



PEDAGOGICAL CONDITIONS FOR THE DEVELOPMENT OF ENERGY-EFFICIENT COMPETENCE IN FUTURE CONSTRUCTION INDUSTRY PROFESSIONALS

Andrii Kalenskyi

Doctor of Pedagogical Sciences, Professor, Leading Researcher of the Department of Content and Technologies of Vocational Education of the Institute of Vocational Education of the National Academy of Sciences of Ukraine, <https://orcid.org/0000-0001-9034-5042>, e-mail: kalenskyandrii@gmail.com

Abstract

Relevance The urgency of developing energy-efficient competence in construction specialists at the current stage is determined by several factors: economic – the implementation of investments in infrastructure reconstruction requires significant financial resources, but increasing energy efficiency will lead to reduced energy consumption in the future; environmental – reducing energy consumption contributes to a decrease in carbon dioxide emissions through the transition to renewable energy sources and other low-carbon technologies.

Objective: To determine the pedagogical conditions for the development of energy-efficient competence in future construction industry professionals.

Methods: Theoretical analysis of pedagogical literature and educational-methodological documentation regarding the formation of energy-efficient competence in construction industry specialists; surveying pedagogical staff and methodologists of vocational education institutions – to determine the list of pedagogical conditions for the development of the studied phenomenon; expert evaluation – to select the most significant pedagogical conditions for the formation of energy-efficient competence in future construction industry professionals.

Results: Through the analysis of theoretical sources, educational and methodological literature, legislative acts, and surveys of teachers, masters, and industrial training instructors, a list of pedagogical conditions for the development of energy-efficient competence in future construction industry professionals was identified; to optimize the identified factors influencing the development of the studied phenomenon, their ranking and expert evaluation were conducted.

Conclusions: According to experts, the main pedagogical conditions influencing the development of energy-efficient competence in future construction industry professionals are: "Availability of teachers who possess energy-efficient competence and improvement of their qualifications in the field of energy-efficient technologies," "Use of active learning methods (project-based learning, case methods, etc.) for the formation of energy-efficient competence," "Creation of an appropriate educational creative environment that will influence the formation of energy-efficient competence in students."

Keywords: *vocational education, energy-efficient competence, active learning methods, pedagogical conditions, energy literacy.*

Introduction. To achieve carbon neutrality in the energy sector and ensure the country's energy security, with the aim of economic development and reducing dependence on external energy sources by 2050, Ukraine has introduced a new Energy Strategy

(Energy Hub of Europe: Ukraine approved its energy strategy..., 2025). It reflects the goals of the European Green Deal and is based on the provisions of a comprehensive approach to the formation and implementation of effective energy policy and the

creation of a foundation for the development of renewable energy and energy-efficient modernization of existing infrastructure in the Ukrainian economy. This Strategy, for example, takes into account: the consequences of the Russian Federation's war against Ukraine, i.e., a significant increase in the importance of the country's energy security and strengthening the resilience of our energy system; the integration of Ukraine's energy system into the pan-European one; the introduction of the latest technologies and innovations into the country's energy system; the fulfillment of Ukraine's international obligations regarding the use of renewable energy and carbon neutrality policy; decentralization of electricity generation to ensure energy independence (Energy Hub, 2023).

The urgency of the problem of developing energy-efficient competence in construction specialists at the current stage is determined by several factors: economic – the implementation of investments in infrastructure reconstruction requires significant financial resources, but increasing energy efficiency will lead to reduced energy consumption in the future; environmental – reducing energy consumption contributes to a decrease in carbon dioxide emissions through the transition to renewable energy sources and other low-carbon technologies.

The military actions of the Russian Federation against Ukraine have led to the disruption of natural ecosystems: destruction of housing, industrial, municipal, and energy facilities. Aggressors regularly attack Ukraine's energy facilities, and as of August 2024, as stated in a study by Top Lead company with partners, the losses of power system capacities due to the full-scale war amounted to 54%. Post-war reconstruction of Ukraine must be "green," i.e., environmentally friendly, considering its impact on the environment and the social well-being of the population, and offer a unique opportunity to diversify existing energy sources towards the use of renewable energy and strengthen the country's energy security (Russo-Ukrainian ..., 2024).

