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Implementation of the Professionally-Oriented Foreign Language Competence in Terms of Integrative Approach for Training Future Engineers

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Abstract

The article deals with the actual issues of forming professionally-oriented foreign language competence concerning the future engineers' training. The article testifies the necessity of rendering future engineers with professionally-oriented foreign language training based on new engineering and technological approaches. The challenges of interdisciplinary studies of any area of economy cause enhanced intensive international collaboration and intercultural cooperation. It implies the improvement of professionally-oriented foreign language competence demand for the next generation of engineers and middle-line staff since it is essential for interdisciplinary and international team work training. Considering the experimental results, it has been confirmed that professional foreign language competence is effectively developed within "Intensive integrative course of foreign language", content and structure of which are based on an integrative approach and a set of suggested organisational principles. The article summarises the results of the direct observation and interviews.

Keywords: foreign language competence, integrative approach, interdisciplinarity, interdisciplinary teams, advancement and development of qualification.

Introduction

State-of-the-art technologies in engineering comprise an interdisciplinary approach applying sufficient knowledge from different courses, i.e., chemistry, physics, geology, biology, ecology, economics, information technology and others. It is a good practice to arrange interdisciplinary collaboration worldwide due to benefits from different engineering and research schools, alongside with practical experience of producers, specifically technologists and engineers. One of the outcomes of globalisation in engineering is a fractional process, in other words, when various parts of machines or mechanisms are manufactured in different countries, which significantly enhances international contact. More and more joint engineering projects are introduced into practice thanks to international and interdisciplinary developments, exchange of practical experience, and international collaboration with various shares of home and overseas capital. The effective interaction within teams is becoming sounder as they are at the same time interdisciplinary and international. At present, engineers' proficiency in English is among the main skills enabling companies to join the international professional community. Foreign professional communication skills are essential for engineering education because students are to obtain effective language training involving professional communication competence (Harmer, 2015). However, modern language training is to be rendered so that engineers could experience the professional activity as a member of an international interdisciplinary team (Graff, 2015). Undoubtedly, there is a strong demand for a change in the language training system directed to a qualitatively new level of cross-cultural competence, global professional language competence of both future engineers and working specialists considering professional communication competence.

The problem has led to the introduction of *English for Specific Purposes* (ESP) into the system of professional training. Moreover, it is regarded as the priority in educational innovation. ESP training enables using a foreign language to work out *global professional language competence* (GPLC). The main characteristic of this competence comes from the demand for curricula defined by accreditation agencies and by the professional roles of a globally competent engineer.

Theoretical Background

The views on the professional foreign language competence formation grounded on the interdisciplinary approach being a crucial part of future engineers training

at higher technical education institutions have been highlighted by J. Beynon, L. G. Brown, A. D. Chan, G. Codner, J. Fishbein A. Lidgett, C. S. Nair, A. Patil, N. Walker, T. Williams and others. A detailed consideration of the widespread terminology in the field of interdisciplinarity can be traced out in the works edited by L. R. Ackoff (1961), T. Ausburg (2016), G. Bammer (2013), J. H. Borland, H. J. Graff (2015), H. H. Jacobs, J. H. Borland (1986), J. T. Klein (1996), D. McDonald (2009), A. Repko (2008; 2013), etc. and in the proceedings of recently held international conferences, namely those taking place under UNESCO auspices (The Charter of Transdisciplinarity, 1994; World declaration on higher education in the twenty-first century: vision and action, 1998).

Great attention is given to the results of researches obtained by scientists from around the world on the following issues: professional training of petroleum engineers (J. Beynon, D. Chan, M. Hole, A. Lidgett, A. Patil, I. Sandra, N. Walker, T. Williams); interdisciplinarity in the training of future engineers (T. Grossman, J. Klein, A. Levin, E. McGrath, L. Meagher, W. Mayville, R. Meeth, W. Newell, A. Repko, M. Tarvainen); development of European universities (Ph. Altbach, T. Husen, J. Keeves, W. Mitter, J. Walker, O. Fulton); curricula features of disciplines (H. Jacobs, G. O'Neill, R. Peters, P. Hirst); internationalisation of engineering education (J. Aigner, Ph. Altbach, E. Birkens, Ch. Broaden); human resources development (M. Armstrong, B. Axelrod, M. Gladwell, H. Handfield-Jones, E. Michaels); motivation and methods and techniques used for encouraging professional development and self-education (E. Deci, M. Hitt, W. Milman, V. Oldham, R. Rager, G. Ryan, Ph. Sanger, K. Smith); approaches and methods of foreign language teaching (C. Brumfit, R. Flavell, J. Harmer, P. Hill, D. Lasagabaste, A. Pincas) and others.

