European Journal of Contemporary Education
E-ISSN 2305-6746
2023. 12(4): 1244-1262
DOI: 10.13187/ejced.2023.4.1244
https://ejce.cherkasgu.press

Pushing Horizons of the English Language Classroom: Edutainment as a Tool to Boost Innovative Potential of Engineering Students

Irina G. Gerasimova [a], Irina S. Oblova [a, *]

[a] Empress Catherine II Saint Petersburg Mining University in Saint Petersburg, Russian Federation

Abstract

As the world faces unprecedented diverse change, the future viability of any company depends essentially on whether and to what extent its employees can build the innovation of tomorrow as well as tackle problems in the workplace. To transform ideas into value-creating and beneficial reality, would-be engineering specialists are to have access to the educational opportunities that enhance their innovative potential. English proficiency for specialists in the field of Engineering and Technology today is not only social, but also an economic necessity for successful innovation. The ESP approach is believed both to increase the relevance of what the students are learning and to enable them to use English they know to learn even more English, since their interest in their field will motivate them. As fluency in ESP is considered to be equally important as major related abilities therefore teaching methods and approaches are to be adjusted to educational goals, current resources and emerging trends that should be timely noticed. The research focuses on describing the model of teaching an ESP course based on the edutainment technology which ensures advance in English as well as innovative potential development. The study comprises a theoretical basis, a methodology including instructional design and measurement methods evaluating effectiveness of the entire model. Students are trained by being involved into solving a variety of tasks many of which require conceptualization, up-to-date technologies and strategic insights such as role-plays and simulation of managing potential workplace issues. The results indicate that the edutainment model of teaching ESP course allows for alterations in engineering students' personality characteristics, thereby enabling their innovative potential development. The findings of the study would provide foreign language teachers with a tool of qualifying students in two directions: their innovative potential is strengthened through acquiring soft skills; English proficiency is improved.

* Corresponding author
E-mail addresses: Gerasimova_IG@pers.spmi.ru (I.G. Gerasimova), Oblova_IS@pers.spmi.ru (I.S. Oblova)

Keywords: edutainment technology, model of ESP teaching, engineering students, higher education, engineering and technology, innovative potential, instructional design, innovative personality, soft-skills.

1. Introduction

Nowadays uncertainty is accepted as a constant companion of society. The world is undergoing large-scale diverse change: from the format of knowledge representation along with radical political and social turmoil and highly disruptive inventions. The dynamics of profound transformations has intensified in recent decades thanks to the market economy the essence of which is increasingly conducive to radical innovation. Due to the constant and rapid development, taking place in science and technology certain alumni's competences become irrelevant even before graduates receive diplomas of higher education. In view of the possibility of reforms, abilities to anticipate changes and proactively respond to the new in the outside world with something new in the interior world have been the indicators for the sustainability of humanity. Such personalities who create innovations are needed especially in engineering field, alumni of which are expected to work on breakthrough technologies, design mining systems as well as nuclear power plants, and other critical infrastructure objects. In recent decades the inherent pressure on the education throughout the world is greatly multiplying by the level of innovation. Higher education can only handle this by being constantly prepared to provide a framework for implementing new ideas and developing competences needed to respond to these challenges (Litvinenko et al., 2022; Pashkevich, Danilov, 2023; Kretschmann et al., 2020). Mastery of foreign languages serves as a career booster required to ensure that graduates of technical universities have a competitive edge in the labour market. For this reason, language tutors have integrated the same kinds of technology into their courses which their learners are expected to use in their future jobs, whether it is online communication through web chats, mobile devices with the Internet as a source for authentic materials, IT for automation of mining industry, digital technologies taken a hold in society, virtual conferencing platforms, etc. (Matrokhina et al., 2023; Skornyakova, Vinogradova, 2022; Almusaed et al., 2023). Thus, possible innovative capacity and actual innovative actions are the keys to the survival in the competitive labour market (Litvinenko et al., 2023). Innovations are likely to be the result of teamwork; the members of such teams are more or more frequently from different countries. For innovative development intercultural competence, knowledge of diversity and foreign language proficiency are required. Students are intended to have applicable knowledge and abilities. It means the systematic cooperation between educational institutions and industries.

The goal of the current study was twofold: to introduce a comprehensive foreign-language teaching model making accommodating for the foreign language communicative competence development engaging and fascinating yet still with special reference to innovative potential advancement, and to assess the innovation level of engineering students.

This raised the following research questions:

1. What are ESP students' needs within mineral resource sector?
2. Why should ESP teachers be concerned with the edutainment educational technologies?
3. How to design or/and choose creative activities to facilitate the development of both communicative competences in a foreign language and engineering students' innovative potential?
4. What is the level of innovation of engineering students after studies based on the edutainment model proposed?

In our research we consider innovative potential of engineering students as an ability to envision possibilities and transforming novel ideas into practical solutions within the mineral resource sector. Despite the fact that researchers have already emphasised that innovative potential is to be developed in order to turn creative ideas into reality there are still few learning models provided innovative competences formation (Udina, Khromov, 2015). Analysis of scientific literature and Internet sources justifies that the concept of the technology combining education and entertainment is less researched especially concerning foreign language training of engineering students (Mikeshin, 2022; Elghomary et al., 2022). It is necessary to spend more time reflecting on how engineering students can be trained to be innovators within foreign-language learning.

Background of edutainment environment

Going beyond the traditional system of higher education with conventional language teaching methods, which give passive roles to students, some technologies strive to engage learners in the

educational process and seem to be an alternative to academic education (Motteram, 2013; Vinogradova et al., 2022; Sveshnikova et al., 2022). One of them is edutainment learning technology pined by R. Heyman in the 1970s that still has much to offer. Edutainment is defined in different ways depending on whether it is considered as a process (what we do), environment (where we do) or a product (what we make) (Chilingaryan, Zvereva, 2020; Yukhmina, Obvintseva, 2023; Hunt et al., 2023). Hence edutainment is usually described as having a number of different dimensions. This contradiction has many causes. A central one is the understanding of what edutainment is. Some researchers insist that entertainment is unlikely to be referred to the basis of the curriculum in higher education (Addai et al., 2023; Wang et al., 2007). Considering edutainment as some environment where learners can enjoy what they learn is seen as a complimentary option of the educational process intended to diversify its conservatism (Karmalova, Khankeeva, 2016). It seems to become a radical rethink for students who feel restricted and defined by the limits of the traditional educational system (Rassadina, 2016). D. Buckingham and M. Scanlon argue that technology edutainment is a merger of traditional content and teaching methods in the context of new technologies (Buckingham, Scanlon, 2005). When considered as a digital content the focus is on the combination of programming and training while keeping the audience entertained (Murzo, Chuvileva, 2021; Anikina et al., 2015). In addition, edutainment can be defined as learning focused on a gaming technology, the main motives of which are fun and happiness (Němec, Trna, 2007). The emotions of the user of a computer screen filled with colourful graphics are balanced by educational content in this technique (Okan, 2003; Addis, 2005). Some researchers believe that learning as entertainment is effective because an emotional connection is established between the learner and the subject being studied (Shafait et al., 2021). Some understanding of the edutainment cannot be related to any category as edutainment is seen somewhere between psychological techniques and multimedia products (Boyko, Koltsova, 2023).

In our research edutainment is treated as creative foreign language teaching technology ensuring motivation to learn a foreign language through the grasping content of the material; satisfaction from the independent decision of a task; social interaction with fellow students; progress in learning; materials related to the practical aspects of students' future professional life. When it comes to foreign language teaching both traditional and edutainment models have advantages and disadvantages (Table 1).

