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## Features of designing an integrated course on the basics of fundamental and applied sciences for bachelors of secondary and professional education

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### Abstract

**Relevance.** In today's society, there is a rapidly growing demand for specialists with a high level of theoretical knowledge that they can apply in practice. The article discusses the features and importance of developing a comprehensive course of basic and applied sciences for bachelor's degrees in secondary and vocational education. This course combines theoretical principles and practical application.

**Purpose.** The purpose of this study is to investigate the characteristics of integrating basic and applied sciences into a bachelor of secondary and vocational education course.

**Methodology.** To achieve this goal, the methods used were scientific literature analysis and empirical research. In addition, surveys of specialists, modelling of the pilot course, its implementation, evaluation, and supplementation. The study involved 58 teachers of fundamental and applied sciences and 157 first-year students.

**Results.** Based on the educators' survey results, a sequenced model of integrated learning was chosen. On this basis, a pilot program for first-year students was developed and implemented. Using an interdisciplinary approach, practical experience, and problem-based learning, this course highlights the key role of integrating basic and applied sciences to improve student's critical thinking, improve problem-solving skills, and prepare them for a successful career and practical skills.

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**Conclusions.** A survey of students shows a positive attitude towards the integrated learning course. The study results are applicable to familiarising and developing integrated courses for students of different specialties by educators and administrators of higher education institutions.

**Keywords:** integration; higher education; vocational choice; cooperation; applied fields; training.

## **Introduction**

To develop future specialists' competencies, it is imperative to integrate individual disciplines' knowledge to solve issues in professional activities. The integration of the curriculum contributes to the comprehensive acquisition of knowledge in a particular field. This makes the learning process effective and forms not only theoretical knowledge but also practical skills and an understanding of the specifics of a particular profession [1]. Modern requirements for knowledge and its application require the development and implementation of effective teaching methodologies to support the sustainability and effectiveness of the learning process in a dynamically developing world [2]. It is necessary to apply the newest pedagogical technologies and introduce systemic changes in vocational education [3].

The relevance of this study is determined by the special state of modern education and the social system, which guarantees the professional success of young people and their competitiveness in the market. Young people need to be taught the basics of material science, engineering as well as technology, and mastering them at the appropriate level is only possible if the appropriate material and technical base and teaching and learning support are available. The most effective way to overcome this situation is to integrate scientific and educational training in bachelor's degree programs of secondary and vocational education, as well as in each discipline of the general technological cycle. As an academic discipline, integrated courses should be based on the fundamental principles of fundamental, applied as well as general technical disciplines, practical application of applied mathematical tools the use of information and communication technologies. Readiness for professional activity is considered the formation of integrated properties and qualities of a personality necessary for a specialist in a certain field of activity [4]. Integrating and continuously organising students' learning activities can increase their motivation to results derived from learning [5]. Moreover, V. Hryshko et al. [6] argued for the introduction of integrated training models to ensure that future lawyers adjust to the dynamics of modern society and incorporate technology into the educational process. Among the areas of modernization of professional training is the development of integrated training programs based on the national qualifications' framework [7]. Previous experimental studies have shown the effectiveness of using integrated courses for student learning, but also the need for a gradual transition to integrated learning [8]. At the same time, a review by D. Matinho et al. [9] shows that a lack of understanding of integrated learning models and a lack of experience in teaching with integrated models leads to a decrease in the effectiveness of integrated learning programs in their development and use.

Taking into account the variety of integrated learning models and the difficulties of teaching integrated programmes, the purpose of the article is to study features

of designing an integrated course on the basics of fundamental and applied sciences for bachelor of secondary and professional education.