Sources. The solution to the post-war "green" reconstruction of the country is to train a competitive construction industry specialist with established energy-efficient competence. Considering this and the international practice of

implementing the European Union Development Strategy, as well as in accordance with Ukraine's approved Energy Strategy until 2050, the environmental education of future construction industry professionals should be a continuous interdisciplinary process of forming ecological competence in students of this industry in solving key environmental problems by reducing energy consumption during their practical activities, which will contribute to environmental protection.

Energy literacy is an understanding of how energy is produced, transported, stored, distributed, and used; awareness of its impact on the environment and social well-being; and knowledge of its efficient use. Researchers O.S. Santillán and K.G. Cedano (2023) analyzed 138 scientific papers on the development of energy literacy, the application of educational methods, and tools for its improvement. We used a number of ideas developed by modern scientists, particularly regarding: the development of energy literacy among high school students in Vietnam and the identification of factors influencing their energy-saving behavior (Lee, Nguyen, & Sung, 2022); the existence of four types of household energy literacy (appliance energy literacy, action energy literacy, financial energy literacy, multifaceted energy literacy) (Van den Broek, 2019); key factors for successful energy transition (strong policy frameworks, technological progress, economic incentives, international cooperation) (Awolesi, Salter, & Reams, 2024); the formation of energy-efficient competence among graduates of domestic vocational education institutions (Glushchenko, 2017; Kulalaieva, 2018, Kuprievych, 2025); the formation of energy-saving competence in students of general secondary education institutions (Tsapenko, 2019). In 2025, the Ministry of Education and Science of Ukraine introduced the "Energy Efficiency Lessons" project, aimed at forming students' skills in smart use of energy resources (MES integrates energy efficiency topic..., 2025).

Article objective: To determine the pedagogical conditions for the formation of energy-efficient competence in future construction industry professionals. In accordance with the objective, the following tasks were defined: to identify a list of pedagogical conditions and experimentally determine the most significant among them for the

development of energy-efficient competence in future construction industry professionals.

Research Methods: Theoretical analysis of pedagogical literature and educational-methodological documentation regarding the formation of energy-efficient competence in construction industry specialists; surveying pedagogical staff and methodologists of vocational education institutions – to determine the list of pedagogical conditions for the development of the studied phenomenon; expert evaluation – to select the most significant pedagogical conditions for the formation of energy-efficient competence in future construction industry professionals.

Results and Discussion. Let's start with the definition of "pedagogical conditions." The Explanatory Dictionary of the Ukrainian Language, edited by D. Hrynchyshyn (1999, p. 278), interprets the term "condition" as: a necessary, obligatory circumstance, a prerequisite that determines or causes the existence or realization of something; the situation in which something takes place, the circumstances under which something is carried out; an agreement or understanding between two or more persons about something; requirements, obligations, or proposals put forward in a contract with respect to the contracting parties. The Philosophical Encyclopedic Dictionary defines the concept of "condition" as a philosophical category "in which the universal relations of a thing to the factors by which it arises and exists are reflected" (Shynkaruk, 2002, p. 482). The concept of "condition" is also identified with necessary circumstances or factors that ensure the achievement of a certain goal; features of real reality to ensure the possibility or optimal circumstances for the purpose of implementing changes. The Great Explanatory Dictionary of the Modern Ukrainian Language further specifies the concept of "condition" as "a necessary circumstance that makes possible the realization, creation, or formation of something or contributes to something" (Busel, 2009, p. 1506), as "a factor, a driving force of any process or phenomenon; an agent" (Busel, 2009, p. 1506).

A. Semenova's (2006, p. 193) dictionary-handbook on professional pedagogy interprets the lexeme "pedagogical conditions" as "circumstances under which the integral productive pedagogical process of professional training of specialists

depends and takes place, mediated by the activity of an individual or a group of people." Ye. Khrykov (2011, p. 13), analyzing pedagogical conditions within the structure of scientific knowledge, argues that these are "circumstances that determine a certain direction of development of the pedagogical process. One can also agree with the opinion that pedagogical conditions are a set of objective possibilities of content, forms, methods, techniques, and means of pedagogical activity." It should be noted that factors "exist objectively, independently of activity," while pedagogical conditions "are created by educators" (Khrykov, 2017, p. 60). However, the assertion that objective possibilities of the material-spatial environment can be considered pedagogical conditions requires more detailed analysis.