Table 1. Traditional versus Edutainment model

Model	Goal	Role of teachers and students	Benefits	Challenges
Traditional model	shapes students into moral and educated individuals who can contribute to the working world; focuses on presenting direct information to students; develops foreign language communicative competence	educators are front and center being gatekeepers of knowledge they choose what to teach and how to teach it	its rigid structure provides students with a sense of order; well-known by educators as it has been around for a long time, so it is easier to implement curriculum that has already been established	eliminates individuality; stifles creativity, treats students as machines to be fed by knowledge to get perfect scores on tests
Edutainment model	focuses on what students are passionate about and what critical thinking skills they can develop; helps students understand how	places the student in the center; students can choose topics they are passionate about; attracts students' interest; students develop their love of	includes any topic that can pique the interest of students; keeps students focused and committed to the course; recognises and honours the	poses a risk of misuse of technology; designing computer games, videos is expensive

	they can be lifelong learners, constantly engaging with new ideas and solving new problems; develops foreign language communicative competence, innovative potential, and soft skills	learning; students use critical thinking skills outside the university as they evaluate and reevaluate their perspectives on real-world topics and issues	creativity and passions of students; engages students in active hands-on learning through projects, experiments, and collaboration with peers; helps learn faster	and time-consuming; the usage of computers and smart gadgets can have a negative impact on students' health

Source: compiled by the authors

Thus, a fruitful educational model such as edutainment contributes to the holistic development of an innovative personality and couples the methods of inquiry-based learning, project learning and action-integrated learning.

Research Design

Our mission was seen as the development of engineering students' English proficiency along with their innovative potential in the mutual and supportive manner. The research steps were as follows: needs of ESP engineering students collecting, research planning, instructional design, developing an edutainment model of teaching foreign languages, testing before and after the experiment, and analysis of test results.

Our goal was to stimulate, encourage, create conditions in which engineering students are eager to become innovative personalities. As students' needs and authentic tasks are paramount in ESP teaching, analysis of learners' habits and preferences serves as a pre-requisite for creating the learning model. So called edutainment technology has a role to play in the development of innovative potential since its dynamic, "squiggly" tasks promoting interest, tailor-made for students' individual needs, talents and ambitions were balanced with traditional academic activities to develop professional and academic expertise.

We would like to state that our model does not make any claims for universality. Its content is learning materials not only for understanding but gaining projective professional experience. The learning model enables the use of different approaches to problem solving or the recognition of different effects of a decision. The path to a right decision is reached via the spiral staircase of error. The course syllabus of the developed model is designed for 36 hours of classroom activities and approximately 36 hours of self-directed learning. The model covers events worldwide and features a set of professional topics spanning major issues such as challenges within the mineral resource sector, increasing productivity, critical thinking, interrelation of language and culture, accelerating progress, country's economic development, technical science breakthroughs, etc. It provides the most appropriate lexis enabling future specialists to read, translate authentic scientific papers, and perform a full-fledged communication.

The learning model is intended specifically for the students having knowledge of English of B1 (the European Framework of Reference for Languages) who aspire to the foreign language proficiency combined with mastering the technical specialty ensuring a balance among scientific, technical areas of expertise and entertainment. The underlying principles within the model are the following:

- working with different types of discourse;
- studying real-world challenges of the mineral resource sector;
- formation of communicative competence in comfortable psychological climate;
- introducing peer discussion as a way of finding solutions to problems facing in the workplace;
- emphasis on the creative development of engineering students, the formation of a personal attitude to what is happening, the accumulation of subjective emotions and individual experience;
- the content of the training material is exclusively practice-oriented;
- facilitating active student participation and dynamism;
- domination of the content that involves audiovisual channels of perception.

The first stage of the research focuses on identifying ESP needs of students. The results received were compared with those given by ESP experts in the methodological and practical literature (Perez Sanchez, Masegosa, 2020; De Vari, 2008). It was then determined that the results from both kinds of questionnaires corresponded in 100 percent of cases (Table 2).

Table 2. ESP students' needs

№	Respondents' needs	ESP experts,%	Students,%
1.	to use professional terminology in English	49	51
2.	to find solutions of issues related to the professional domains	67	33
3.	to exchange scientific ideas in the field of the corresponding specialty with international communities	62	38
4.	to get acquainted with new technologies all over the world	31	69
5.	to stay up to date with engineering trends world wide	35	65
6.	average	49	51

Source: compiled by the authors

Based on the most frequently given answers got from the second year engineering students it seems that a relatively large proportion of the responders agreed that the primary focus, the developers of the model of ESP teaching should take into account, was the acquaintance with new technologies (69 %) and future job challenges including technical vocabulary use (51 %). While ESP experts prioritized sharing of scientific ideas and finding an overriding factor of the same pattern repeated by the international community. In general, both respondents' gist remains the same: professional issues should be maximized in teaching a foreign language to engineering students.

After the target students' needs had been identified an ESP learning model was adjusted. On this background, training materials were selected, adopted, and practiced. Those were followed by practical classes devoted to both foreign language competency and innovative potential development guaranteeing transfer from theory into practice. In addition, students were systematically assessed by means of written 3 minute tests in order to make them aware of gaps in knowledge acquisition. The final graduation paper aimed to check if engineering students were able to independently handle a problem in an engineering company.

Amongst the range of different types of discourse video watching is viewed as a way of combining education and entertainment. The idea of the activity is said to be easier for students to grasp from watching short video than from a verbal explanation, and that as they become more familiar with the idea and techniques used (Brame, 2016). As an alternative video may be replaced or supplemented by podcasts, images, audio, animations, etc. enhancing the student learning experience, cultivating students' oral and written communication, critical and analytical reasoning, creative thinking, and problem solving. In this way students were offered to watch videos providing occupational problems meaningful to learners. Videos from streaming sites used as warm-up activities were not arranged in any particular order. Talks having gathered hundreds of thousands of views online served as the base for discussions. They were the following: «The world's English mania» by Jay Walker; «Try something new for 30 days» by Matt Cutts; «Don't insist on English!» by Patricia Ryan; «4 reasons to learn a new language» by John McWhorter; «The secrets of learning a new language» by Lýdia Machová; «Go ahead, make up new words! » by Erin McKean; «How to speak so that people want to listen» by Julian Treasure; «Could your language affect your ability to save money? » by Keith Chen, etc.

These suggested videos make it possible to bridge the traditional educational environment in the classroom with a medium that is part of students' both professional experience. The drive to explore seems to be an essential condition for interest in innovation. The larger the environment under exploration is, the more knowledge one gets, the greater the level of innovation is.

The content structure of the units can be presented as following:

1. Key lexis; students are provided with a list of vocabulary accompanied by pronunciation

and grammar activities.

2. Main text/video/podcast of the unit (adapted, app. 2000 words) While watching the videos students are faced with complicated tasks such as diagnosing the current situation, discussing occupational problems and coming up with possible solutions in order to boost students' interest and engagement.