## **Literature review**

The research conducted on the integration of basic and applied science courses demonstrates the need for targeted efforts by teaching staff. The development of innovations makes it imperative to implement innovative approaches. Integrated courses in basic and applied sciences have many advantages for undergraduate students and contribute to the development of personal qualities for future professionals and the development of teachers' skills [10]. In particular, an introductory course in chemistry/biology contributed to the creation of a collaborative working environment for students and improved their success rate in subsequent courses [11]. Integrating student research into social studies courses has led to a better understanding of social issues among students [12]. The development of integrated courses in the basic and applied sciences should take into account the goals and outcomes of the course. In addition, it should take into account the structure of the program. Research on the implementation of integrated learning models, in particular in the medical field, shows that it is necessary to create an integrated environment with in-depth study of subjects by students of certain specializations. In particular, I. Dominguez and A. C. Zumwalt [13] consider the possibility of observing the clinical application of theoretical knowledge in medical practice and prove that this facilitates the integration of curricula. the creation of an integrated basic science course for undergraduate students, learning and retention of core scientific content can be supported by better alignment in the curriculum. Ganguly 2019. examines the possibilities of integrating philosophy into disciplinary curricula [14]. Three models of clinical application of basic science education are considered, including medical modernization, and development of parallel sessions.

N. Winarno et al. [15] describe in detail the models of curriculum integration based on data analysis in scientific sources. The authors propose dimensions of curriculum integration (within the same discipline, between different disciplines, and in the student's mind), which is also supplemented by a graphical representation of the models. The curriculum facilitates knowledge acquisition, and the person responds by restructuring and transforming his intellect. Budley describes four ways of integrating a program: fusion, incorporation, correlation and harmonization. Fusion combines at least two disciplines, for example, the physical sciences – physics and chemistry. Incorporation adds or absorbs one curriculum element into another. Making connections among subjects that are taught separately so that they overlap is an example of correlation. Thematic units are an example of integration. Harmonization integrates various curriculum elements.

Integrating education for sustainable development into teacher education is still an under-researched issue [16];

17]. Studies on the implementation of multimodal approaches based on both mathematical and physical development evoke deeper social perspectives, thus emphasizing the importance of promoting key competencies and the role they play in education for sustainable development [18; 19].

The interdisciplinary approach to learning that underpins the approach is key to developing education that promotes education for sustainable development and helps students to solve complex problems, and use theoretical knowledge in a holistic way, and in practice Rico et al. [20]. Research has been conducted on the effectiveness of integrated approaches, including the STEM approach in education at all levels [21]. I. Rahmania [22] investigated the effectiveness of project-based learning and STEM, which contributes to the development of critical and creative thinking in students, logical and systematic, which are essential skills for people in the 21st century to face global challenges.

**Materials and Methods**

To achieve this goal, authors used the methods of data analysis of the literature on the topic, surveys (teachers –

on the choice of an integrated course model, students – on the assessment of teaching the selected, developed, and implemented pilot course), and comparison with the assessment of students who studied the course using the traditional (divided into separate disciplines) methodology.

The study involved 58 educators of fundamental and applied sciences and 157 first-year students. The choice of participants was based on the capabilities of the higher education institutions where the study was conducted. This is also due to the importance of developing integrated learning from the first year and continuing such developments for further study.

To survey the teachers, a questionnaire was developed based on the study by N. Winarno et al. [15], in which they chose the model option that they believe would be acceptable in teaching subjects at a particular institution. The teachers answered the question: which model of integrated learning would you recommend for teaching students of Bachelor of Secondary and Vocational Education? The answers with a description of the features of the models are presented in the form of a table below (Table 1).

**Table 1.** Options for choosing models of integrated learning for educators

Connected	Within each subject area, course content is connected to the topic, concept to the concept, one year’s work to the next, and relates ideas explicitly
Nested	With each subject area, the teacher targets multiple skills: a thinking skill, and a content-specific skill based on standards
Shared	Shared planning takes place in two disciplines in which overlapping concepts or ideas emerge as organizing elements
Webbed	Webbed curricula represent the thematic approach to integrating subject matter
Integrated	The integrated curricular model represents a cross-disciplinary approach similar to the shared model
Sequenced	Topic or units of study are rearranged and sequenced to coincide with one another. Similar ideas are taught in concert while remaining separate subjects
Threaded	Standard, thinking skills, social skills, graphic organizers, technology and a multiple intelligences approach to learning thread through all disciplines.
Immersed	The individual integrates all data, from every field and disciplines by funnelling the ideas through area of interests of the students
Networked	An ongoing external source of input, forever providing new, extended, and extrapolated or refined ideas.