Indeed, the educational space, its resourcefulness, technical equipment, and architectural features can influence the learning process, creating certain prerequisites for its organization. In accordance with the Energy Strategy of Ukraine for the period up to 2050, in educational institutions of the construction industry, the pedagogical conditions for the formation of energy-efficient competence must meet the following requirements:

- pedagogical conditions are an integral element of a holistic eco-oriented pedagogical process of forming energy-efficient competence in future construction industry professionals;
- pedagogical conditions reflect the totality of opportunities of the modern educational and material-spatial environment of a construction educational institution that can positively or negatively affect the formation of energy-efficient competence in future professionals;

- the structure of pedagogical conditions includes both internal elements (ensuring influence on the development of the personal ecological sphere of subjects of the educational process in a construction educational institution) and external ones (contributing to the formation of the procedural eco-oriented component of the system);

- the implementation of correctly chosen pedagogical conditions ensures the formation and development of energy-efficient competence in future construction industry professionals.

Thus, by pedagogical conditions, we understand an interconnected set of objective possibilities, content, forms, methods, and pedagogical techniques aimed at achieving the goals and objectives set in the study.

In the first stage, through the analysis of pedagogical, scientific, and methodological literature, legislative acts, and surveys of lecturers, vocational training teachers, educators, practical training masters, and vocational education instructors, a list of pedagogical conditions for the development of the studied characteristic of construction industry specialists was determined. In the next stage, from the compiled list of pedagogical conditions, experts (researchers from the Institute of Vocational Education of the National Academy of Educational Sciences of Ukraine, lecturers, vocational training teachers) specified those that, firstly, contained scientific novelty, and secondly, were circumstances that increase the likelihood of effective formation of all components of energy-efficient competence in future construction workers.

Based on the results of the first stage regarding the determination of pedagogical conditions for the formation of energy-efficient competence, the following list was compiled:

1. Formation of stable motivation in future construction industry students for the judicious use of energy resources.

2. Updating the content of professional training for construction industry students to include modern energy-efficient technologies.

3. Integration of energy efficiency into professional disciplines of construction industry institutions.

4. Use of active learning methods (project-based learning, case methods, etc.) for the formation of energy-efficient competence.

5. Formation of practical skills through laboratory work and training sessions; development of ecological awareness and responsibility in future construction workers.

6. Availability of teachers who possess energy-efficient competence and improvement of their qualifications in the field of energy-efficient technologies.

7. Creation of an appropriate educational creative environment that will influence the

formation of energy-efficient competence in students.

8. Interaction of construction vocational education institutions with scientific institutions, educational and methodological centers, and other educational institutions regarding joint projects, grants, organization of competitions, Olympiads, webinars, trainings, and conferences on energy efficiency.

9. Establishment, generalization, implementation, and dissemination of innovative pedagogical experience regarding the formation of energy-efficient competence in future construction industry professionals.

10. In construction vocational education institutions, the priority should be the application of modern eco-oriented pedagogical technologies with equal access for all participants in the educational process to electronic resources used to facilitate the educational process.

The specified list of pedagogical conditions includes circumstances that increase the likelihood of effective formation of all components of energy-efficient competence in future construction workers. However, the list also contains pedagogical conditions that give efficacy to the same factors, and also significantly influence the development of individual components of energy-efficient competence.