3. Unit vocabulary exercises (app. 250 words) (Table 3).

Table 3. Programme outline

Module/ topic	Content	Hours
Introduction. Academic focus	Reading: Recognising the difference between fact and opinion. Identifying the main and supporting arguments. Stereotypes. Writing: Organising and outlining ideas. Self-editing and correcting. Listening: Confirm predictions about content and structure of a lecture. Note-taking. Speaking: Summarising and building on what the speaker says. Vocabulary: Becoming familiar with academic vocabulary. Grammar: Word order in a sentence and its message. Predicate vs. attribute. Unambiguous Ving forms.	2
Module 1. Systems and order	Reading: Predicting the content of a text from visual information. Is this news? Writing: Adding supporting evidence using reasons and examples. Listening: Abbreviations and symbols. Understanding the main points in a lecture. Recognising and practicing signposting language. Speaking: Recognising language for referring to visual information. Presenting visual information. Evaluating presentation guidelines. Participating in a discussion. Vocabulary: Vocabulary & terminology for technical specialisations. Creating and using classification phrases. Grammar: Passive voice.	6
Module 2. Technologies and processes	Reading: Understanding a description of a process in a text/ Identifying and using signposting language for describing a process. Writing: Analysing written description of processes. Writing a paragraph describing a process. Listening: Taking notes on a description of a process. Speaking: Analysis of the manufacturing process. Referring to the structure of a process. Responding to requests for further details. Giving a short poster presentation. Vocabulary: Vocabulary & terminology for technical specialisations. Building word families through suffixes. Using multiple suffixes to build more complex words. Grammar: Expressing the present and the past.	10
Module 3. Challenges of the mineral resource sector	Reading: Identifying and using signposting language for describing a process. Development of the innovation component of domestic production. Writing: Analysing written description of processes. Writing a paragraph describing a process. Listening: Taking notes on a description of a process. Production dynamics and innovation perspectives. Speaking: Analysing and referring to the structure of a process. Responding to requests for further details. Taking a novel approach to project sustainability. Giving a short poster presentation. Vocabulary: Vocabulary & terminology for technical specialisations. Grammar: Expressing the future. Infinitive. Functions. Infinitive constructions equivalent to clauses. Subjunctive mood. The conditionals.	8
Module 4. Technical science innovations and breakthroughs	Reading: Understanding a description of a process in a text. Exploring technical means, methods and technologies of mining. Technology and equipment for development of mineral resources. Writing: Analysing written description of processes. Innovator's dilemma: How to innovate. Listening: Taking notes on a description of a process. Innovation: definition, classification, stages.	10

	Speaking: Analysing and referring to the structure of a process. Responding to requests for further details. Giving a poster presentation. Breakthrough technologies in engineering. Vocabulary: Vocabulary & terminology for technical specialisations. Building word families. Grammar: Modality as the author's attitude toward what he has to say. Degrees of comparison.	

Source: compiled by the authors

Variety is crucial in innovative potential development, and a succession of activities in the model proposed is the following:

Briefing phase: warm-up – simulation of chosen aspect of occupational activity input: before watching the video lexical areas are to be covered and tutors are to check that students are familiar with vocabulary. A list of essential vocabulary or actual lexis in the technical field – that the students are likely to find difficult – is provided beforehand. Students are encouraged to deduce meaning of the key phrases where possible, using dictionaries where this fails. Activities can be adapted up or down. There are different types of activities: pair work, small group work, involving groups of threes or fours, and all students circulating freely. The emphasis is on successful communication rather than on the English language correctness. In the preparation phase, students should be given sufficient time to digest the information such as technical terms, specialised terminology, issues of engineering standards, legal framework, handling of hazards and risks, equipment, and their proper use, etc. and ask the tutor for help with anything they do not understand.

Action phase: watching of proper study materials taken from reliable and valid sources representing the current state of engineering is vital. Videos provide a stimulus for natural and meaningful communication: giving both a reason and a motivating context for communication. There are said to be while-watching tasks fostering creative thinking – particularly those involving student-centred, interaction-based, and open-ended elements. Since the foreign language communicative competence needed by would-be engineers is to be related to their professional field, a language learning approach should be based on the activities that are relevant and up-to-date to their specialty acquisition in an international context. It is a multitasking activity – from improving students' foreign language skills of taking notes, debating to raising the level of foreign language proficiency as a whole. The majority of students have high level of computer literacy, that's why they prefer eLearning, hands-on activities, blogs, podcasts, and mobile applications. The tasks reflecting the most current knowledge and skills must be completed position for position. Techniques used include information gap, matching, exchanging, collecting, combining, arranging, puzzles, and simulation. They contribute to the involvement of students in research simulation, creative thinking and their imagination use. Building on the basics of engineering students' soft skills such as teamwork, problem-solving and decision-making are practiced. Acquiring soft skills helps students become better communicators, leaders, and problem solvers in the workplace.

Debriefing phase: evaluation of students' experience. Authors draw on their practical experience of designing learning activities of students' skills integration in the context of simulating professional communication. Student discussion, case study and role plays are claimed to be mutually compatible and complementary and are most effective when applied in a consistent manner. Students are put into controversial situations in order to know how to deal with challenges. Small – and large-scale success during problem solving gives students confidence that they can succeed by relying on their own knowledge, skills and desires. Students talk about their experience to their fellow students, facilitated by the tutor who draws out the main points. All participants should describe how they feel and receive feedback from their group mates and the tutor.

A follow-up written self-assessment may be helpful to identify points that attendees of the short-term programme find confusing. It contains the following:

- a protocol for the student
- how do I see my skills and why?
- what was essential feedback for me; what did I learn?

Areas of difficulty mentioned by students form a basis for subsequent training.

In our model, a creative personality is developed using the following:

- skills to form and articulate an opinion and adjust it to different cultural, economic, professional situations;
- use of innate talents to impulse and act as the originator of one's own actions and words;

- abilities to maintain a core of rules, norms and values, convictions and beliefs.

Classroom management needs to be detailed and precise. Because the tutor's role changing they act as an instruction-giver, materials designer, guide, problem-solver, monitor, evaluator, collaborator, assessor, and a researcher.

2. Materials and methods

The experiment was initiated at the Saint Petersburg Mining University in order to assess the effectiveness of the edutainment model aimed at simultaneous development of both foreign language proficiency and innovative potential. Statistical data processing and graphical representation of the data obtained were performed by means of SPSS 17 (IBM) and Microsoft Office Excel 2017. The randomization method was used in forming experimental and control groups. Numerical values were presented as M±SD where SD is the standard deviation; M being the sample mean. The comparison in the groups was based on the nonparametric methods such as the Mann-Whitney test for independent samples and the Wilcoxon test for dependent (correlated) samples. Differences between the experimental and control groups were considered statistically significant at $p<0.05$, where p is the Type I error probability when testing the null hypothesis. In all cases two-tailed criteria were employed.

The engineering students enrolled in the special short-term ESP programme that addresses gaining additional academic competences were taught via an edutainment model suggested. There were originally 853 students learning General English at the Department of Foreign Languages for two academic semesters (2021–2022 academic year). After taking a placement test enabling them to gauge the level of proficiency in a foreign language the students were randomly assigned to the experimental or control group each consisting of 180 people selected on the basis of a confirmed English proficiency level of B1 (the Common European Framework of Reference for Languages). It should be noted that there was no special selection in the experimental and control groups, except for the English language proficiency level. The control group comprised 180 participants, with 109 male and 71 female students of the average age of 17 to 19, the experimental group included 180 participants, with 100 male and 80 female students of the average age of 17 to 19. The gender and the age of students were not taken into an account either when dividing them into the control and experimental groups, or when making calculations; the gender and age were mentioned for reference only. All participants had been preliminary informed about the study and agreed to participate in it.

Besides it should be noted that chosen edutainment technology is considered to be suitable for our current university students' needs as they belong to generation Z (born between 1995 and 2012) called "digital natives" and characterised by being multi-tasking, creative and productive according to the theory of generations (Eck Duymaer van Twist et al., 2021).

During the educational experiment, students of the control group were taught under a traditional approach, through classical learning and teaching aids; while students of the experimental group were given additional English classes complementary to the main course of study in their second-year university.

At the beginning of the 2nd year each student learning English as a second language in the Saint Petersburg Mining University is to take a placement test enabling them to gauge the level of proficiency in a foreign language. These available data of all 2nd year students' level of foreign language skills were used as input for our experiment.

The study was conducted between September 2022 and March 2023. At the end of the study both groups were tested on their English language skills followed by the 16PF Questionnaire to compare possible differences in the personality of the experimental and control group students. The changes that occurred with students in the control and experimental groups were analysed.

