

Application Software Package as a Means of Professional Training of Sewing Industry Specialists in the Conditions of the University

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Abstract: The article is devoted to the application software package usage as a means of professional training of sewing industry specialists in the conditions of the university. It is established that the information competence formation of future sewing industry engineers should be carried out taking into account the peculiarities of the Information and Communication Technologies (ICT) usage at modern enterprises. The content peculiar features of information training of future sewing industry specialists have been studied based on of the analysis of educational curricula developed at Mukachevo State University. Foreign experience in the ICT usage in higher education has also been considered on the example of the Technical University of Liberec, Czech Republic.

The following scientific methods as systematization, analysis, generalization of theoretical sources and statistical data, structuring of pedagogical information on designing the content of educational curricula as well as the comparative analysis of foreign experience in the ICT usage in higher education have been applied to conduct the research.

The authors suggest that the development of own information products by the higher educational establishment, which are used within professionally-oriented disciplines are among the ways to increase the ICT competencies of future specialists in the garment industry.

Thorough study of the peculiarities of the application software packages usage during the training and production and engineering practices in the conditions of garment production also improve the level of information competence of students.

Keywords: *application software packages; professional training; garment industry specialists; university.*

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1. Introduction

Nowadays, one of the priority areas of higher education in Ukraine is the informatization of the educational process, training of future professionals for the active and productive usage of information and communication technologies (ICT). Qualitative formation of information competence of engineering students, in particular the future garment industry specialists is of special importance, which ensures their competitiveness in the national and European labour market in terms of automation and computerization of modern production (Blog Texprocess, 2019). It should be noted that the development of the specialist's ability to determine the technical and technological ICT usage peculiarities in the garment industry at the stage of designing new garments and developing design documentation for their manufacture is relevant (Blog Texprocess, 2019; Kolosnichenko et al., 2015).

In the context of training specialists, who must have high professional mobility and versatility, it is extremely important for engineering institutions to use in their educational process those software products that are relevant to production at present conditions. In the higher education system, the formation of information competence of future specialists is regulated by the standards of higher education, and carried out according to educational curricula that determine the set of disciplines. However, the content, methods, forms, teaching aids laid down in the academic disciplines do not fully take into account the specificity of the enterprises functioning in the industry under the influence of social and economic factors, as well as scientific and technological progress in the sphere of ICT. Thus, the discrepancies appear between the rapid development of software and hardware used in production, and the rates of change in the education system, which must train professionals in accordance to the labour market demands (Ivanova, 2004).

2. Literature review

The training of specialists in the field of garment production with the modern ICT usage is the subject of many research, because the integration of information, computing and communication technologies in the educational environment is one of the main changes in engineering education during the last century (Froyd et al., 2012). Scientists substantiate the ICT usage as a powerful and necessary tool for the implementation of modern advanced educational learning technologies, such as active learning

(Hartikainen, et al., 2019; Lorens et al., 2017; Streveler et al., 2017; Vera et al., 2006), multimedia technology (Lucke et al., 2017), the method of the “flipped classroom” (Höhne et al., 2004; Yelamarthi, et al., 2015), project-based learning (Bissel, 2002, Gibson et al., 2002; Nguyen et al., 2020), distance learning (Heap et al., 2004), etc. The ICT are also an effective tool in the teaching environment to control the knowledge and skills of engineering students (Dopper & Sjoer, 2004; Simões et al., 2010).

Scientists M. Kolosnichenko et al. (2010), A. Perminova (2011), I. Ivanova (2004), M. Skvarok (2015), and others are studying the improvement of professional training methods of future sewing specialists by means of computer technologies.

Scientist A. Perminova (2011) in her work points out, that it is the educational process informatization in particular, and the development of pedagogical and computer technologies have provided the rapid development of training methods for future engineering personnel of the sewing profile, updating the content as well as introducing new special disciplines. At the same time, the scientist remarks, that the active involvement of informational teaching aids in the educational process “on the one hand, provides high-quality, efficient and dynamic material presentation, promotes the development of students' motivation, their collective work, reduces the time for achievement test. On the other hand, ICT is an expensive tool that limits the possibility of direct communication of the applicants for education” (Perminova, 2011).