In the second stage, to optimize the identified factors influencing the formation and development of energy-efficient competence in future construction workers, their expert evaluation was conducted. The expert group (7 people) consisted of specialists with experience in forming energy-efficient competence in future construction workers, specifically: research fellows from the Institute of Vocational Education of the National Academy of Pedagogical Sciences of Ukraine, lecturers, and methodologists from vocational education institutions (three doctors of pedagogical sciences, three candidates of pedagogical sciences, and one doctor of philosophy). Based on the results of the first stage, an expert list with a list of ten pedagogical conditions for the formation of energy-efficient competence in future construction industry professionals and detailed instructions for its completion for the purpose of expertise was compiled. The study applied a method of expert

evaluation of the quality and effectiveness of pedagogical conditions, namely ranking – arranging these conditions, identified in the first stage, by their degree of importance. Each expert assigned a natural number – a rank (ordinal number determining the place of each factor in the overall set of factors) – to each of the aforementioned conditions. A pedagogical condition that, in the expert's opinion, most positively influences the development of energy-efficient competence in future construction industry professionals, is assigned rank 1, a less significant one – 2, an even less important one – 3,

$$\sum_{j=1}^n x_{ij} = \frac{(1+n)n}{2}$$

where n - is the number of pedagogical conditions; x_{ij} - is the rank of the j -th factor for the i -th respondent.

Thus, the sum of numbers in all rows (52.5+53+50+16+35.5+14+19+37+59+49) equals

and so on. If, in the expert's opinion, the pedagogical conditions are identical in their impact on the formation and development of energy-efficient competence, they should be assigned the same numerical values (Table 1).

Based on the results of the ranking, a matrix was created to determine the position of each pedagogical condition within the overall structure of the studied factors. To verify the correctness of the matrix creation, the control sum of all rows was analyzed, and the fulfillment of the condition was checked using Formula 1:

the control sum (55 x 7 = 385), which allows for the correct analysis of data from the properly filled matrix.

Table 1

Matrix of Expert Evaluation Results for the Significance of Pedagogical Conditions for the Formation of Energy-Efficient Competence in Future Construction Industry Professionals

Expert №	Pedagogical Conditions *(№)										$\sum_{j=1}^n \sum_{i=1}^m x_{ij}$
	1	2	3	4	5	6	7	8	9	10	
I	8	10	9	1	6	2	3	4	7	5	55
II	9	7	5	2	4	3	6	1	8	10	55
III	5,5	8	7	3	9	1	2	5,5	10	4	55
IV	5	7	6	2	4	1	3	10	8	9	55
V	10	8	5	1	3	4	2	9	7	6	55
VI	8	7	10	4	5	1	2	3	9	6	55
VII	7	6	8	3	4	2	1	5	10	9	55
$\sum_{j=1}^n \sum_{i=1}^m x_{ij}$	52,5	53	50	16	35	14	19	37,5	59	49	385
Sum	8	8	7	2	4	1	3	5	10	6	

The first position in the rank matrix, with the lowest score (14), was taken by the pedagogical condition "Availability of teachers who possess energy-efficient competence and improvement of their qualifications in the field of energy-efficient technologies."

The second most significant condition influencing the development of energy-efficient competence, according to experts, is "Use of active learning methods (project-based learning, case methods, etc.) for the formation of energy-efficient competence."

The third position in terms of points (19) was taken by the pedagogical condition "Creation of an appropriate educational creative environment that will influence the formation of energy-efficient competence in students." This means a comfortable and creative pedagogical educational environment in construction educational institutions, where relations between the teacher and the student are primarily built on pedagogical interaction, cooperation, and co-creation, and on students' awareness and understanding of eco-oriented learning material, structured through active learning methods and a transition from subject-based

learning to personally-oriented ecological education for future construction industry professionals.

Unfortunately, despite the importance of forming energy-efficient competence in future construction industry professionals for solving the problem of post-war "green" reconstruction of the country, this problem has not been sufficiently addressed in scientific research, dissertations, or scientific articles.

For example, in her research, M. Tsapenko (2019, p. 128) believes that to form energy-saving competence in general secondary education students during physics lessons, the following conditions should be considered: ensuring the formation of energy-saving competence in accordance with the tasks and goals of the educational field; implementing the cross-cutting content line "Environmental Safety and Sustainable Development"; creating a model in accordance with didactic theory. In her dissertation research, O. Hlushchenko (2017, pp. 80-81) selected pedagogical conditions that influence the formation of energy-efficient competence in future skilled workers in the machine-building industry, specifically: forming stable motivation in students for rational use of energy resources; updating the content of vocational training to include modern energy-efficient technologies in the machine-building industry; using project-based learning methods in the educational process, focused on forming practical skills and abilities in future skilled workers regarding effective energy use.