Due to the interpretive nature, the study follows a qualitative method that offers descriptive statistics. The survey relied primarily on structured questionnaire and target group interviews, classroom observation, and analysis of scientific literature to generate a comprehensive understanding of the students' perceptions of the edutainment learning model as well as their interest in, appreciation for, and comfort with their foreign language studies and to analyze their important inner experiences that cannot be uncovered through observation alone. Data were collected on an anonymous basis via online survey application

Questionnaires and interviews were conducted to collect meaningful data about the experience and expectations of the experimental group of students. The questionnaire consisted of 11 positive and negative statements. Accordingly, an interview script was developed, followed by semi-

structured face-to-face interviews that aimed to become acquainted with the learning experience. Open-ended questions were adopted, thus seeking to encourage a vivid interaction. The script acted as a guide, and the order of the questions changed depending on participants' responses. It included questions about the needs within ESP course, the skills that the students developed by employing the edutainment environment. Each interview lasted approximately 15 to 20 min.

Ongoing assessment and final assessment are used to evaluate the knowledge, abilities, and skills a student has acquired. The ongoing assessment is conducted through tests that contain questions on each module throughout the course.

Some fundamental characteristics of human personality or psychological traits were measured employing the factor analysis being a statistical procedure for reducing the redundancy in a set of intercorrelated scores. One major technique of the factor analysis developed by Cattell, the principal-components method, finds the minimum number of common factors that can account for an interrelated set of scores.

3. Results

The findings of the study provide useful insights concerning the development of would-be engineers' innovative potential which in its turn would ensure introduction of breakthrough technologies in engineering. Engineering students learning ESP based on proposed edutainment model are expected to have the following professional competences:

- knowledge of the vocabulary & terminology for technical specialisations;
- abilities to resolve critical problems proactively in a sustainable and efficient way; to stay up to date with engineering trends at the enterprises of the sector of mineral resources; to come up with new ideas and technologies that increase productivity and generate greater output and value with the same input;
- skills to articulate an opinion, to make a presentation, to describe graphs/equipment/calculations, to participate in a discussion.

Figure 1 shows that most of the surveyed experimental group students are aware of multiple communicative activities of their future professional life connected to the English language proficiency after completing the programme. Furthermore, most of them find it easy or can perform the activities with some little help of the tutor or the Internet (Figure 1).

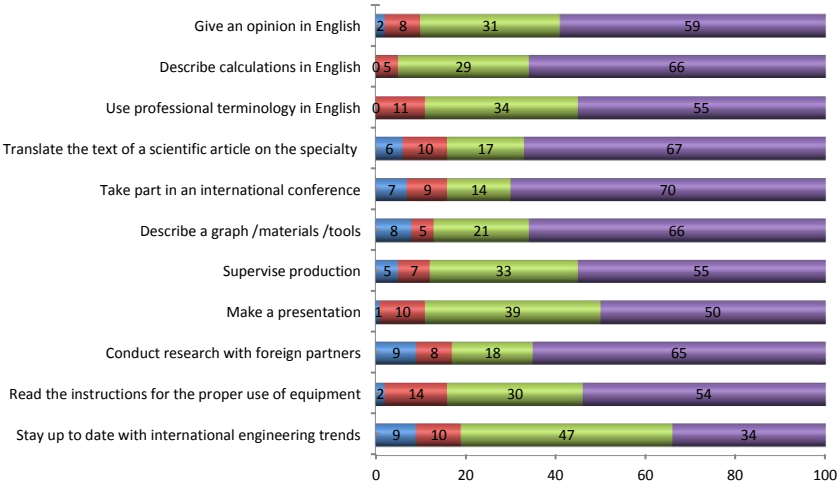

Fig. 1. The students' self-assessment results related to ESP, %
Source: compiled by the authors

In addition to the self-assessment, students' English skills were tested as well. The results are given in Figure 2.

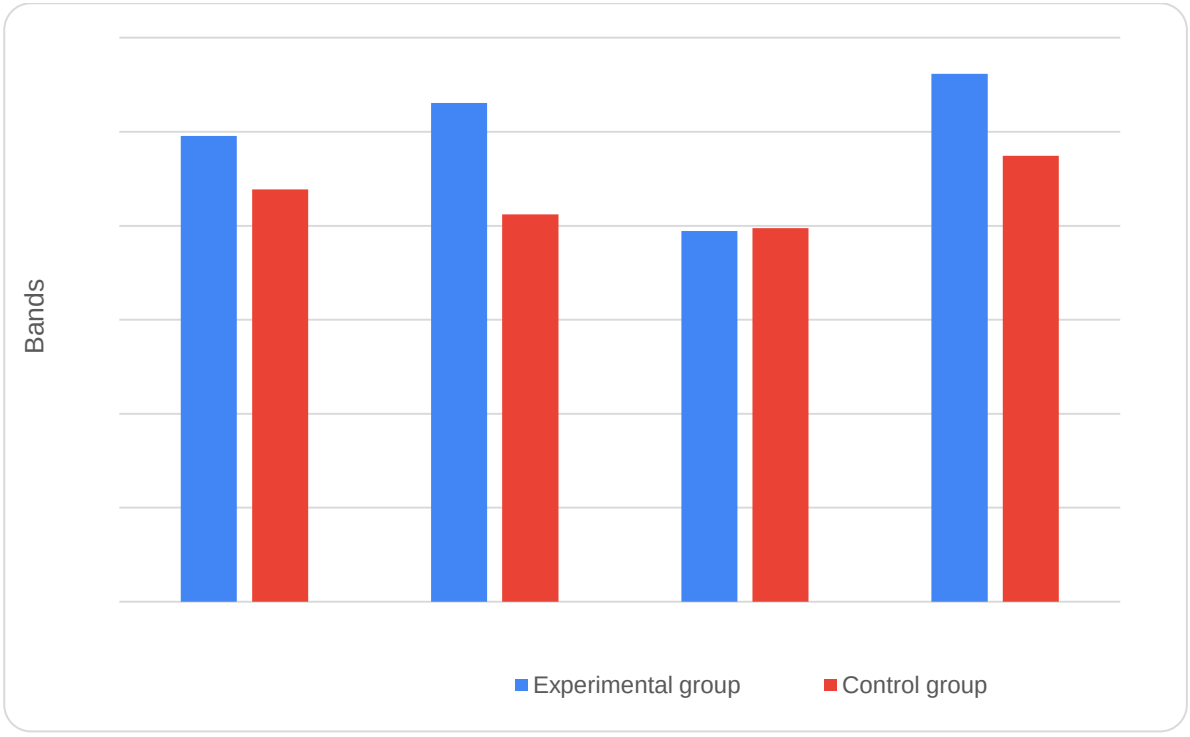

Fig. 2. Final stage results of the English language proficiency tests
Source: compiled by the authors

Conscientiousness and openness are considered to be the most valuable global factors concerning innovative potential evaluation among personality traits. For this reason, it is these global factors that were the basis of comparison within our research. After successful completion of the short-term training programme students' individual psychological characteristics providing capacity for insight, self-esteem, internalisation of standards, openness to change, level of interpersonal trust, quality of attachments, attitude toward authority, scope for core, leadership, and functional skills were assessed using the Sixteen Personality Factor Questionnaire (the 16PF) developed by R.B. Cattell, M. Tatsuoka and H. Eber (Shmelev et al., 1987). After the test has been administered a total score computed from each of the 16 personality characteristics is recorded. These totals have been created in a way to correlate to the sten scale. Scores on the 16PF are presented on a 10-point scale which is bipolar, meaning that each end of the scale has a distinct meaning. The sten scale has a mean of 5.5 and a standard deviation of 2, with scores below 4 considered low and scores above 7 considered high. Below is a table outlining the average course engineering students' personality traits measured by the 16PF Questionnaire (Table 4).