The concept of the study is based on a set of interrelated philosophical, sociological, historical, psychological, pedagogical and other provisions. The interdisciplinarity of the study necessitated appeal to the concepts of psychopedagogy, psychophysiology, principles of general, comparative, professional, engineering pedagogy, pedagogy of higher school and education management, which enable systematic and objective analysis, the multidimensionality of scientific research on the chosen problem.

In 2007 the key requirement of all agencies was the need for a global model of engineering accreditation that can be applied to estimate engineers' global professional skills (Patil & Codner, 2007, p. 642). Accordingly, A. Patil, C. S. Nair, and G. Codner (2008) specified six fundamental qualities of a globally competent engineer. Next year, A. D. Chan and J. Fishbein (2009, pp. 4–9) extended this enumeration by making up ten qualities. Having analysed the qualities and require-

ments of leading international accreditation agencies for a globally competent engineer (Criteria for accreditation engineering programmes, 2014, pp. 17–19; Criteria for engineering education accreditation, 2016; JABEE common criteria for the accreditation of professional education programmes, 2012), we identified five core blocks of GPLC intended to master language skills of a globally competent engineer.

1. Communication skills: the ability to work and communicate in the domestic and overseas medium with those who represent any nation and culture; ability to dispute, and convince, to give personal feedback outside the meeting or use techniques in the meeting to keep the discussion focused; ability to be flexible enough to work with their communication style, to understand the speaker's point of view on most topics delivered at a natural speed and in standard language, justify and sustain views clearly by providing relevant explanations and arguments, politely interject while someone else is speaking during a work-related meeting, manage a discussion on familiar topics confirming comprehension, etc., respond to interruptions and encourage decision-making in meetings using fixed expressions, extract specific details on a professional topic, lead a discussion, expanding and developing ideas. In addition, it is an ability to work and share information clearly and concisely within a team and among colleagues, exhibit the ability to listen actively and be quick in understanding information and new ideas, display an aptitude for developing the skills of others and to help them solve any problems they have, give constructive feedback, successfully encounter all targets.
2. Self-reliance: the capability to study and introduce innovations by yourself in a certain subject; ability to use up-to-date information technologies; knowledge and skills of searching for and collecting professional information in different databases (library and electron ones); the ability of advancement and development of qualification.
3. Worked out critical ways of analysing: the capability to cope quickly with a problem of any complexity, respond adequately; ability to analyse, generalise, observe, interpret, criticise, reason, and act creatively; mastery of critical thinking techniques; ability to select evaluation criteria reasonably, knowledge of value system; ability to analyse, process and present information in the form of review, report.
4. Intercommunication expertise: the ability to be a member or a leader of the multidisciplinary and cross-cultural group; ability to exchange views and ideas with employees of other companies; ability to supervise and report;

labour market research; ability to effectively interrelate and operate in the inventive medium; ability to develop an argument giving reasons in support of or against a particular point of view; bring relevant personal experiences into a conversation to illustrate a point, justify and sustain views clearly by providing relevant explanations and arguments.

5. Morally correct attitude: the ability to understand the importance and influence of own profession on society, industry, nature, and economy worldwide; knowledge and ability to effectively apply professional ethics; the understanding of responsibility in making professional decisions; skills of running an international business, solving problems related to national differentiations; ability to understand diversities and specific differences between native and other cultures; knowledge of ethical points of cultures; ability to synthesise the knowledge of diverse disciplines and skills for applying them in a unified environment; ability to collaborate internationally.

Formed on the mentioned qualities needed from a global engineer, GPLC is described as expected future expert's ability to effectively use foreign language awareness and skills in the secondary language medium to overcome fundamental communicative, presentation, and technical professional issues, communicate successfully and ethically under the conditions of professional international collaboration, to be a member or leader of interdisciplinary, international teams, to think critically and act pliantly under any conditions of professional cross-cultural cooperation, along with willingness and adaptability for life-long professional self-improvement in the sphere of international communication. Considering GPLC essential parts, we should mention that communication skills are not just in line with others which are core skills, as mastering all other integral parts is performed presumably through communication.