The researcher N. Kulalaieva (2018) states that the pedagogical conditions for the development of energy-efficient competence in students of vocational (vocational-technical) education institutions in the construction industry are: the

availability of teachers who possess energy-efficient competence; specially designed content of educational material; creation of an appropriate educational environment that will influence the formation of energy-saving behavior in students. According to V. Kuprievych (2025, p. 257), the pedagogical conditions for the formation of energy-efficient competence in future construction industry professionals are: integration of energy efficiency into professional disciplines (construction, electrical engineering, mechanical engineering, etc.); use of active learning methods (project-based learning, case methods, STEM approaches); formation of practical skills through laboratory work and training, development of ecological awareness and responsibility in future workers; professional development of teachers in the field of energy-efficient technologies.

Conclusions. As a result of the conducted research, the main pedagogical conditions capable of effectively influencing the development of energy-efficient competence in future construction industry professionals were identified, namely: "Availability of teachers who possess energy-efficient competence and improvement of their qualifications in the field of energy-efficient technologies"; "Use of active learning methods (project-based learning, case methods, etc.) for the formation of energy-efficient competence"; "Creation of an appropriate educational creative environment that will influence the formation of energy-efficient competence in students." Further research will be aimed at designing a model for the development of energy-efficient competence in future construction industry professionals and experimentally verifying the effectiveness of the identified pedagogical conditions.

List of references

- Бусел, В. Т. (Укл. та ред.) (2009). *Великий тлумачний словник сучасної української мови*. Перун.
- Глуценко, О. В. (2017) Формування енергоефективної компетентності майбутніх кваліфікованих робітників машинобудівного профілю : дис. кан. пед. наук : 13.00.04. Київ.
- Гринчишин, Д. Г. (Ред.). (1999). *Тлумачний словник української мови* (3-тє вид., перероб. і допов.). Освіта.
- Енергетичний хаб Європи: Україна схвалила енергетичну стратегію до 2050 року (2025) <https://greentransform.org.ua/ukrayina-shvalyla-energetychnu-strategiyu-do-2050-roku/?print-posts=pdf>
- Кулалаєва, Н. (2018). Педагогічні умови формування енергоефективної компетентності майбутніх фахівців будівельної галузі. https://kpl.dp.ua/wp-content/uploads/2018/06/Kulalaova_N_V.pdf

Купрієвич, В. (2025). Енергоефективна компетентність майбутніх фахівців будівельної галузі. Матеріали конференцій МЦНД, (14.02. 2025; Полтава, Україна), 256-259.

МОН інтегрує тему енергоефективності в шкільну програму з нового навчального року (2025). <https://mon.gov.ua/news/mon-intehruie-temu-enerhoefektyvnosti-v-shkilnu-prohramu-z-novoho-navchalnoho-roku>

Російсько-українська війна вплив на довкілля (2024). <https://www.topleadprojects.com/ukrainian-war-in-ua-environment-2024>

Семенова, А. В. (Ред.) (2006). *Словник-довідник з професійної педагогіки*. Пальміра.

Хриков, Є. М. (2011). Педагогічні умови в структурі наукового знання. *Шлях освіти*, (2), 11–15.

Хриков, Є. М. (2017). *Методологія педагогічного дослідження: монографія*. Харків. ФОП Панов А. М.

Цапенко, М. (2019). Модель методики формування енергозберезувальної компетентності на уроках фізики в учнів закладу загальної середньої освіти. *Наукові записки Бердянського державного педагогічного університету. Сер.: Педагогічні науки*, (2), 125-134.

Шинкарук, В. І. (Ред.). (2002). *Філософський енциклопедичний словник*. НАН України, Інститут філософії ім. Г. С. Сковороди. Абрис.