Source: N. Winarno et al. [15].

To choose the appropriate model of integrated learning, the features of such models were analyzed, open meetings with teachers were held, and the most suitable ones were selected for designing an integrated course on the basics of fundamental and applied sciences for bachelor of secondary and professional education, taking into account the capabilities of teachers, educational institutions and the possibilities of teaching an integrated course. The survey was conducted in two stages: the first stage included the selection of two models voted for by the majority of teachers, and the second stage included the final selection of the model to be used for integrated learning. The survey

was conducted while discussing the effectiveness of the models and studying their features during consultations and organized meetings.

The integrated learning course was developed using information and communication technologies. This included an educational video explaining certain phenomena in two disciplines, students' independent work using digital technologies, artificial intelligence, etc.

The integrated course was implemented during three academic semesters for first-year and the second students. This is due to the peculiarities of the curriculum, and the fact that the developed integrated course created

propaedeutic principles for studying the cycle of academic disciplines of professional training.

After the pilot implementation of the course, a survey of students was conducted using the questionnaire developed by Visser-Wijnveen et al. [23]. This questionnaire consists of scales and questions that allow you to assess the effectiveness of integrated learning by students. The validity and reliability of the questionnaire were confirmed by the authors.

This study was conducted in one country, and the choice of participants was based on the capabilities of researchers and educational institutions. The choice of the integrated learning model was not based on the practical experience of teachers, but on the theoretical study of the features of the models and discussions about the capabilities of the educational institution and teachers to

teach according to certain models. The course evaluation was conducted by students, while for teachers it is necessary to develop questionnaires that will allow them to evaluate the various nuances of integrated courses, which requires some experience in teaching such courses.

**Results**

The teachers studied in detail the features of each model of integrated learning and, when answering the questions, taking into account the advantages and disadvantages of a particular model, and their capabilities of teaching integrated courses according to each model. After that, the teachers were interviewed about the most effective model of implementing an integrated course, in their opinion. The results are presented in Table 2.

**Table 2.** Results of the first survey on the model of integrated learning that can be effectively used to teach students of Bachelor of Secondary and Vocational Education

Model	No.	%
Connected	2	3.45%
Nested	5	8.62%
Shared	4	6.90%
Webbed	9	15.52%
Integrated	12	20.69%
Sequenced	16	27.59%
Threaded	3	5.17%
Immersed	4	6.90%
Networked	3	5.17%

Source: created by the authors.

The first survey was followed by discussions and debates on the possibilities of developing an integrated course based on the models chosen by the majority of students for Bachelor of Secondary and Vocational Education, taking into account the capabilities of teachers,

presentations of educational material using multimedia technologies, and other nuances. Teachers discussed each model and how they would teach it. After that, a second survey was conducted to choose from three models, integrated, webbed, and sequenced (Table 3).

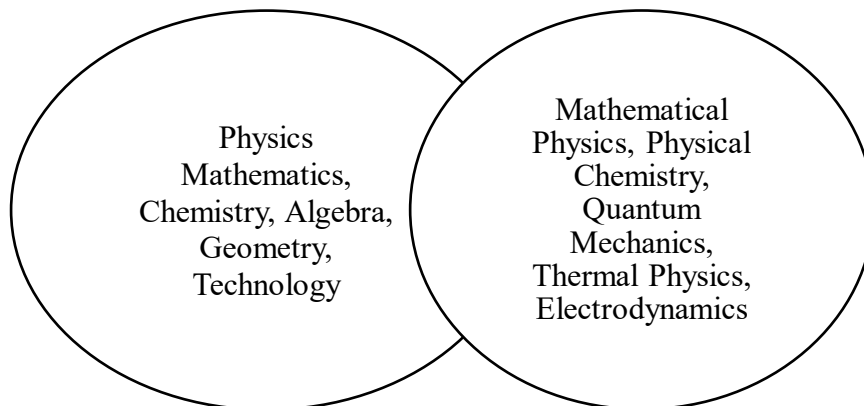
**Table 3.** Results of the second survey on the integrated learning modality that can be effectively used to teach students of Bachelor of Secondary and Vocational Education

Webbed	5	8.62%
Integrated	10	17.24%
Sequenced	43	74.14%

Source: created by the authors.