There have been major changes in the petroleum industry, which have created challenges in terms of profit and manpower. It should be mentioned that the principal employability skills any engineer needs to succeed in the workplace are the following: collaboration, teamwork, communication, creativity, proactivity, problem-solving, critical thinking, flexibility, self-management, resilience. When comparing GPLC components and Ukrainian state requirements for training engineers, it is evident that state educational standards do not fully meet the requirements of a global labour market. At most, one can say that GPLC components are presented separately as constituents of different state educational competencies.

Research Methodology

The article aims to explore whether students' vocabulary learning can be improved through an "Intensive integrative foreign language course" based on an integrative approach and interdisciplinarity and to further enhance their GPLC development. Interdisciplinarity is regarded as one of the efficient means to encourage young specialists, motivate future engineers and increase the effectiveness of fruitful interaction of professionals from various fields of economy. The solution to certain tasks and the achievement of the goal required direct observation and interviews.

Participants

A total of 70 fourth-year students from two classes of Ivano-Frankivsk National Technical University of Oil and Gas in Ukraine participated in this study. One class was randomly selected as the experimental group, and the other was assigned as the control group. The experimental group consisted of 29 male and 6 female students. The control group consisted of 27 male and 8 female students. Students were aged between 20 and 22 years old and had learned English for 15 to 17 years. Both groups had four hours of English classes a week taught by the same lecturer.

Instrument

It is suggested that GPLC of students and engineers should be efficiently developed by introducing an "Intensive integrative foreign language course" based on an integrative approach and interdisciplinarity. The course could be a part of both basic university and further professional development training. The integrative approach is conditioned by the interdisciplinary character of the engineer's professional activity, as well as more general trends – the integration of science, education, and industry resulting in uniting the content of different disciplines (Jacobs & Borland, p. 162). The integrative approach makes it possible to link the vocation-related disciplines with a foreign language that generates sustained interest in language learning and encourages motivation. The regular interdisciplinary integration focused on the professional sphere during the foreign language classes positively affects the development of professional qualities. Interdisciplinary integration enables students to build an integrative professional worldview, develop

critical thinking and imagination, increase cognitive activity, develop creative skills, and perform intensive cognitive and research activities (Lori, 2014, p. 34). Such an approach strengthens the preparation for work in interdisciplinary, international teams and projects and can be adopted to basic and further education.

The fundamental principles of “Intensive integrative course of foreign language” aimed at GPLC development were distinguished in the following way: the principle of professional relevance (the content of the course was designed considering professional functionality), the principle of language authenticity (the course should facilitate both communication skills development and the skills of the correct usage of speech patterns), the principle of time and load management (the course is designed in such a way that student’s active and passive vocabulary increases quadruply in comparison with the traditional training method), context-based principle (the content is picked out in such a way that new words are learnt in the process of contextual guess and in the subsequent learning process they become an impetus for student’s response), the principle of motivating content (learning content creates professional environment producing situations to encourage learners to speak), the principle of integration of all learning activities (communication skills are incapable of being separated from other types of language activities, as there should be integration of speaking with other language competencies), the principle of teaching to learn (learning content is to teach students to use foreign language as a means for information search and self-improvement), the principle of speaking and culture integration (the course content is to be concentrated on the development of speaking intercultural), the principle of critical thinking development (tasks are to be focused on the development of student’s critical thinking that enables a future specialist flexibility to analyse professional environment of the future workplace).

The “Intensive integrative course of a foreign language” suggests a combination of learning methods forming the conditions of GPLC development, e.g., role-playing, debates, brainstorming, case study, problem tasks, jigsaw technique, project method.

At the end of the semester, students in the experimental groups were required to answer a questionnaire developed by the researchers of this study. The questionnaire containing 13 items was divided into two categories: attitude and learning effect.