Awolesi, O., Salter, C. A., & Reams, M. (2024). A Systematic Review on the Path to Inclusive and Sustainable Energy Transitions. *Energies*, 17(14), 3512. <https://doi.org/10.3390/en17143512>

Lee, Y. F., Nguyen, H. B. N., & Sung, H. T. (2022). Energy literacy of high school students in Vietnam and determinants of their energy-saving behavior. *Environmental Education Research*, 28(6), 907–924. <https://doi.org/10.1080/13504622.2022.2034752>

Santillán, O. S., & Cedano, K. G. (2023). Energy Literacy: A Systematic Review of the Scientific Literature. *Energies*, 16(21), 7235. <https://doi.org/10.3390/en16217235>

Van den Broek, K. L. (2019). Household energy literacy: A critical review and a conceptual typology. *Energy Research & Social Science*, 57, 101256. <https://doi.org/10.1016/j.erss.2019.101256>

Translated & Transliterated

Busel, V. T. (Ukl. ta red.). (2009). *Velykyi tlumachnyi slovnyk suchasnoi ukrainskoi movy* [Large Explanatory Dictionary of the Modern Ukrainian Language]. Perun, [in Ukrainian]

Enerhetychni khab Yevropy: Ukraina skhvalyla enerhetychnu stratehiu do 2050 roku. (2025) [Energy hub of Europe: Ukraine approved energy strategy until 2050]. <https://greentransform.org.ua/ukrayina-shvalyla-enerhetychnu-strategiyu-do-2050-roku/?print-posts=pdf>, [in Ukrainian].

Hlushchenko, O. V. (2017) *Formuvannya enerhoefektyvnoi kompetentnosti maibutnikh kvalifikovanykh robotnykiv mashynobudivnoho profilu (dys. kan. ped. Nauk)* [Formation of energy-efficient competence of future qualified workers in the mechanical engineering field: Dissertation in Pedagogical Sciences]. Kyiv, [in Ukrainian].

Hrynchyshyn, D. H. (Red.). (1999). *Tlumachnyi slovnyk ukrainskoi movy (3-tie vyd., pererob. i dopov.)*. [Explanatory Dictionary of the Ukrainian Language (3rd ed., revised and supplemented)]. Education, [in Ukrainian]

Khrykov, Ye. M. (2011). *Pedahohichni umovy v strukturі naukovoho znannia*. [Pedagogical conditions in the structure of scientific knowledge]. *Shlyakh osvity*, (2), 11–15, [in Ukrainian]

Khrykov, Ye. M. (2017) *Metodolohiia pedahohichnoho doslidzhennia: monohrafiia*. [Methodology of pedagogical research: monograph]. Kharkiv. FOP Panov A. M., [in Ukrainian]

Kulalaieva, N. (2018) *Pedahohichni umovy formuvannya enerhoefektyvnoi kompetentnosti maibutnikh fakhivtsiv budivelnoi haluzi* [Pedagogical conditions for the formation of energy-efficient competence of future construction industry specialists]. https://kpl.dp.ua/wp-content/uploads/2018/06/Kulalaova_N_V.pdf, [in Ukrainian]

Kuprievych, V. (2025). *Enerhoefektyvna kompetentnist maibutnikh fakhivtsiv budivelnoi haluzi* [Energy-efficient competence of future construction industry specialists]. Proceedings of the ICND Conference, (14.02. 2025; Poltava, Ukraine), 256-259, [in Ukrainian]

МОН інтегрує тему енергоефективності в шкільну програму з нового навчального року [The Ministry of Education and Science integrates the topic of energy efficiency into the school curriculum from the new

academic year] (2025). <https://mon.gov.ua/news/mon-intehruie-temu-enerhoefektyvnosti-v-shkilnu-prohramu-z-novoho-navchalnoho-roku> [in Ukrainian].

Rosiisko-ukrainska viina vplyv na dovkillia [Russian-Ukrainian war impact on the environment] (2024). <https://www.topeadprojects.com/ukrainian-war-in-ua-environment-2024>, [in Ukrainian]

Semenova, A. V. (Red.). (2006). Slovnyk-dovidnyk z profesiinoi pedahohiky [Dictionary-reference book on professional pedagogy]. Palmira. [in Ukrainian]

Shynkaruk, V. I. (Red.). (2002). Filosofskyi entsyklopedychnyi slovnyk. [Philosophical Encyclopedic Dictionary]. NAS of Ukraine, Institute of Philosophy named after G. S. Skovoroda. Abstract, [in Ukrainian]

Tsapenko, M. (2019). Model metodyky formuvannia enerhozberezhualnoi kompetentnosti na urokakh fizyky v uchniv zakladu zahalnoi serednoi osvity [A model of the methodology for forming energy-saving competence in physics lessons for students of a general secondary education institution]. Scientific notes of the Berdyansk State Pedagogical University. Ser.: Pedagogical Sciences, (2), 125-134, [in Ukrainian]

Awolesi, O., Salter, C. A., & Reams, M. (2024). A Systematic Review on the Path to Inclusive and Sustainable Energy Transitions. *Energies*, 17(14), 3512. <https://doi.org/10.3390/en17143512>, [in English].

