination sources such as industrial waste spills, pesticides and herbicides etc., landfills problems in Ukraine and abroad, sanitation and hygiene problems evolved. Choose the most impressive in your opinion photo from online international exhibition "*The water hubs*" showing the water global crises. Support your speech with the photo description.

Read and discuss the poem about water called "Recycled" by Verne N. Rockcastle. Work in mini groups to write your own poem. Start each line with a new letter of the phrase *Water treatment*.

Part 3.

Aim: understanding the work of water treatment technologies.

Creative skills: creative thinking, personal expression.

ESP skills: listening, speaking, reading, writing about water treatment technologies.

Functional language: brainstorming, summarising, interviewing, giving opinions, analysing CV.

Description. How water treatment technologies can save life? How chemical engineers can test water for bacteria? Answer the *kahoot.it* quiz on waste water treatment. Read the article about water treatment methods (*chlorination, disinfection, filtration, coagulation, flocculation* etc.). Prepare a mind map to show technologies used by chemical engineers to purify water, their advantages and disadvantages.

Interview your groupmates using the questions of the handout (*best ways to purify water, new water treatment technologies he or she can suggest* etc.). Add more questions to the list and present the results of the survey.

In groups think of the experiment you can do to demonstrate water properties (test the starting concentration of contaminated water, tension, viscosity, electrical conductivity, turbidity etc.). You can do it at the lab or as a home assignment. Make a video commenting all your actions in English. What lab equipment from the handout did you use for the experiment? Which treatment method would you recommend for a million gallons of water to be cleaned? What if water contains heavy metals and pharmaceuticals from industries? Mark if the sentences in the handout are true or false.

Read and discuss water purification chemist job duties, skills needed and salaries mentioned in the handout. Is this career path a good fit for you? Find an English CV of a water purification chemist that attracted your attention. What information would you add to his/her CV or omit, discuss whether the best engineers are born or made, the basic things for success in your opinion? Would you hire this person if you were the boss of a treatment company?

Part 4.

Aim: understanding the work of water treatment companies.

Creative skills: researching, imagination, personal expression, creative thinking.

ESP skills: listening, speaking, reading, writing about water treatment companies.

Functional language: comparing, evaluating and describing companies.

Description. Do you know any successful water treatment companies in Ukraine or abroad? Search Google to get more ideas. Visit the official sites of the companies. Discuss how strong their brands are, the products they offer. Read an article *What's a company's brand?* (<http://blog.leightonbroadcasting.com/blog/what-is-a-companys-brand-whats-your-brand>). In pairs think of your own water treatment company; name it; draw its brand, create your company's slogan. Watch and discuss video about making catchy portfolios in pairs, create an English portfolio for your company.

Part 5.

Aim: advertising water treatment company.

Creative skills: creative thinking, artistry, personal expression.

ESP skills: listening, speaking, reading, writing about water treatment companies.

Functional language: negotiating, prioritising, analysing.

Description. What is your favourite advertisement? Read *the 17 Best Advertisement examples and what made them successful* (<https://blog.hubspot.com/marketing/best-advertisements>). In your group, discuss and answer the seven questions of *How to create an advisement for your water treatment company* handout. Watch videos about the secrets of making a creative video, coming up with creative video ideas. In pairs make a video advertising your water treatment company (up to 5 minutes).

Show your advertisement to the national bank workers (invited ESP teachers play their role and can give a business loan only to three companies). Answer their additional questions concerning the type of a product you are offering; the kind of premises you need; the equipment you want to have; ways to advertise your business, the amount of money you would like to get etc. The winner is the pair who gets the bank loan.

Most students who participated in the experiment declared in the unanimous questionnaire that the project had been motivating for them (85%). However, 15% didn't notice any increase in motivation. Students' feedback was also asked about professional language acquisition. Most students (83%) agreed that integrated art and ESP approach helped them to improve their professional speaking, listening, writing and reading skills. 100% of the students confirmed that art and ESP integration had a beneficial influence on their collaboration skills. 97% noted critical thinking and creativity skills improvement. The answer for the last question revealed that 86% of the students are interested in having more art and ESP integrated projects in the future.

47 ESP teachers of Igor Sikorsky KPI were also questioned. The vast majority of them (95%) confirmed that art elements can be beneficially used for their ESP lessons. Most of them (80%) would like to try using art and ESP integrated projects for their classrooms in case they are professionally oriented and have clear instructions. All teachers agreed that it is difficult to match ESP objectives with art ideas and mentioned different kinds of art such as drawing/painting (80%), songs (75%), literature (80%), collage (15%), photography (85%), crafts (25%), performance (25%), as potentially beneficial for their ESP students. Such diversity proved the necessity of changing art activities for different parts of the project.

Conducted at Igor Sikorsky KPI pedagogical experiment allowed us to measure some of the benefits of the suggested approach. Results of the pedagogical experiment revealed the positive dynamics of the levels of performance of measured criteria in the experimental group (Table 3).