Procedure

At the start and end of the semester, all participants were required to take a pre- and a post- GPLC development (global professional language competence) test. During the second to the tenth week, only in the experimental group, English was taught based on selected material integrated with the major disciplines of professional profile. To implement the integrative approach, a variable set of practical tasks was used with the problems close to those encountered in the professional conditions and global interdisciplinary environment. During communicative games, students were divided into teams, each with its own role of their future profession, for instance, geologists, drillers, geophysicists, geotechnicians, technicians, etc. Competitive base and a high level of independence in problem-solving intensified motivation to learn professional English. The students clarified relevant professional matters of cross-cultural and interdisciplinary character. For instance, during business role-playing, projects and problem-solving tasks, the students were able to address the issues of presenting new petroleum field equipment, studying oil and gas production methods, and drilling technologies used abroad. While performing the task, it was necessary to follow rules of decorum, cross-cultural conventions, and consider foreign colleagues' national and cultural features. Besides, six randomly selected students in the experimental group were interviewed after the experiment.

Data Collection and Analysis

Both quantitative and qualitative data were collected. The quantitative data were collected from the survey questionnaire and the students' scores in the pre- and post-tests. The qualitative data was collected from classroom observation and interviews. The independent sample t-test was used to determine if there was a difference between the means of the two groups. Also, a paired sample t-test was utilised to determine whether the post-test score of the experiment group was different from the pre-test score. In addition, content analysis was used to analyse the qualitative data.

Results – The Effectiveness of the Use of “Intensive integrative foreign language course” for GPLC Development

Independent Sample T-Test

Table 1 demonstrates the results of the independent sample t-test. It can be seen that there was no significant difference in the total scores of post-test GPLC development between the control and the experimental group ($F = .019$, $p = 0.893$). Neither did the listening section scores ($F = 1.119$, $p = 0.289$) and the reading section scores ($F = 1.029$, $p = 0.322$) between the control and the experimental group. It showed that using “Intensive integrative foreign language course” improved students’ GPLC development test scores insignificantly.

Table 1. Independent sample t-test analysis of post-GPLC development test scores

Post-test	F	t	df	Sig.
Listening	1.119	-0.338	70.000	0.289
Reading	1.029	-1.180	70.000	0.322
Total	.019	-0.802	70.000	0.893

Paired Sample T-Test

Table 2 shows the results of the paired sample t-test of the pre- and post-GPLC development test scores of the experimental group. The results of the listening section ($t = 3.770$, $p = 0.001$) and total score ($t = 2.998$, $p = 0.008$) indicated that there were significant differences in the pre-test and post-test. However, both post-scores were significantly lower than the pre-test scores. It corresponded with the t-test results that “Intensive integrative foreign language course” helped improve students’ GPLC development test scores insignificantly.

Table 2. Paired sample t-test analysis of pre- and post-GPLC development test scores of the experimental group

Pre- and post-test	N	M	SD	t	df	Sig.	
Listening	Pre-test	34	197.08	58.711	3.770	33	0.001*
	Post-test	34	167.58	58.561			
Reading	Pre-test	34	111.49	52.507	0.319	33	0.917
	Post-test	34	108.47	43.119			
Total	Pre-test	34	306.38	96.765	2.998	33	0.008*
	Post-test	34	274.28	84.558			

Note * $p < 0.5$.

End-of-Term Questionnaire – Learning effect

As shown in Table 3, most students (85%) believed that they obtained a myriad of GPLC vocabulary words via “Intensive integrative foreign language course” ($M = 5.37$). In addition, about half of the students (58%) stated that the course improved their ability to memorise words for professional English communication ($M = 4.78$) and their English reading ability ($M = 4.79$). Further, more than half of the students (64%) felt that the course effectively improved their English listening ability ($M = 4.87$). More than half of the students (54%) believed that the course revealed the ability to self-study and self-development in the area of professional communication ($M = 4.65$). In general, most students (76%) regarded “Intensive integrative foreign language course” as satisfactory in enriching their level of English communicative skill development ($M = 5.14$).