Lee, Y. F., Nguyen, H. B. N., & Sung, H. T. (2022). Energy literacy of high school students in Vietnam and determinants of their energy-saving behavior. *Environmental Education Research*, 28(6), 907–924. <https://doi.org/10.1080/13504622.2022.2034752>, [in English].

Santillán, O. S., & Cedano, K. G. (2023). Energy Literacy: A Systematic Review of the Scientific Literature. *Energies*, 16(21), 7235. <https://doi.org/10.3390/en16217235>, [in English].

Van den Broek, K. L. (2019). Household energy literacy: A critical review and a conceptual typology. *Energy Research & Social Science*, 57, 101256. <https://doi.org/10.1016/j.erss.2019.101256>, [in English].

DOI: <https://doi.org/10.32835/2707-3092.2025.30.204-212>

ПЕДАГОГІЧНІ УМОВИ РОЗВИТКУ ЕНЕРГОЕФЕКТИВНОЇ КОМПЕТЕНТНОСТІ МАЙБУТНІХ ФАХІВЦІВ БУДІВЕЛЬНОЇ ГАЛУЗІ

Андрій Каленський

доктор педагогічних наук, професор, провідний науковий співробітник відділу змісту і технологій професійної освіти Інституту професійної освіти НАПН України, <http://orcid.org/0000-0001-9034-5042>, e-mail: kalenskyandrii@gmail.com

Реферат:

Актуальність проблеми формування та розвитку енергоефективної компетентності спеціалістів у будівельній галузі на сучасному етапі обумовлена такими чинниками: економічний – впровадження інвестицій в відбудову інфраструктури потребує значних фінансових ресурсів, проте підвищення енергоефективності призведе до зниження енерговитрат в майбутньому; екологічний – скорочення енергоспоживання сприяє зменшенню викидів вуглекислого газу через перехід на відновлювані джерела енергії та інші низьковуглецеві технології.

Мета: визначити педагогічні умови розвитку енергоефективної компетентності майбутніх фахівців будівельної галузі.

Методи: теоретичний аналіз педагогічної літератури і навчально-методичної документації щодо формування енергоефективної компетентності фахівців будівельної галузі; опитування педагогічних працівників, методистів закладів професійної освіти – для визначення переліку педагогічних умов розвитку досліджуваного феномена; експертне оцінювання – для вибору найбільш значущих педагогічних умов формування енергоефективної компетентності майбутніх фахівців будівельної галузі.

Результати: засобами аналізу теоретичних джерел і навчально-методичної літератури, законодавчих актів, опитування педагогів, майстрів та інструкторів виробничого навчання визначено перелік педагогічних умов розвитку енергоефективної компетентності майбутніх фахівців будівельної галузі; задля оптимізації

визначених факторів, що впливають на розвиток досліджуваного феномена, було проведено їх ранжування й експертне оцінювання.

Висновки: основними педагогічними умовами, що впливають на розвиток енергоефективної компетентності майбутніх фахівців будівельної галузі, на думку експертів визнано: «Наявність викладачів, які володіють енергоефективною компетентністю та підвищення їх кваліфікації у сфері енергоефективних технологій», «Використання активних методів навчання (проектне навчання, кейс-методи тощо) для формування енергоефективної компетентності», «Створення відповідного освітнього креативного середовища, що впливатиме на формування в учнів енергоефективної компетентності».

Ключові слова: *професійна освіта, енергоефективна компетентність, активні методи навчання, педагогічні умови, енергетична грамотність.*

Manuscript received: 10.03.2025

Accepted for publication after peer review: 07.05.2025

Published: 12.06.2025