Table 4. Primary factors and descriptors in Cattell's 16 Personality Factor Model of an average student completed an ESP course

Global factors	Primary factors	Descriptors of low range					Descriptors of high range				
Extraversion/ Introversion	A Warmth Reserved/Warm	1	2	3	4	5	6	7	8	**9**	10
	F Liveliness Serious/Lively	1	2	3	4	**5**	6	7	8	9	10
	H Social Boldness Shy/Bold	1	2	3	4	**5**	6	7	8	9	10
	N Privateness (Forthrightness) Private/Forthright	1	2	3	4	**5**	6	7	8	9	10
	Q 2 Self-Reliance (Affiliative) Self-Reliant/Group-Oriented	1	**2**	3	4	5	6	7	8	9	10
Receptivity or openness	I Sensitivity Sensitive/Unsentimental	1	2	3	4	5	6	**7**	8	9	10

(versus Tough-Mindedness)	M Abstractedness Abstracted/Practical	1	2	3	4	5	6	7	8	9	10
	Q 1 Openness to Change Open-to-Change/Traditional	1	2	3	4	5	6	7	8	9	10
	A Warmth Reserved/Warm	1	2	3	4	5	6	7	8	**9**	10
Lack of restraint/ Self-control Self-controlled (or conscientious) versus Unrestrained	G Rule-Consciousness Expedient/Rule-Conscious	1	2	3	4	5	6	7	8	**9**	10
	Q 3 Perfectionism Tolerates disorder/Perfectionistic	1	2	3	4	**5**	6	7	8	9	10
	F Liveliness (versus Seriousness) Serious/Lively	1	2	3	4	5	**6**	7	8	9	10
	M Abstractedness Abstracted/Practical	1	2	3	4	5	**6**	7	8	9	10
	B Reasoning and problem-solving	1	2	3	4	5	6	7	8	9	10
Low Anxiety/ High anxiety Neuroticism	C Emotional Stability Emotionally Stable/Reactive	1	2	3	4	**5**	6	7	8	9	10
	L Vigilance Trusting/Vigilant	1	2	**3**	4	5	6	7	8	9	10
	O Apprehension Self-Assured/Apprehensive	1	2	**3**	4	5	6	7	8	9	10
	Q 4 Tension Relaxed/Tense	1	2	3	**4**	5	6	7	8	9	10
Accommodation /Independence Agreeableness	E Dominance Deferential/Dominant	1	2	3	4	**5**	6	7	8	9	10
	H Social Boldness Shy/Bold	1	2	3	4	**5**	6	7	8	9	10
	L Vigilance Trusting/Vigilant	1	2	3	4	5	6	7	8	9	10
	Q 1 Openness to Change Open-to Change/Traditional	1	2	3	4	5	6	7	8	9	10

Source: compiled by the authors

The individual and psychological characteristics of the average short-term training programme graduate and the control group student were plotted in Figure 3.

The following conclusions can be drawn from the 16PF analysis. Students who successfully completed studies based on the edutainment model had slightly higher indicators of openness and conscientiousness global factors compared with the students from the control group. Students with a high score on the mentioned-above factors are generally seen as bright, open to experience, quick learners who also tend to be more adept at abstract thinking and problem solving. A high score (7 or above) suggests a person who is capable of conceptualising and solving more complex issues. Openness emphasises imagination and insight the most out of all five personality traits. Students are known to be creative, open to trying new things, focused on tackling new challenges. They are also more likely to hold unconventional beliefs, tend to good impulse control, and goal-directed behaviors. These results have indicated the success of the proposed edutainment model.

Statistical data analysis using the Mann-Whitney test showed no statistically significant differences ($p > 0.05$) between the experimental and control groups both on the scale of the Sixteen Personality Factor Questionnaire and in the English language proficiency level (B1) at the placement test (Table 5).

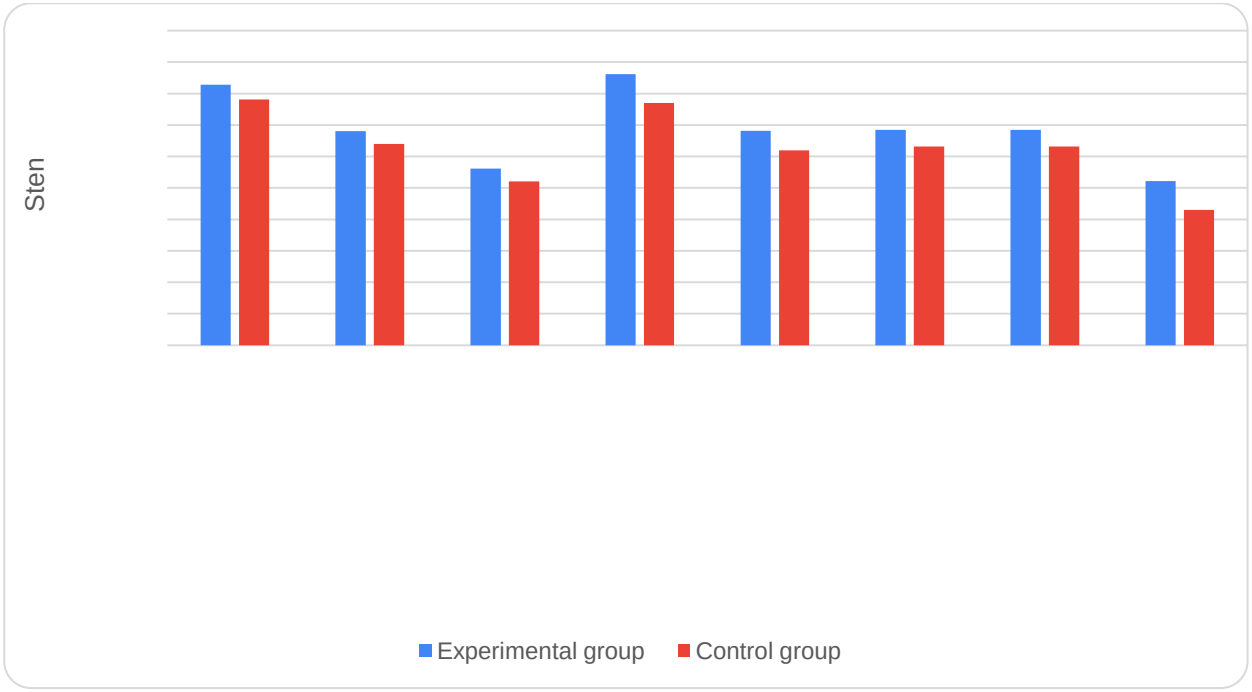

Fig. 3. Final stage results of the 16PF analysis
Source: compiled by the authors

Table 5. Comparative analysis of the placement test results of the experimental and control groups (Compiled by the authors)

Variables	Placement test						
	Experimental group		Control group		Sample mean, %	Mann-Whitney Z-test	p value
	M	SD	M	SD			
The Sixteen Personality Factor Questionnaire							
Factor A Warmth Reserved/Warm	7.75	0.69	7.67	0.62	1.1	1,08	0.278
Factor B Reasoning and problem-solving (cognitive ability)	6.20	1.01	6.19	0.93	0.2	0.52	0.606
Factor F Liveliness (versus Seriousness) Serious/Lively	5.10	0.67	5.10	0.67	0.0	0.00	0.999
Factor G Rule-Consciousness Expedient/Rule-Conscious	7.57	0.74	7.66	0.60	-1.2	-0.86	0.392
Factor I Sensitivity Sensitive/Unsentimental	6.01	0.66	6.01	0.66	0.0	0.00	0.999
Factor M Abstractedness Abstracted/Practical	6.31	0.72	6.24	0.57	1.0	1.40	0.162
Factor Q 1 Openness to Change Open-to-Change/Traditional	6.19	0.87	6.19	0.84	0.0	0.07	0.946
Factor Q 3 Perfectionism Tolerates Disorder/Perfectionistic	4.47	1.01	4.24	0.65	5.5	1.81	0.070
English proficiency band scoring							
Listening	4.00	0.00	4.00	0.00	0.0	0.00	0.999

Reading	4.00	0.00	4.00	0.00	0.0	0.00	0.999
Writing	3.78	0.64	3.95	0.50	-4.5	-0.61	0.542
Speaking	4.17	0.59	4.06	0.61	2.7	1.62	0.104
Overall score	15.84	1.03	16.01	0.70	-1.1	0.43	0.668

Source: compiled by the authors

Statistical data analysis by the Mann-Whitney test revealed statistically significant differences ($p < 0.05$) in a number of factors on the scales of the 16PF questionnaire between the experimental and control groups at the final test.