Table 3. Descriptive analysis of end-of-term questionnaire

Items	N	M	SD	Strongly agree	Agree
1. I obtained a myriad of GPLC vocabulary words via the course.	32	5.37	.925	52%	33%
2. This course improved my ability to memorise words for professional English communication.	32	4.78	1.189	46%	12%
3. This course revealed the ability to self-study and self-development in professional communication.	32	4.65	1.148	35%	19%
4. This course increased my English listening ability.	32	4.87	1.225	49%	15%
5. This course enhanced my English reading ability.	32	4.79	1.126	43%	15%
6. This course improved my ability to communicate ethically in a cross-cultural environment.	32	4.79	1.096	36%	33%
7. In general, this course contributed to improving my level of English communicative skill development.	32	5.14	.999	43%	33%

Descriptive Analysis of End-of-Term Questionnaire – Attitude

As presented in Table 4, the majority of students (82%) stated that “Intensive integrative foreign language course” was effective ($M = 4.87$). In addition, most (75%) confessed that it was interesting to learn new professionally-oriented vocabulary by using this course ($M = 4.32$). Compared with the traditional learning method, most students (76%) would rather use this course to learn new words ($M = 4.55$). About half of the students (62%) believed that this course was fascinating ($M = 4.06$), and most (65%) agreed that this is an effective tool for learning

vocabulary for their GPLC development ($M = 4.11$). Most students (72%) also expressed that they would recommend this course to their friends ($M = 4.82$).

Table 4. Descriptive analysis of end-of-term questionnaire

Items	N	M	SD	Strongly agree	Agree
1. To my mind, this course is effective.	32	4.87	.932	49%	33%
2. To my mind, it is enjoyable to learn new professionally-oriented vocabulary by using this course for my GPLC development.	32	4.32	.869	56%	19%
3. I would rather use this course to learn professionally-oriented vocabulary than the traditional learning method.	32	4.55	1.148	51%	25%
4. This course fascinates me to learn new professionally-oriented vocabulary for my GPLC development.	32	4.06	1.225	47%	15%
5. To my mind, this course is an effective tool for learning new professionally-oriented vocabulary for my GPLC development.	32	4.11	1.125	46%	19%
6. I would recommend this course to my friends.	32	4.82	1.216	38%	34%

Interview

Most students indicated that the “Intensive integrative foreign language course” was tremendously interesting for their GPLC development. They liked a variable set of practical tasks used with the problems close to those encountered in the professional conditions and global interdisciplinary environment. During communicative games, students were divided into teams, each with its own role of their future profession, for instance, geologists, drillers, geophysicists, geotechnicians, technicians, etc. Competitive base and a high level of independence in problem-solving intensified motivation to learn professional English. The students clarified relevant professional matters of cross-cultural and interdisciplinary character. For instance, during business role-playing, projects, and problem-solving tasks, the students were able to address the issues of presenting new petroleum field equipment, studying oil and gas production methods, and drilling technologies used abroad. While performing the task, it was necessary to follow rules of decorum, cross-cultural conventions, and consider foreign colleagues’ national and cultural features.

In general, most students liked “Intensive integrative foreign language course”, but there were several contradictory comments. For instance, two students said that tasks on thinking critically in the professional environment were not of great importance. One student mentioned that tasks stating the ability to communicate ethically in the cross-cultural environment were quite difficult.

The students were also asked to express their opinions on the pros and cons of the “Intensive integrative foreign language course”. The following pluses were formulated: 1) a great variety of professionally-oriented vocabulary; 2) the acquiring professionally-oriented vocabulary functions were sufficient; 3) their self-confidence increased after performing tasks correctly; 4) useful when preparing for their GPLC development; and 5) interesting communicative tasks. As for minuses, two students considered that the answer time was quite short, and their responses were wrong because of tension. Moreover, three students boiled down that their eagerness to be questioned again was little after passing the same task. It was not supportive when preparing for an exam that needs regularly reviewing the words. When students were asked if they would recommend this course to their friends, thirteen students answered that they would willingly advise the course to others because they were sure that their English ability to improve. Two students mentioned that the professionally-oriented vocabulary was easy to forget when not used in a field environment. Among the interviewees, four students stated that they would probably carry on studying the course because it helped them enhance their professionally-oriented English language competence and succeed in teamwork, problem-solving, flexibility, and critical thinking.