Therefore, the sequenced model was chosen for the development and implementation of the pilot integrated learning course. Accordingly, a course was developed: based on a review of scientific sources and taking into

account the educators' responses, an integrated bachelor's program "Fundamentals of Basic and Applied Sciences" have been formed, as shown in Figure 1.



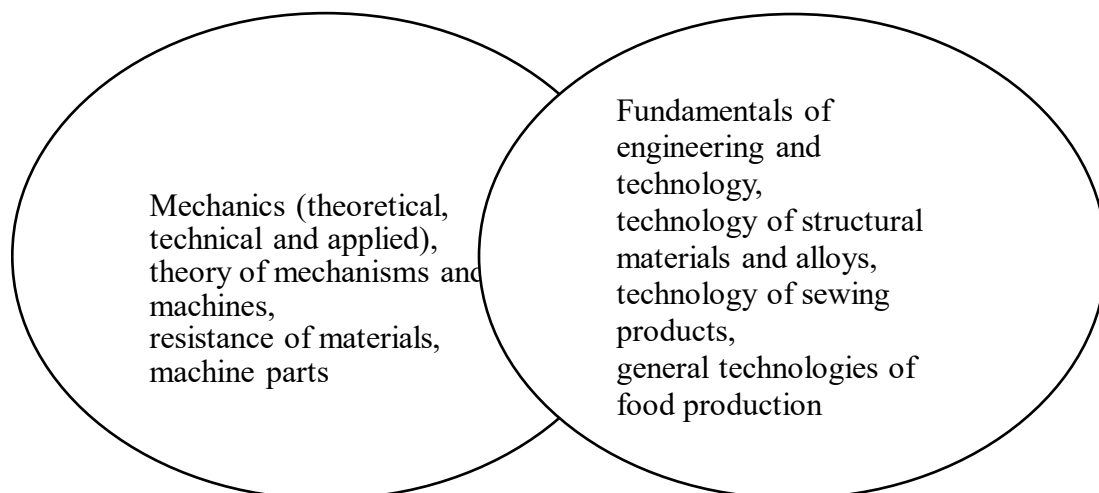
**Figure 1.** Combination of Block of disciplines of general education training and Block of integrated academic disciplines of the initial level

In this regard, the integration of chemical knowledge of the disciplines of general education with the disciplines of the cycle of technical and technological disciplines of professional training is important for improving education quality. They contain many general questions that can be analyzed from the point of view of the development of chemical knowledge. For example, there is a relationship between the classification of metals, their atomic crystal structure, the types of crystal lattices, and the types of chemical bonds in solids. It was possible to trace the development of knowledge regarding the determination of types of chemical bonds, and their influence on the structure of substances. When considering the properties of cast iron, special attention is paid to the features of production, heat treatment of cast iron, carburizing process, production of cast iron, steel, their differences, and marking. The topic "Corrosion of metals" is closely related to materials science. Particular attention was paid to the means of protecting metals from corrosion, especially chemical methods: passivation, oxidation, phosphating and bluing, the concepts of system, metal alloy, component, and phase, which in the course of the discipline "Chemistry" were considered as elements of the integration of physical chemistry, are significantly deepened. The

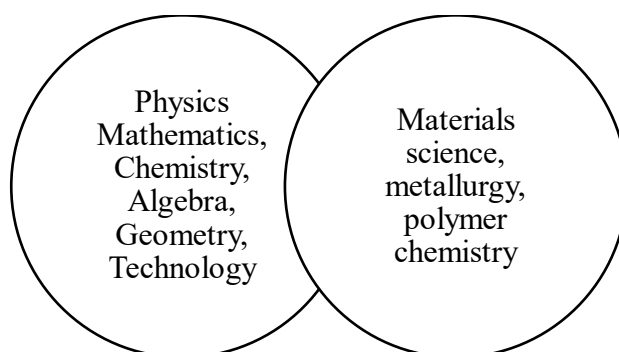
concept of "solid solutions, chemical compounds, mechanical mixtures" should also be developed, which is an integral part of the terminology of the technology of structural materials and alloys. Integration processes also involve the construction of diagrams of the state of iron-carbon alloys and cooling curves, which are presented only in the form of a conceptual apparatus in the course of general training "Chemistry".