I. Ivanova (2004) emphasizes the importance of the development a system of didactic and methodological principles as well as their application in the educational process.

Researcher M. Skvarok (2015), emphasizes, that in the process of professional and pedagogical training in the context of modern information and educational trends, personal computer skills, usage of Internet resources, knowledge of computer science, information culture as well as the ability to implement the latest IT tools to solve professionally-oriented tasks are the priority for future engineers – teachers of sewing profile (Skvarok, 2015).

At the same time, the importance of monitoring the modern information programs usage in the garment industry, in order to improve the content of professional training of future specialists in the garment industry, is not updated in scientific works. Although, according to foreign researchers (Froyd et al., 2012), the introduction into the educational process of inexpensive, the ICT and application software packages (ASP) that are

most widely used in industry and easy to implement, can contribute to more effective achievement of educational goals in the educational process.

The acquisition of ICT competencies for future specialists in the garment industry is a professional necessity due to the labour market requirements to engineering specialties of this profile, as modern garment production is moving towards active computerization, informatization and complex automation of all stages of the product life cycle: pre-design research, design, production and operation (Blog Texprocess, 2019).

Aim of the research: to analyze the usage of the application software package usage as a means of professional training of sewing industry specialists in the conditions of the university.

3. Research methods

To achieve this goal, the following methods have been used: systematization, theoretical analysis and generalization of information sources and statistics in order to disclose the content of application software packages in the training of future garment industry engineers in the conditions of the higher education establishment; pedagogical information structuring concerning the educational programs content designing; comparative analysis of foreign experience of the ICT usage in higher education and strategies for their development in European countries, the application of which will contribute to the effective implementation of innovative technologies in the educational process of Ukrainian higher education.

4. Results

In order to find out the peculiarities of the usage of software products, in particular ASPs, in the professional training of sewing industry specialists in the conditions of the university, firstly we should determine their features. At domestic enterprises complex automation is realized only partially at the corresponding automated workplaces (AWP), in the vast majority it is a workstation of the designer, a workstation of the template automatic spreader, a workstation of the technologist of garments, a workstation of the organizer of production, a workstation of the pattern cutting overlooker.

The content features of software products and their application in production conditions have been studied at modern garment enterprises of light industry in the Transcarpathian region Mukachevo Knitwear Factory “Mriya”, PJSC “Uzhgorod Clothing Factory”, PJSC “Grono-Teks”, LLC

“Mukachevo Garment Factory”, “Ukran Abitex”, “Novitex”, “Miltex-Ukraine”, LLC “Sanders-Vynohradiv”, “Hoh-Bereg” LTD, Manufacturing and trading sewing enterprise “Kopanski dzherela”, “Edelweiss-Lego” (Holovne upravlinnia statystyky u Zakarpatskii oblasti, 2019).

It has been established that light industry production enterprises use CAD software products (Memetova, 2011) from leading foreign developers, such as Lectra systems (France), Gerber (USA), Assist, Grafis, NovoCut systems (Germany), etc.

At the same time, the analysis of the enterprises activity shows that most domestic enterprises work with software products of the Ukrainian developer CAD Legprom - “Julivi CAD”.

These are such enterprises as PJSC “Grono-Teks”, in Vynohradiv, CJSC “Uzhhorodska shveyyna fabryka “Parada”, in Uzhhorod, LLC “Mukachevo Garment Factory”, LLC “Edelweiss - Lego” in Mukachevo and others.

The study of the information products usage in the educational process of higher education establishments, in particular universities, directs our research to the study of the content of quality informational training of the light industry future professionals in such establishments. Mukachevo State University (MSU, 2020) is the largest “supplier” of engineering personnel to garment enterprises in the Zakarpattia region.