Conclusions

The outcomes of the independent sample t-test indicated that mean scores of the post-GPLC development test for the control and the experimental group were not significantly different. Further, the results of the paired sample t-test showed that “Intensive integrative foreign language course” was not significantly supportive in improving the students’ scores in the GPLC development test, either. However, the questionnaire results demonstrated that the students were certain that the course helped them obtain new vocabulary. The students also agreed that the course improved their ability to memorise professionally-oriented vocabulary and enhanced their GPLC performance. The students were satisfied with the course, specifically introducing interesting tasks and games. Moreover, students’ evaluations and attitudes towards “Intensive integrative foreign language course”

were mainly positive. Students emphasised that the course was effective and fascinating. Compared with the traditional learning method, they preferred to use this course to learn professionally-oriented English vocabulary. Subsequently, they were eager to recommend it to their friends. The qualitative data collected from classroom observations underlined that the students had positive reactions when using the course. The majority of them undoubtedly enjoyed it. Besides, most students demonstrated a positive attitude toward the course during the interviews. The students also preferred to learn via this course and were willing to recommend it to their friends. Only one student stated that the course did not help her because the new words were difficult to retain without reviewing first. Ultimately, the students stressed out that this course improved their GPLC development. Although the independent sample t-test showed no significant improvement between the pre and post GPLC development scores of the experimental group, this course was able to extend the students' willingness and confidence to learn professionally-oriented English. This research has some limitations. The number of females did not exceed 20% in both classes, and the six students interviewed were all females. It is recommended that future studies recruit participants with an equal quantity of males and females. Eventually, this research presented the positive effects of using "Intensive integrative foreign language course" for GPLC development. It should be mentioned the course increased the students' motivation and self-confidence; thus, this study still recommends the use of the "Intensive integrative foreign language course" in class because it is of great importance in expanding students' professionally-oriented foreign language competence.

Thus, the competitiveness of current manufacturing is ensured by an expert of a new profile who is able to work internationally, implementing effective professional activity within international interdisciplinary teams. It is strictly assumed that the shift in foreign language training directed to the development of global professional language competence is a cornerstone in the change of focusing on the professionally-oriented foreign language training engineers of the different areas of the economy with a high share of international collaboration and interdisciplinary activities. Foreign language competence is a tremendously significant 21st-century skill that future specialists need to equip themselves with to achieve and increase their employability. The international nature and scope of the job market require that prospective employees show competence in one more than one language. Thus, foreign language competences would secure a stronger footing in a global market.

References

- Aberšek, B. (2010). Development of communication training paradigm for engineers. *Journal of Baltic Science Education*, 9(2), 99–108.
- Ackoff, R. L. (1961). Systems, organizations, and interdisciplinary research. In D. P. Eckman (Ed.), *Systems: research and design: Proc. 1st Systems symp. Case Inst. of Technology* (pp. 26–42). John Wiley and Sons, Inc.
- Augsburg, T. (2016). *Becoming Interdisciplinary* (3rd edition). Kendall.
- Bammer, G. (2013). *Disciplining Interdisciplinarity*. Australian National University Press.
- Chan, D., & Fishbein, J. (2009). A global engineer for the global community. *Journal of Policy Engagement*, 1(2), 4–9.
- Criteria for accreditation engineering programs. (2014). Baltimore, ABET. <http://www.abet.org/wp-content/uploads/2015/05/E001-15-16-EAC-Criteria-03-10-15.pdf>
- Criteria for engineering education accreditation (2016). *General Criteria. China Engineering Education Accreditation Association (CEEAA)*. Beijing, 2012–2016. http://www.ceeaa.org.cn/criteriaG_en.html
- Dlaska, A. (2013). The role of foreign language programmes in internationalising learning and teaching in higher education. *Teaching in Higher Education*, 18(3), 260–271.
- Doiz, A., Lasagabaster, D., & Sierra, J. M. (2014). Language friction and multilingual policies in higher education: the stakeholders' view. *Journal of Multilingual & Multicultural Development*, 35(4), 345–360.
- Graff, H. J. (2015). *Undisciplining Knowledge; Interdisciplinarity in the Twentieth Century*. Johns Hopkins University Press.
- Harmer, J. (2015). *The Practice of English Language Teaching* (5th edition). Pearson Education ESL.
- Hymes, D. H. (1972). On Communicative Competence. In J. B. Pride & J. Holmes (Eds), *Sociolinguistics. Selected Readings. Part 2* (pp. 269–293). Penguin.
- JABEE common criteria for accreditation of professional education programs. (2012). Tokyo, JABEE. http://www.jabee.org/public_doc/download/?docid=6434
- Jacobs, H., & Borland, J. H. (1986). The Interdisciplinary Concept Model: Theory and Practice. *Gifted Child Quar, Fall*, 30(4), 159–163.
- Khairnar, C. M. (2015). Advance Pedagogy: Innovative Methods of Teaching and Learning. *International Journal of Information and Education Technology*, 5(11), 869–872. <https://doi.org/10.7763/ijiet.2015.v5.629>
- Klein, J. T. (1996). *Crossing Boundaries: Knowledge, Disciplinarity, and Interdisciplinarity*. University of Virginia Press.
- Krivoruchko, V. A., Raissova, A. B., Makarikhina, I. M., Yergazinova, G. D., & Kazhmutatova, B. R. (2015). Mobile-Assisted Learning as a Condition for Effective Development of Engineering Students' Foreign Language Competence. *International Education Studies*, 8(7), 158–168.
- Lappalainen, P. (2010). Integrated language education – a means of enhancing engineers' social competences. *European Journal of Engineering Education*, 35(4), 393–403.