Thus, the response style indices on the Factor A "Warmth" in the experimental group of students were statistically significantly higher by 6.0% compared with the control group of students ($p < 0,001$).

The cognitive ability scale sten score of the students from the experimental group was statistically significantly higher by 6.4 % than one from the control group students ($p < 0.001$). The liveliness-seriousness scale sten score (Factor F) of the experimental group students was statistically significantly higher by 7.7 % than the control group students' sten score ($p < 0.001$). The experimental group had 11.9 % improvement in the rule-consciousness scale sten score compared with the control group ($p < 0.001$). The sensitivity scale sten score of the experimental group students was statistically significantly higher by 10.0 % compared with the control group students ($p < 0.001$). The abstractedness scale sten score of the students in the experimental group was statistically significantly higher by 8.2 % than the score of the control group students ($p < 0.001$). The openness-change scale sten score of the experimental group students was statistically significantly higher by 8.4 % than the score of the control group ones ($p < 0.001$). Besides the results showed that the experimental group indicated a statistically significant increase by 21.1 % in the perfectionism scale sten score compared with the control group ($p < 0.001$).

In addition, the edutainment model proposed accelerates students' academic improvement of their listening, speaking, and reading skills. Thus, at the end of the studies the statistically significant improvement in English language proficiency was observed ($p < 0.05$). The listening band of the experimental group students was statistically significantly higher by 12.9 % than that in the control group ($p < 0.001$). The reading band in the experimental group was statistically significantly higher by 28.8 % than that one in the control group ($p < 0.001$). The speaking band of the experimental group students was statistically significantly higher by 18.4 % than one in the control group ($p < 0.001$). The total band in the experimental group was statistically significantly higher by 15.1 % than in the control group ($p < 0.001$). However, no statistically significant changes in writing skills were observed in both groups (Table 6).

According to the statistical analysis of the dynamics of indicators using the Wilcoxon criterion students of the experimental group demonstrated positive dynamics after training based on the edutainment model. The sten scores of all the scales of the 16PF questionnaire increased statistically significantly at the final stage relative to ones at the placement test ($p < 0.001$) in the following way:

- the warmth scale indicator increased by 6.9 %;
- the cognitive ability scale indicator increased by 9.8 %;
- the liveliness scale indicator increased by 10.1 %;
- the rule-consciousness scale indicator increased by 13.8 %;
- the sensitivity scale indicator increased by 13.3 %;
- the abstractedness scale indicator increased by 8.5 %;
- the openness to change scale indicator increased by 10.7 %;
- the perfectionism scale indicator increased by 16.5 %.

Similarly, the English language proficiency bands increased statistically significantly at the final stage relative to the entry test ones ($p < 0.001$). Thus, the listening scale band increased by 23.9 per cent, the reading scale band increased by 32.7 per cent, the writing scale band increased by 4.4 per cent, the speaking scale band increased by 34.8 per cent. As a result, total band increased by 25.2 per cent (Table 7).

Table 6. Comparative analysis of the final test results of experimental and control groups

Variables	Final test results						
	Experimental group		Control group		Sample mean, %	Mann-Whitney Z- test	p value
	M	SD	M	SD			
Sixteen Personality Factor Questionnaire							
Factor A Warmth Reserved/Warm	8.28	0.63	7.81	0.49	6.0	6.70	<0.001
Factor B Reasoning and problem-solving (cognitive ability)	6.80	0,98	6.40	0.87	6.4	5.61	<0.001
Factor F Liveliness (versus Seriousness) Serious/Lively	5.61	0.53	5.21	0.68	7.7	5.06	<0.001
Factor G Rule-Consciousness Expedient/Rule-Conscious	8.62	0.96	7.70	0.67	11.9	11.46	<0.001
Factor I Sensitivity Sensitive/Unsentimental	6.81	0.40	6.19	0.53	10.0	9.28	<0.001
Factor M Abstractedness Abstracted/Practical	6.84	0.50	6.32	0.54	8.2	7.95	<0.001
Factor Q 1 Openness to Change Open-to-Change/Traditional	6.85	0.58	6.32	0.71	8.4	7.41	<0.001
Factor Q 3 Perfectionism Tolerates Disorder/Perfectionistic	5.21	0.71	4.31	0.58	21.1	11.39	<0.001
English proficiency band scoring							
Listening	4.95	0.21	4.39	0.34	12.9	13.29	<0.001
Reading	5.31	0.37	4.12	0.46	28.8	15.10	<0.001
Writing	3.94	0.16	3.97	0.19	-0.8	-1.05	0.293
Speaking	5.62	0.69	4.74	0.57	18.4	10.85	<0.001
Overall score	19.82	0.83	17.23	0.83	15.1	15.52	<0.001

Source: compiled by the authors

Table 7. Dynamics of indicators in the experimental group

Variables	Experimental group						
	Placement test		Final test		Sample mean, %	Wilcoxon Z-test	p value
	M	SD	M	SD			
the Sixteen Personality Factor Questionnaire							
Factor A Warmth Reserved/Warm	7.75	0.69	8.28	0.63	6.9	7.7	<0.001
Factor B Reasoning and problem-solving (cognitive ability)	6.20	1.01	6.80	0.98	9.8	7.8	<0.001
Factor F Liveliness (versus Seriousness) Serious/Lively	5.10	0.67	5.61	0.53	10.1	7.5	<0.001
Factor G Rule-Consciousness Expedient/Rule-	7.57	0.74	8.62	0.96	13.8	9.3	<0.001

Conscious							
Factor I Sensitivity Sensitive/Unsentimental	6.01	0.66	6.81	0.40	13.3	9.3	<0.001
Factor M Abstractedness Abstracted/Practical	6.31	0.72	6.84	0.50	8.5	7.7	<0.001
Factor Q 1 Openness to Change Open-to-Change/Traditional	6.19	0.87	6.85	0.58	10.7	8.4	<0.001
Factor Q 3 Perfectionism Tolerates Disorder/Perfectionistic	4.47	1.01	5.21	0.71	16.5	9.2	<0.001
English proficiency band scoring							
Listening	4.00	0.00	4.95	0.21	23.9	11.3	<0.001
Reading	4.00	0.00	5.31	0.37	32.7	11.3	<0.001
Writing	3.78	0.64	3.94	0.16	4.4	3.6	<0.001
Speaking	4.17	0.59	5.62	0.69	34.8	10.4	<0.001
Overall score	15.84	1.03	19.82	0.83	25.2	11.5	<0.001

Source: compiled by the authors

Statistical analysis of the dynamics of indicators in the control group by the Wilcoxon criterion showed statistically significant increase in the sten scores of the 16PF questionnaire scales at the final stage relative to the placement test data ($p < 0.05$) in the following way:

- the warmth scale indicator increased by 1.9 % ($p < 0.001$);
- the cognitive ability scale indicator increased by 3.4 % ($p < 0.001$);
- the liveliness scale indicator increased by 2.2 % ($p = 0.032$);
- the sensitivity scale indicator increased by 3.0 % ($p < 0.001$);
- the abstractedness scale indicator increased by 1.3 % ($p = 0.028$);
- the openness to change scale indicator increased by 2.1 % ($p = 0.002$).