Theoretical analysis of educational and professional programmes (EPP), approved and put into effect at MSU during 2019-2020, which trains future specialists in the field of design and technology of garments, allowed to summarize information on the main components of educational programs - Fig. 1:

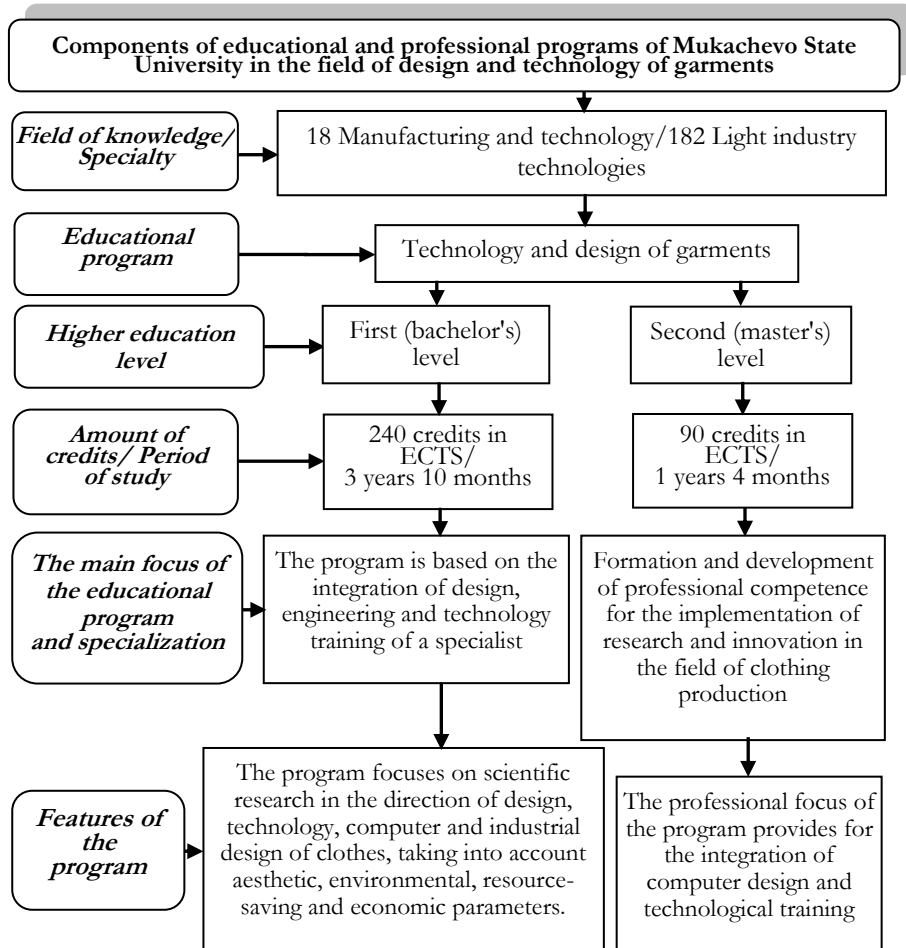


Figure 1. Components of educational and professional programs of MSU, according to which the training of specialists in the garment industry is carried out (Source: authors' development)

Thus, the formation of high - quality information and computer training for "Bachelor" and "Master" degrees is laid down in the content of Educational and professional program (EPP) and is implemented in the disciplines with the usage of equipment, hardware and software of specialized computer laboratories of MSU - table 1 and 2:

Table 1. The list of ASPs, that provides the formation of high-quality information and computer training for the future garment industry specialists, “Bachelor” degree