Classes were held in parallel with Physics and Mathematical Physics, complementing and continuing both. To do this, teachers created teaching material in such a way that the required material was taught in a way that was understandable. This material was interconnected between two or more subjects. Students needed to understand the material in the basic subjects and use this knowledge in order to solve certain problems in the applied subjects.

The same analogy was used to build training materials and curricula for the block of integrated academic disciplines of the initial level and process installation (Figures 2 and 3) and combination of block of disciplines of general education training and materials science division.



**Figure 2.** Combination of cycle of technical and technological disciplines of professional training – materials science division, process installation, block of motion and interaction between material bodies



**Figure 3.** Combination of Block of disciplines of general education training and materials science division

In the integrated model, teachers taught according to the need to study the material. For example, first, they introduced complex materials, such as materials science, metallurgy, and polymer chemistry, and then, to master the specifics, they studied materials from Physics, Mathematics, Chemistry, Algebra, Geometry, and Technology.

It includes mastering the theoretical foundations and methods of modern, fundamental, applied research and specialised disciplines; developing and acquiring practical skills in the use of fundamental laws and methods of mechanics, electrodynamics and electrical engineering; mathematical apparatus in the performance of tasks related to the design of mechanical units and mechanisms; organic

and inorganic laws that contribute to the performance of professional duties. It includes the study of the laws of inorganic chemistry, which, in principle, contribute to the performance of professional duties at an appropriate scientific and technical level.

Fundamental education is one of the main criteria of the education system and has a significant impact on the development of students' scientific and theoretical thinking, their ability to set specific new tasks and creative thinking, the ability to foresee and evaluate the consequences of decisions and actions, the laws of fundamental properties, the laws of conservation in nature and their manifestation, and stimulates cognitive activity aimed at discovering

There is no doubt that applied science, which develops on the basis of fundamental science, develops methods and ways of applying and practically using the results of fundamental research. This is due to the fact that fundamental research is aimed at discovering the objective laws of the real universe, and applied research is aimed at discovering and applying them in practice. The symbiosis of chemistry, mechanics, electrical engineering, electrodynamics, optics, analytical geometry, descriptive geometry, static analysis as well as electronics justifies the need for such an integrated course.

The most important component of the integration process is the cycle of technical and technological disciplines of professional training of students, which includes basic information from such autonomous courses as: theoretical mechanics, theory of mechanisms and machines, resistance of materials, machine parts and lifting machines. The main objectives of this course are:

- 1) the study of the general laws of motion and equilibrium of material bodies;
- 2) the study of the structure and classification of mechanisms, the design of kinematic schemes of mechanisms, their dynamic analysis and synthesis, balancing mechanisms and devices. Mastering these issues is the basis of technical and technological education of students, since it ensures the formation of the necessary

competencies for the formulation and solution of many engineering problems that are encountered daily in the practical activities of specialists;

3) study of methods for calculating structural elements for strength, rigidity and stability;

4) familiarization with the structure of devices, design features, areas of their application, the basics of calculation and design of machine parts and mechanical devices for general purposes.

In the section devoted to the foundations of theoretical mechanics, the general laws of motion and equilibrium of material bodies are studied. The resistance component of the material provides information about the strength, rigidity and stability of parts of buildings and machines. In the theory of mechanisms and machines, methods of research, design, kinematics and dynamics of mechanisms and machines can be included in the integration process. The Machine Parts section will introduce students to the methods of calculation and design of general-purpose parts that perform the same function in different machines and devices.