Likewise, the values of a number of the studied scales for English language proficiency bands increased statistically significantly at the final stage relative to the levels of the placement test ($p < 0.001$). Thus, the listening scale band increased by 9.7 % ($p < 0.001$), the reading scale band increased by 3.0 % ($p = 0.001$), the speaking scale band increased by 16.9 % ($p < 0.001$). As a result, total band increased by 7.6 % ($p < 0.001$) (Table 8).

Table 8. Dynamics of indicators in the control group

Variables	Control group						
	Placement test		Final test		Sample mean, %	Wilcoxon Z-test	p value
	M	SD	M	SD			
the Sixteen Personality Factor Questionnaire							
Factor A Warmth Reserved/Warm	7.67	0.62	7.81	0.49	1.9	3.6	<0.001
Factor B Reasoning and problem-solving (cognitive ability)	6.19	0.93	6.40	0.87	3.4	4.4	<0.001
Factor F Liveliness (versus Seriousness) Serious/Lively	5.10	0.67	5.21	0.68	2.2	2.1	0.032
Factor G Rule-Consciousness Expedient/Rule-Conscious	7.66	0.60	7.70	0.67	0.5	1.3	0.178
Factor I Sensitivity Sensitive/Unsentimental	6.01	0.66	6.19	0.53	3.0	4.3	<0.001

Factor M Abstractedness Abstracted/Practical	6.24	0.57	6.32	0.54	1.3	2.2	0.028
Factor Q 1 Openness to Change Open-to-Change/Traditional	6.19	0.84	6.32	0.71	2.1	3.2	0.002
Factor Q 3 Perfectionism Tolerates Disorder/Perfectionistic	4.24	0.65	4.31	0.58	1.5	1.9	0.054
English proficiency band scoring							
Listening	4.00	0.00	4.39	0.34	9.7%	9.1	<0.001
Reading	4.00	0.00	4.12	0.46	3.0%	3.3	0.001
Writing	3.95	0.50	3.97	0.19	0.5%	0.3	0.732
Speaking	4.06	0.61	4.74	0.57	16.9%	9.3	<0.001
Overall score	16.01	0.70	17.23	0.83	7.6%	10.6	<0.001

Source: compiled by the authors

It can be seen that the increase of indicators in the experimental group is greater than in the control group. In addition, in the control group there was no statistically significant increase in three global factors such as rule-consciousness, perfectionism and writing skills.

4. Discussion

The person's innovative personality is characterised by the synergistic interaction of the following elements: having competence, values, virtues; acquiring prestige; radiating charisma; earning respect, and gaining authority (Dubakov, Olar, 2019). Employees having innovative potential that is the ability to identify a problem, propose and evaluate possible novel ideas, and provide an innovative and practical solution are essential to the lifeblood of any enterprise of the mineral resource sector (Kazanin et al., 2021; Bazhin, Issa, 2021). Specialists having innovative potential are capable to lead the company out of the dark ages by redesigning something known or implementing completely new products. In the long term, these students' competences result in success for students, both in the university and later at the workplace. They are convinced that they can work and study with great elan after confronting some new and unusual occupational situations within their studies on the basis of the proposed edutainment model. According to some scientists such positive and negative experiences lead to deep reflection and reorientation (Duggal et al., 2021; Makhovikov et al., 2023). Only during such poignant moments does a person feel deep engagement set in, because it takes concern. Concern leads to different consciousness that results in different behaviour (Pestalozzi, 1989).

5. Conclusion

The aim of the research was to suggest the learning model which contributes to the simultaneous development of both the engineering students' foreign language communicative competence and their innovative potential. To reach it, the needs of engineering students were analyzed; different resources, both self-study and in-class were assessed in order to suggest the most suitable activities for the development of the innovative potential. To cultivate the innovative potential of learners the edutainment model based on students' needs was designed. The proposed model results in improvement of the English language proficiency and observable changes in students' behaviour including alterations in personality characteristics related to innovative potential development which may indicate viability of the proposed edutainment model.

6. Limitations

In this study, some limitations are to be mentioned. Firstly, the experiment was conducted only with second-year engineering students. Secondly, there was no special selection of the participants into experimental and control groups apart from their English proficiency level (B1).

Author contribution

I.G.G. and I.S.O. conceived of the presented idea and designed the research; I.S.O. developed the theory; I.G.G. and I.S.O. carried out the experiment; I.G.G. performed the computations; I.G.G. supervised the project; I.G.G. and I.S.O. wrote the paper.

All authors have read and agreed to the published version of the manuscript.

Funding

This research received no external funding.

Conflicts of Interest

The authors declare no conflict of interest.

References

Addai et al., 2023 – *Addai, P., Sarfo, J.O., Okyere, I., Kumordzie, B.* (2023). Student satisfaction and session of study as predictors of loyalty among university students. *European Journal of Contemporary Education*. 12(2): 331-341.

Addis, 2005 – *Addis, M.* (2005). New technologies and cultural consumption-Edutainment is born! *European Journal of Marketing*. 39(7/8): 729-736.

Almusaed et al., 2023 – *Almusaed, A., Almssad, A., Yitmen, I., Homod, R.Z.* (2023). Enhancing Student Engagement: Harnessing "AIED"'s Power in Hybrid Education – A Review Analysis. *Education Sciences*. 13(7): 632. DOI: 10.3390/educsci13070632

Anikina et al., 2015 – *Anikina, O.V., Yakimenko, E.V.* (2015). Edutainment as a modern technology of education. International conference on research paradigms Transformation in Social Sciences 2014. *Procedia-Social and Behavioral Sciences*. 166: 475–479. DOI: 10.1016/j.sbspro.2014.12.558

Bazhin, Issa, 2021 – *Bazhin, V.Yu., Issa, B.* (2021). Influence of heat treatment on the microstructure of steel coils of a heating tube furnace. *Journal of Mining Institute*. 249: 393-400. DOI: 10.31897/PMI.2021.3.8

Boyko, Koltsova, 2023 – *Boyko, S.A., Koltsova, E.A.* (2023). Teaching English for special purposes to bachelors of engineering and technology: corpus approach and terminological units. *European Journal of Contemporary Education*. 12 (1): 28-39.

Brame, 2016 – *Brame, C.J.* (2016). Effective educational videos: principles and guidelines for maximizing student learning from video content. *CBE—life sciences education*. 15(4): es6, 1-6. DOI: 10.1187/cbe.16-03-0125

Buckingham, Scanlon, 2005 – *Buckingham, D., Scanlon, M.* (2005). Selling learning: towards a political economy of edutainment media. *Media, Culture and Society*. 27(1): 41-58. DOI: 10.1177/0163443705049057

Chilingaryan, Zvereva, 2020 – *Chilingaryan, K., Zvereva, E.* (2020). Edutainment as a new tool for development. *Proceedings of INTCESS 2020 – 7th International Conference on Education and Social Sciences*, DUBAI (UAE). Pp. 341-349.

De Vari, 2008 – *De Vari, Sh.* (2008). Educational gaming. Interactive edutainment. Distance learning for educators, trainers and leaders. Boston. 5(3): 35-44.

Dubakov, Olar, 2019 – *Dubakov, A., Olar, J.* (2019). The use of edutainment technology in teaching English as a second foreign language to future teachers. *Proceedings of EDULEARN19 11th International Conference on Education and New Learning Technologies*, Palma, Mallorca, Spain. Pp. 83-86.