Item No.	Academic disciplines	ECTS credits	Application package Name	Tasks Solved with the Application Package
1	Fundamentals of information technology	5	MS OFFICE, Basic, Pascal, Paint, Corel Draw, AutoCAD	Working with various types of documents: texts, spreadsheets, presentations, databases and others, programming, creating educational projects using modern computer technologies
2	Engineering and computer graphics	7	MS OFFICE, «KOMPAS-3DLT», AutoCAD	Automation of design work, the creation of drawings of individual parts or connecting units, diagrams, specifications, tables, instructions, calculation and explanatory notes, technical specifications, text and other documents.
3	Wares design basics: design of garments	8	AutoLISP-“Sketch”, Corel Draw, Adobe Illustrator, AutoCAD,	Development of technical and artistic sketches of clothing models;
4	Wares design basics: clothing design	8	AutoLISP-“Constructor”, CAD “Grazia”,	Creation of drawings of the basic construction of clothes;
5	Design preparation of production	4	Demo version Julivi CAD, GRADIR	Technical reproduction of patterns
6	Fundamentals of Computer Technology and Fashion Design	6	Adobe Photoshop, PowerPoint	Advertising and presentation of design works
7	Materials science of garments	9	Bio Stat	Statistical processing of measurement data
8	Selection of materials for clothing	4	RANG	Expert assessment and ranking of factors
9	Preparatory cutting production and technology fundamentals	6	Optimizer.com	Rationing of material consumption

10	Planning and statistical processing of the experiment	4	Bio Stat, RANG, Mathcad, Origin	Statistical processing of measurement data Expert assessment and ranking of factors Quantitative data analysis, engineering calculations, statistical calculations and working with probability distributions
11	Fundamentals of Technical Creativity and Patent Science	3	AutoLISP-“Sketch”, CorelDraw, AutoCAD, Adobe Photoshop, Office suite of applications MS OFFICE	Development of technical and artistic sketches of clothing models; Submission of work results for registration of patent documentation
12	Automation of garment production processes	3	MS OFFICE, CAD “Grazia”, Software complex “Technology”	Development of technical documentation Production planning and preparation
13	Composition of clothes Typical clothing design Features of designing clothes from new materials	3 4 4	AutoLISP-“Sketch”, Corel Draw; Adobe Illustrator, AutoCAD, AutoLISP- “Constructor”, CAD “Grazia”, GRADIR, Adobe Photoshop, PowerPoint, MS OFFICE Publisher, Adobe Photoshop	Development of technical and artistic sketches of clothing models; Creation of drawings of the basic construction of clothes; Technical reproduction of patterns Advertising and presentation of design works

Total: 78

(Source: authors' development)

The analysis of the software products application allows to divide the packages of the applied programmes, which are used in the course of professional preparation of sewing industry specialists, into programmes of special purpose (Auto LISP - “Sketch”, Auto LISP- “Designer”, CAD “Grazia” Julivi CAD and others) and programs of the general purpose (Office application package MS OFFICE, “COMPASS-3DLT”, AutoCAD).

In the process of educational activity, students improve their design and construction competencies.

The usage of special purpose software products in the educational process of garment industry specialists training for “Master” degree provides

a deepening of the training content and the possibility of professional competencies improvement - table 2.

Table 2. The list of ASPs, that provides the formation of high-quality information and computer training for the future garment industry specialists, “Master” degree

Item No.	Academic disciplines	ECTS credits	Application package Name	Tasks Solved with the Application Package
1	Engineering design clothes and CAD	6	MS OFFICE, Corel Draw, Adobe Illustrator, AutoCAD, AutoLISP-“Sketch” CAD “Grazia”	Preparation of design and engineering text documents and analysis tables of adopted design solutions Development of technical and artistic sketches of clothing models Development of assembly diagrams for technological processing of parts and assemblies of garments Creation of drawings of the basic construction of clothes; development of a set of patterns, technical reproduction of patterns, performing the layout of patterns Development of a technological sequence for the manufacture of garments; drawing up a sewing flow diagram
2	Research Methodology in the Apparel Industry	3	PLANNIG EXPERIMENT, MS OFFISE (Excell), Bio Stat, ORIGIN	Analysis of factors influencing the hardware measurement error Mathematical and statistical processing, analysis of results Statistical processing of measurement data, construction and analysis of graphs of the experimental plan.
3	Methodology for competitive garments developing	5	RANG	Expert assessment and ranking of factors
4	Artistic design and clothing modeling	4	Corel Draw, Adobe Photoshop, Adobe Illustrator, MS OFFICE Publisher	Development of technical and artistic sketches of clothing models Development of graphic advertising compositions. Development of compositions, trademarks and logos
5	Innovative technologies of garment production	6	MS (Access), DBMS FoxPro, Autodesk 3ds max,	Creation of databases Database management Creation of three-dimensional computer-3dsaided clothing models, of various shapes and complexity