Table 3

Results of the Pedagogical Experiment

Criteria	Coefficient of learning	
	Initial assessment	Final assessment
Language	0.61	0.85
Engineering creativity	0.55	0.72
Intellectual engagement	0.63	0.86
Collaboration skills	0.5	0.75

Bespalko (1968) suggested the minimum sufficient coefficient of learning – 0.7. From the second column of Table 3, it is evident that the coefficient of learning is higher than 0.7. The obtained outcomes proved the effectiveness of the approach and its positive influence on language skills, creativity, engagement and collaboration.

Discussion

For some ESP teachers, a mix of art and engineering may seem unusual. However, engineers can be found working in the arts and entertainment sectors, sports, education and financial services. Some art activities can be related to engineering design and other innovative areas. Approach with art elements helps to recruit, train, and retain such a workforce in ways that are effective and sustainable and foster innovation (Segarra et al., 2018).

The issues for the discussion have emerged in the process of our research.

1. *With the enhancement of active learning the students' level of engineering creativity increases.* Our results confirm the point of view of Boy (2013) who thinks that art elements offer active learning and with A.M. Connor, S. Karmokar and C. Whittington (2015) that it restores creativity in disciplines such as engineering which is often not perceived as being creative but rather logical-mathematical. ESP teachers who were invited to judge the project videos mentioned the high level of creativity demonstrated by the students. This partially happened due to an initial discussion of making a creative and catchy video, creative learning tasks and work in a virtual learning environment. Besides, considering how water treatment problems are shown in various aspects of life such as visual art, literature, business help students to think from a new perspective and come up with more fresh ideas. Combined art and competition elements of some tasks of the project and a wide range of art involved helped to increase student's motivation.

2. *The second issue for the discussion is the students' active engagement in the learning process.* Due to art elements, they are curious to get the result. Specially designed projects help learners to solve real life complex problems in the future. Our observations of the first students of chemical technology faculty at Igor Sikorsky KPI and the research of Liao, 2016; Root-Bernstein, 2015; Colucci-Gray et al., 2017; Swaminathan & Schellenberg, 2015 demonstrated that art integrated learning allows student to understand things by using the 21st century skills such as problem-solving, critical and creative thinking, reasoning, creativity, imagination, research skills, environmental literacy, personal expression, collaboration, cultural literacy, leadership and responsibility and communicative competences, and not simply acquiring knowledge which they can quickly forget.

3. *The third disputable issue is collaboration skills enhancement.* If the project is multidisciplinary and multipurpose, it fosters students' team collaboration skills. Many tasks of the project are done in mini groups or pairs. Teamwork is quite rare in engineering education in Ukraine and ESP classes can partially compensate for this lack. For different tasks, students worked with different partners and they got used to cooperation with different students. Watching and discussing videos about building a collaborative team, roles of group members and the benefits of collaborative work was also very helpful.

Also, teamwork helps students to cope with their weaknesses such as observed high anxiety level and difficulty learning professional vocabulary. All students are different and can have individual achievements. Their progress can have different paces but doing some art they get memorable experience that can be beneficially used for language acquisition. Experience is a basis for utilising skills and competence (Boy, 2013).

4. *The fourth point is regarding authentic language materials that we integrate in ESP course which positively influences language acquisition as well as creative skills.* The teachers can modify some tasks of the projects depending on faculty, student's need and interests. We recognise the adaptability of an integrated lesson as an additional important advantage. An integrated art and ESP approach is flexible to adapt to Ukrainian engineers' interests and needs. Besides, it allows teachers to integrate authentic up-to-date

language materials (texts, videos, Internet profiles of the companies, virtual tours, scientific articles). All these mentioned advantages should be taken into account while designing projects with art elements for a particular group of students.

Nevertheless, one of the problems that can occur while implementing an art and ESP integrated approach is a lack of materials necessary to explore art in Ukraine. Besides, sometimes art activities can be time-consuming. So, we recommend some art-related parts to be given as homework for students. Another problem is that most Ukrainian teachers are not used to art and ESP integration and at first it can seem unrealistic or not useful for language learning. Accurately determined language objectives and carefully structured activities are considered as a basis for solving this problem.

The general positive feedback of the students of the experimental group about this approach and the questioning of ESP teachers' understanding of the potential benefits of art elements in ESP syllabus prove the necessity of further research in this direction. In the future, more art and ESP integrated projects involving different professional situations of chemical engineers should be developed. The other educational outcomes of the approach should be carefully studied. It would give students a possibility to reinforce their learning outcomes and delve into their speciality with the help of art and ESP integration.

Conclusions

The increasing demand for creativity and innovation in modern education, the increasing number of collaborations between engineering and humanities and an increasing societal demand for the 21st century skills of an engineer signal the necessity of art and ESP integration.

The results obtained from the pedagogical experiment support our hypothesis and give us the opportunity to argue that the use of art and ESP integrated projects can help students to improve their professional language as well as their creativity, engagement and collaboration skills.

Art can be successfully integrated into foreign language learning if teachers take into account age, foreign language proficiency level, needs and interests of the student and their values as well as other psychological features. The integration of ESP and art elements in education is a new but purposeful approach in Ukraine which requires a significant level of teachers' preparation, experience and creativity.

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