Duggal et al., 2021 – *Duggal, K., Gupta, L.R., Singh, P.* (2021). Gamification and machine learning inspired approach for classroom engagement and learning. *Mathematical Problems in Engineering*. 21: 1-18. DOI: 10.1155/2021/9922775

Eck Duymaer van Twist et al., 2021 – *Eck Duymaer van Twist, A., Newcombe, S. Strauss-Howe* (2021). Generational Theory. In James Crosley and Alastair Lockhart (eds.) Critical Dictionary of Apocalyptic and Millenarian Movements.

Elghomary et al., 2022 – *Elghomary, K., Bouzidi, D., Najima D.* (2022). Design of a Smart MOOC Trust Model: Towards a Dynamic Peer Recommendation to Foster Collaboration and Learner's Engagement. *International Journal of Emerging Technologies in Learning (iJET)*. 17(05): 36-56. DOI: 10.3991/ijet.v17i05.27705

Hunt et al., 2023 – *Hunt, J.H., Taub, M., Marino, M., Duarte, A., Bentley, B., Holman, K., Kuhlman, A.* (2023). Effects of game-enhanced supplemental fraction curriculum on student engagement, fraction knowledge, and STEM interest. *Education Sciences*. 13(7). 646. DOI: 10.3390/educsci13070646

Karmalova, Khankeeva, 2016 – *Karmalova, E.Y., Khankeeva, A.A.* (2016). Ed'yuteinment: ponyatie, spetsifika, issledovanie potrebnosti v nem tselevoi auditorii [Edutainment: concept, specifics, research of demand for edutainment among the target audience]. *Vestnik Chelyabinskogo gosudarstvennogo universiteta*. 7(389). 101: 64-71. [in Russian]

Kazanin et al., 2021 – *Kazanin, O.I., Marinin, M.A., Blinov, A.M.* (2021). Professional retraining in the staffing system for the mining enterprises. *Occupational safety in industry*. 7: 79-84. DOI: 10.24000/0409-2961-2021-7-79-84

Kretschmann et al., 2020 – *Kretschmann, J., Plien, M., Nguyen, T.N., Rudakov, M.L.* (2020). Effective capacity building by empowerment teaching in the field of occupational safety and health management in mining. *Journal of Mining Institute*. 242: 248. DOI: 10.31897/PMI.2020.2.248

Litvinenko et al., 2023 – *Litvinenko, V.S., Petrov, E.I., Vasilevskaya, D.V., Yakovenko, A.V., Naumov, I.A., Ratnikov, M.A.* (2023). Assessment of the role of the state in the management of mineral resources. *Journal of Mining Institute*. 259: 95.

Litvinenko, et al., 2022 – *Litvinenko, V.S., Bowbrick, I., Naumov, I.A., Zaitseva, Z.* (2022). Global guidelines and requirements for professional competencies of natural resource extraction engineers: Implications for ESG principles and sustainable development goals. *Journal of Cleaner Production*. 338: 1-9.

Makhovikov et al., 2023 – *Makhovikov, A.B., Kryltsov, S.B., Matrokhina, K.V., Trofimets, V.Ya.* (2023). Secured communication system for a metallurgical company. *Non-ferrous metals*. 4: 5-13. DOI: 10.17580/tsm.2023.04.01

Matrokhina et al., 2023 – *Matrokhina, K.V., Trofimets, V.Y., Mazakov, E.B., Makhovikov, A.B., Khaykin, M.M.* (2023). Development of methodology for scenario analysis of investment projects of enterprises of the mineral resource complex. *Journal of Mining Institute*. 259: 112-124. DOI: 10.31897/PMI.2023.3

Mikeshin, 2022 – *Mikeshin, M.I. (*2022). Metallurgical science in the virtual world. *Non-ferrous metals*. 7: 98-103. DOI: 10.17580/tsm.2022.07.12

Motteram, 2013 – *Motteram, G.* (2013). Innovations in learning technologies for English language teaching. London, UK, 197 p.

Murzo, Chuvileva, 2021 – *Murzo, Yu., Chuvileva, N.* (2021). Use of information technologies in developing foreign language competence for professional interaction of undergraduate and postgraduate students specializing in mineral resources. *International Journal of Emerging Technologies in Learning*. 16(03): 1440153.

Němec, Trna, 2007 – *Němec, J., Trna, J.* (2007). Edutainment or entertainment. Education possibilities of didactic games in science education. In book: Němec, J. (ed.). The evolution of children play- 24 ICCP. Word Play Conference. Brno. Pp. 55-64.

Okan, 2003 – *Okan, Z.* (2003). Edutainment: Is learning at risk? *British Journal of Education Technology*. 34(3): 255-264. DOI: 10.1111/1467-8535.00325

Pashkevich, Danilov, 2023 – *Pashkevich, M.A., Danilov, A.S.* (2023). Ecological security and sustainability. *Journal of Mining Institute*. 260: 153-154.

Perez Sanchez, Masegosa, 2020 – *Perez Sanchez, M., Masegosa, A.G.* (2020). Gamification as a teaching resource for English-medium instruction and multilingual education at university. In book: Advances in educational technologies and instructional design. IGI Global. 248–267. DOI: 10.4018/978-1-7998-1097-1.ch012

Rassadina, 2016 – *Rassadina, S.A.* (2016). Culturological elements of edutainment employed in basic cultural formation of non-humanities students. *Journal of Mining Institute*. 219: 498. DOI: 10.18454/PMI.2016.3.498

Shafait et al., 2021 – *Shafait, Z, Khan, M.A., Sahibzada, U.F., Dacko-Pikiewicz, Z, Popp, J.* (2021). An assessment of students' emotional intelligence, learning outcomes, and academic efficacy: A correlational study in higher education. *PLoS ONE*. 16(8): e0255428. DOI: 10.1371/journal.pone.0255428

Shmelev et al., 1987 – *Shmelev, A.G., Pohil'ko, V.I., Solovejchik, A.S.* (1987). 16PF Questionnaire. [Electronic resource]. URL: https://psytests.org/multi/cat16pfA-run.html; https://psyonline.ru/tests/cattell/

Skornyakova, Vinogradova, 2022 – *Skornyakova, E.R., Vinogradova, E.V.* (2022). Fostering engineering students' competences development through lexical aspect acquisition model. *International Journal of Engineering Pedagogy*. 12(6): 100-114.

Sveshnikova et al., 2022 – *Sveshnikova, S.A., Skornyakova, E.R., Troitskaya, M.A., Rogova, I.S.* (2022). Development of engineering students' motivation and independent learning skills. *European Journal of Contemporary Education*. 11(2): 555-569. DOI: 10.13187/ejced.2022.2.555

Udina, Khromov, 2015 – *Udina, N., Khromov, S.* (2015). Learning technologies and new models of teaching foreign languages. In book: The Magic of Innovation: New Techniques and Technologies in Teaching Foreign Languages Chapter: 2. Publisher: Cambridge Scholars Publishing. Editors: Dmitry A. Kryachkov, Elena B. Yastrebova and Olga A. Kravtsova. Pp. 27-43.

Vinogradova et al., 2022 – *Vinogradova, E.V., Borisova, Y.V., Kornienko, N.V.* (2022). The development of creative thinking in engineering students through web-related language learning lecture notes in networks and systems. *Technology, Innovation and Creativity in Digital Society*. 345: 881-891.

Wang et al. 2007 –*Wang, Ya., Zuo, M., Li, X.Y.* (2007). Edutainment technology – A new starting point for education development of China. *Proceedings-37th Annual frontiers in education conference – Global Engineering: knowledge without borders, opportunities without passports*. Pp. 10-13. DOI: 10.1109/FIE.2007.4417994

Yukhmina, Obvintseva, 2023 – *Yukhmina, Y.A., Obvintseva, N.V.* (2023). Edutainment technologies in foreign language teaching at university. *International Research Journal*. 1(127): 1-4. DOI: https://doi.org/10.23670/IRJ.2023.127.4