Google SketchUp Modeling relatively simple 3D objects			
6	Examination of materials and garment	4	RANG Ranking of factors
7	Computer preparation of design specification	4	Office suite ofDesign and use of electronic forms of MStechical documents OFFICE AutoCAD, Development of technical and artistic sketches of clothing models, розробка Adobe Illustrator, технологічних карт CAD “Grazia” Formation of schemes, patterns, technical reproduction of patterns, performing the layout of patterns
8	Modeling and optimization of technological processes garment production	5	CAD “Grazia”, Rationing of material consumption Corel Draw, Development of assembly diagrams for technological processing of parts and assemblies of garments AutoCAD, Software complexDevelopment of a technological sequence “Technology” for the manufacture of garments Calculation of sewing threads
9	Designing clothes for unstandart shapes	6	MS OFFICE, Preparation of design and engineering text documents and analysis tables of adopted design solutions Corel Draw, Development of technical and artistic sketches of clothing models AutoCAD, CAD “Grazia” Creation of drawings of the basic construction of clothes.
Total:43			

(Source: authors' development)

5. Discussion

The development of its own applied software products, by the higher education establishment, which will be further used, in particular, within professionally-oriented disciplines, can be considered as a way to improve the information competence of the future garment industry specialists.

Thus, teachers and students of Mukachevo State University, the Department of Engineering, Technology and Professional Education, have developed a number of applications that are actively used in the educational process to improve the future garment industry specialists information competence, including Auto LISP- “Sketch”, Auto LISP- “Designer”, RANG, Optimizator.com, software package “Technology”.

Higher technical educational establishments of neighbouring European countries, which train engineering personnel for light industry, are

moving towards the active implementation of ICT in the educational environment. These are the Technical University of Liberec (Czech Republic) (Technical University of Liberec, 2020) and the Alexander Dubček University of Trenčín (Slovakia) (Alexander Dubcek University of Trenčin, 2020). Study of the experience of the garment industry specialists training of these Higher Educational Establishments testifies their intensive usage of the ASPs in the educational process.

Based on the theoretical analysis of the educational program “Výroba oděvů a technické konfekce” (“Manufacture of clothing and technical products”), put into operation in 2019 at the Technical University of Liberec, (Czech Republic) for “Bachelor” degree, it has been established that within the disciplines of “Textilní technologie II” (Textile Technology II); “Konstrukce střihů oděvů” (Clothing design); “Zpracování dat” (Data Processing); “Technologická příprava výroby a logistika” (Technological preparation of production and logistics); “Technologie výroby oděvů” (Clothing manufacturing technologies); “Zkoušení textilií” (Testing of the textile quality); “Modelování střihů oděvů” (Clothing cuts modelling); “CAD/CAM systémy v oděvní výrobě” (CAD / CAM systems in the production of clothing) used the software products, that are widely implemented in industry.

At the same time within the disciplines “Základy programování v MATLABU” (Fundamentals of programming in MATLAB), “Speciální měřící metody” (Special measurement methods), “Počítačem podporované Modelování” (Computer modelling support), “Konstrukce počítačovou technikou” (Design using computer technology), “Počítačová simulace v oděvní výrobě” (Computer modelling in the production of clothing) educational program “Textilní Inženýrství” (Textile Engineering) for “Master” degree of the same university, put into operation in 2019, the specialized software products are used as a tool for research in the field.