- Lasagabaste, D. (2008). Foreign Language Competence in Content and Language Integrated Courses. *The Open Applied Linguistics Journal*, 1, 30–41.
- Lori, N. (2014). Interdisciplinarity in engineering education: Trends and concepts. *Engineering Education*, 14, 31–37.
- McDonald, D., Bammer, G., & Deane, P. (2009). *Research Integration Using Dialogue Methods*. Australian National University Press.
- Nguyen, D. Q. (1998). The Essential Skills and Attributes of an Engineer: A Comparative Study of Academics, Industry Personnel and Engineering Students. *Global Journal of Engineering Education*, 2(1), 65–76.
- Patil, A. S. (2004). A research project concerning the development of a scientific model for accreditation and quality assurance in engineering education. *World Transactions of Engineering and Technology Education*, 3(2), 131–139.
- Patil, A. (2010). *Global accreditation for global engineering attributes: a way forward*. <http://acquire.cqu.edu.au:8080/vital/access/services/Download/cqu:4206/ATTACHMENT01?open=true>
- Patil, A., & Codner, G. (2007). Accreditation of engineering education: review, observations and proposal for global accreditation. *European Journal of Engineering Education*, 32(6), 639–651.
- Patil, A. S., & Pudlowski, Z. J. (2005). Important Issues of the Accreditation and Quality Assurance and a Strategy in the Development of an Accreditation Framework for Engineering Courses. *Global Journal of Engineering Education*, 9(1), 49–58.
- Patil, A., Nair, C. S., & Codner, G. (2008). Global accreditation for global engineering attributes: A way forward. Proc. 19th conf. of the Austral. Assoc. for Eng. Education, Yeppoon, Queensland, Dec. 7-10. Yeppoon: Austral. Assoc. for Eng. Education. <http://acquire.cqu.edu.au:8080/vital/access/services/Download/cqu:4206/ATTACHMENT01?open=true>.
- Reimers, F., & Chung, C. (Eds.). (2016). *Teaching and learning for the twenty-first century: educational goals, policies and curricula from six nations*. Harvard Education Press.
- Repko, A. (2008). *Interdisciplinary Research: Process and Theory*. Sage.
- Repko, A. (2013). *Introduction to Interdisciplinary Studies*. Sage.
- Stavytska, I. (2017). The formation of foreign language competence of engineering students by means of multimedia. *Advanced Education*, 7, 123–128.
- Stranovská, E., Hvozdková, S., Munková, S., & Gadušová, Z. (2016). Foreign Language Education and Dynamics of Foreign Language Competence. *The European Journal of Social and Behavioural Sciences*, 17(3), 2141–2153.
- Tenopir, C., & King, D. W. (2004). *Communication patterns of engineers*. IEEE Press; Education Society A John Wiley & Sons, Inc.
- The Charter of Transdisciplinarity. (1994). <https://inters.org/Freitas-Morin-Nicolescu-Transdisciplinarity>
- World declaration on higher education in the twenty-first century: vision and action. (1998). Adopted by the World Conf. on higher education, UNESCO House, Paris, France, 9 Oct. 1998; UNESCO Culture of Peace Programme. <http://www.unesco.org/cpp/uk/declarations/world.pdf>