For high-quality application of ICT in Higher technical educational establishments of the Czech Republic and Slovakia, the extensive material and technical capabilities have been created with the support of various funds and development programmes of the European Union. The following licensed software is used in the educational process: InvesMarkFutura by Investronica sistemas (Spain), AccuMark by Gerber Technology (USA), PDS Tailor by Classi CAD (Czech Republic), etc. (Technical University of Liberec, 2020).

It is possible to conduct a comparative analysis of the use of application software programmes in training garment industry specialists,

“Bachelor” and “Master” degrees in Mukachevo State University and Liberec, on the basis of the consolidated data (Tables 1 and 2), the study of curricula and the content of the disciplines of Higher educational establishments in the Czech Republic and Ukraine, - Figure 2

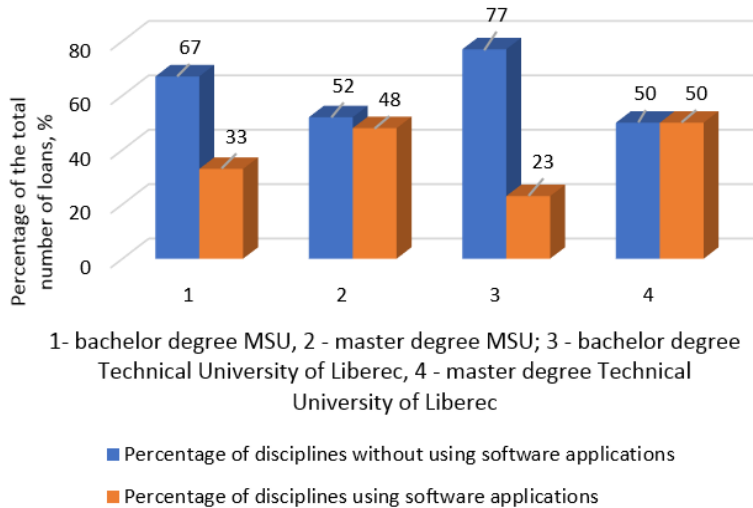


Figure 2. Comparative analysis of disciplines (number of credits) “Bachelor” and “Master” degree, in the educational content of which packages of applied programs are used
(Source: authors' development)

The comparative analysis of the level of the ASPs usage in the future garment specialists training according to educational and professional programme “Design and technology of garments”, “Bachelor” and “Master” degrees in higher education at Mukachevo State University shows the unevenness and some unsystematic application of such programmes (Figure 2). As it can be seen from this figure, the disciplines for "Bachelor" degree in MSU, during the study of which application software packages (ASP) are used, comprise about 1/3 of the total (78 credits out of 240), and for “Master” degree such disciplines comprise almost half (43 credits out of 90).

It should also be mentioned that according to the analysis of the objectives solved by ASPs within the disciplines of “Bachelor” degree (table 1), a significant number of applied programmes concerns the execution of work related to the development of models sketches, construction of drawings for basic clothing designs, i.e. with types of design work.

At the same time, there is almost no use of ASPs that would allow

studying the tasks concerning computerization and automation of production management and technological processes, which is most relevant for domestic garment enterprises, working in terms of job-processing contracts.

Only within the disciplines for “Master” degree (Table 2) “Engineering design of clothing and CAD”, “Innovative technologies of garment production” and “Modelling and optimization of technological processes of garment production” with the help of ASPs is the objectives of the technological module are performed.

The improvement of information competence of the future garment industry specialists, studying at MSU, is effectively realised during the students' training, production and engineering practice at the sewing enterprises. By improving practical training, students can directly study the peculiar features of the technological process informatization as well as the specificity of work with software products, which are used in this enterprise.

If we compare Mukachevo State University and the Technical University in Liberec regarding the level of the software products usage, then, when speaking of the ASPs usage MSU is slightly ahead quantitatively (by 10%), but qualitatively TUL looks better, because it uses more specialized software products in training of the garment industry specialists. MSU, to a greater extent, uses general purpose programmes, and therefore, the cooperation with garment enterprises is very important, because it allows students to see the work of software products that solve problems of production management and design of technological processes.

6. Conclusions

The requirements of a market economy and modern production put forward new requirements to the garment industry specialists. A competitive specialist must quickly adapt to the changing realities of production, use information technology in professional activities, possess non-standard way of thinking, communication skills, high productivity, creative approach to work, be able to work in a team, make quick decisions in different production situations as well as be responsible for them. There is a significant demand for professionals with high computer literacy and high general cultural competencies.

The improvement of educational curricula based on the software products usage, represented in modern industries, cooperation with companies-developers of application programs stimulate high-quality information and computer training of the future garment industry specialists.

This will intensify the use of educational technologies based on modern computer base, enable the creation of a powerful information and computer learning environment through the introduction of ASPs used in domestic and European garment industry enterprises, optimize the learning process based on individualization of learning, opportunities to combine the processes of studying, consolidating and controlling the acquired knowledge, skills and abilities; motivation of the applicants for education, development of creative thinking of the individual.

References

- Alexander Dubcek University of Trencin. (2020). Faculty of Industrial Technology. Alexander Dubcek University of Trencin <http://fpt.tnuni.sk>
- Bissel, C. C. (2002). Supporting student projects at a distance through ICT: The UK Open University approach. *European Journal of Engineering Education*, 27(1), 5-12. <https://doi.org/10.1080/03043790110100155>
- Blog Texprocess. (2019, May 24). *Thinking in 3D from outset*. Texprocess. <https://www.texprocess-blog.com/en/thinking-in-3d-from-the-outset>
- Dopper, S. M., & Sjoer, E. (2004). Implementing formative assessment in engineering education: the use of the online assessment system Etude. *European Journal of Engineering Education*, 29(2), 259-266 <https://doi.org/10.1080/0304379032000157187>
- Froyd, J. E., Wankat, P. C., & Smith, K. A. (2012). Five Major Shifts in 100 Years of Engineering Education. *Proceedings of the IEEE (Special Centennial Issue)*, 1344–1360. https://www.researchgate.net/publication/260648443_Five_Major_Shifts_in_100_Years_of_Engineering_Education
- Gibson, I. S., O'Reilly, C., & Hughes, M. (2002). Integration of ICT within a project-based learning environment. *European Journal of Engineering Education*, 27(1), 21-30. <https://doi.org/10.1080/03043790110100182>
- Hartikainen, S., Rintala, H., Pylväs, L., & Nokelainen, P. (2019). The Concept of Active Learning and the Measurement of Learning Outcomes: A Review of Research in Engineering Higher Education. *Education Sciences*, 9(4), 276. <https://doi.org/10.3390/educsci9040276>
- Heap, N. W., Kear, K. L., & Bissel, C. C. (2004). An overview of ICT-based assessment for engineering education. *European Journal of Engineering Education*, 29(2), 241-250. <https://doi.org/10.1080/0304379032000157204>
- Höhne, G., & Henkel, V. (2004). Application of multimedia in engineering design education. *European Journal of Engineering Education Volume 29(1)*, 87-96 . <https://doi.org/10.1080/0304379032000129278>

- Holovne upravlinnia statystyky u Zakarpatskii oblasti [The head office of statistics in the Transcarpathian region] (2019, June 6). *Lehka promyslovist oblasti* [Light industry]. <http://www.uz.ukrstat.gov.ua/news/2019/press/press1395>
- Ivanova, I. I. (2004). *Systema kompiuternoho modelyrovania v proffesionalnom obrazovannyi konstruktorov-modelerov* [Computer modeling system in professional education of fashion-designer], (Dyss. kand. ped. nauk). Toliatty [Diss. Candidate of Pedagogical Sciences] [Unpublished doctoral dissertation]. Togliatti University.
- Kolosnichenko, M., Pashkevich, K., & Ostapenko, N. (2015). Informatsiini tekhnologii navchannia – shliakh do pidhotovky konkurentozdatnykh fakhivtsiv z dizainu odiahu [Information technologies of teaching – path to preparation of competitive specialists of clothes design]. *Visnyk Kyivskoho natsionalnoho universytetu tekhnologii ta dizainu, seriia “Ekonomichni nauky”* [Bulletin of Kyiv National University of Technology and Design, series “Economic Sciences ”], 182-188.
- Kolosnichenko, M.V., Shcherban, V. Y., & Protsyk, K. L. (2010). *Kompiuterne proektuvannia odiahu*. [Computer designing of clothes]. Kyiv, Osvita Ukrainy [Education of Ukraine].
- Lorens, A., Berbegal-Mirabent, J., & Llinàs-Audet, X. (2017) Aligning professional skills and active learning methods: an application for information and communications technology engineering. *European Journal of Engineering Education*, 42(4), 382-395. <https://doi.org/10.1080/03043797.2016.1189880>
- Lucke, T., Dunn, P. K., & Christie, M. (2017). Activating learning in engineering education using ICT and the concept of “Flipping the classroom”. *European Journal of Engineering Education*, 42(1), 45-57. <https://doi.org/10.1080/03043797.2016.1201460>
- Memetova, S. E. (2011). Sravnitelnyiy analiz vozmozhnostey programmnyih moduley SAPR «Tehnolog» dlya proektirovaniya odezhdyi. [A comparative analysis of the capabilities of CAD «Technology» software modules for designing clothes] *Uchenyie zapiski Kryimskogo inzhenerno-pedagogicheskogo universiteta* [Scientific notes of the Crimean Engineering and Pedagogical University], 27, 157-161. http://nbuv.gov.ua/UJRN/VzKipu_2011_27_37
- Mukachevo State University. (2020). *Osvitni prohramy* [Educational programs]. Mukachevo State University. <https://msu.edu.ua/osvitni-programi>
- Nguyen, H., Wu, L., Fischer, C., Washington, G., & Warschauer, M. (2020). Increasing success in college: Examining the impact of a project-based introductory engineering course. *Journal of Engineering Education*, 109, 384–401. <https://doi.org/10.1002/jee.20319>
- Perminova, A.V. (2011). Rozvytok metodyk navchannia maibutnykh inzheneriv - pedahohiv shveinoho profilu u druhii polovyni XX stolittia [Development

- of methods of training future engineers - teachers of sewing profile in the second half of the twentieth century]. (Dys. kand. ped. nauk) [(Diss. Candidate of Pedagogical Sciences)] [Unpublished doctoral dissertation]. Kharkiv University.
- Simões, J. A., Revlas, C., & Moreira, R. (2010). Project-based teaching–learning computer-aided engineering tools, *European Journal of Engineering Education*, 29(1), 147-161. <https://doi.org/10.1080/0304379032000129223>
- Skvarok, M. Yu. (2015). Profesiina pidhotovka maibutnykh inzheneriv-pedahohiv do proektuvannia odiahu zasobamy informatsiynykh tekhnolohii [Professional training of future engineers-teachers for designing clothes by means of information technologies]. (Dys. kand. ped. nauk) [(Diss. Candidate of Pedagogical Sciences)] [Unpublished doctoral dissertation]. Drohobych University.
- Streveler, R. A., & Menekse, M. (2017). Taking a Closer Look at Active Learning. *Journal of Engineering Education*, 106, 186-190
<https://doi.org/10.1002/jee.2016>
- Technical University of Liberec. (2020). *Faculty of Textile Engineering*. Technical University of Liberec. <http://www.ft.tul.cz>
- Vera, C., Félez, J., Cobos, J. A., Sánchez-Naranjo, M. J., & Pinto, G. (2006). Experiences in education innovation: developing tools in support of active learning. *European Journal of Engineering Education*, 31(2), 227-236.
<https://doi.org/10.1080/03043790600567969>
- Yelamarthi, K., & Drake, E. (2015). A Flipped First-Year Digital Circuits Course for Engineering and Technology Students. *EEE Transactions on Education*, 58(3), 179-186. <https://doi.org/10.1109/TE.2014.2356174>