The technological and materials science block of the cycle of technical and technological disciplines of professional training is designed to provide knowledge about structural materials and their properties, methods of their production, the main technological methods of shaping parts, to get acquainted with the capabilities of modern mechanical engineering and promising technologies for processing structural materials, to reveal the physical essence of the phenomena occurring in materials under the influence of various factors in conditions production and operation, their influence on the properties of materials, the study of the theory of heat treatment and other means of hardening materials that give high reliability and durability to parts of machines, tools and other products.

The course pilot implementation was conducted during one semester. After that, students were surveyed about the effectiveness of the integrated course using a questionnaire. Table 4 presents the evaluation results.

**Table 4.** Assessment of students' perception of the integrated course

Subscale	Number of questions Sample item Score value (max 5)	Number of questions Sample item Score value (max 5)	Number of questions Sample item Score value (max 5)	SD
Integration of research	4		2.34	,65
Reflection	4	I have learned to pay attention to how research is conducted	3.05	,48
Participation	5	My contribution to the research made a difference	1.95	,97
Current research	5	I was introduced to my lecturer's research	2.84	,75
Motivation	4	I became passionate about my research work	2.69	,84
Quality	3	My lecturers taught me personally properly	3.55	,79
Persuasion	3	Teaching that pays a lot of attention to research stimulates my learning	3.47	,84

According to the student survey results, students positively assessed the implementation of the developed pilot course. At the same time, there are nuances that should be taken into account when developing the next

courses, in particular, increasing student participation in research activities (the students' score was 1.95 out of 5). However, this may be due to the peculiarity of the

educational material in the first year, when students study more theoretical foundations of the disciplines.

## **Discussion**

The idea of developing an integrated course for students is substantiated by many experts' works who have shown that integrated learning allows for a deeper understanding of the relationship between basic and applied sciences. Fostering creativity and the ability to integrate knowledge and skills, communication and problem-solving skills are critical qualities for future professionals, and education systems aim to develop these skills [24]. Interdisciplinary integration is based on the philosophical synthesis of knowledge. It is intended to ensure that teachers from different disciplines have a common approach to solving common problems. It allows the study of educational materials comprehensively. The combination of information from textbooks and practical work has had a positive impact [25]. That is why teachers should have not only a deep theoretical knowledge of their chosen discipline but also modern consultative methods of solving various related professional problems. This requires appropriate professional training for teachers, including self-education.

The integration of academic subjects into the modern education system is one of the directions of the active search for effective pedagogical solutions. This contributes to the elimination of existing contradictions through the prism of student creative potential. Integrated courses have been gaining popularity worldwide as they provide students with a holistic approach to learning different subjects by blending them into one curriculum [26]. In particular, the introduction of the integrated course "Fundamentals of Mechanical Design" proposed by Liang et al. [27] was well received by students, as they used more innovative and practical teaching methods. Such courses promote interdisciplinary thinking that enables students to apply their knowledge across multiple domains. The study also shows sufficient student satisfaction with the integration of training courses, so it can be summarised that these courses enhance critical thinking skills in students by providing opportunities for hands-on experiences that enable them to connect theory with practice. The significance of designing an integrated course on fundamental and applied sciences is manifold. First, such a course promotes cross-disciplinary collaboration that encourages creativity among students from different backgrounds [28]. Second, it provides access to diverse perspectives necessary for problem-solving in complex real-world situations [29]. Thirdly this type helps learners obtain a deeper understanding at both theoretical and practical levels. Technical disciplines play an essential role in preparing students for vocational education-related jobs through hands-on training experiences that improve their skills [26]. This is confirmed by the results of the survey of first-year students who took part in this study, which should be taken into account since the vast majority of traditional study programs do not provide for the development of research skills or interest in research and the development of motivation to study theoretical disciplines to conduct their own observations. Also, the integration of practical and empirical disciplines contributes to the development of a broader view of

technology and theoretical knowledge in various fields [29-31]. Integration as a phenomenon appeared in science as a result of its opposite – the differentiation of sciences and their fields, the growing level of knowledge and requirements for them in each field, which leads to a deepening of specialization in the sciences and within science as a whole, inevitable with the deepening and narrowing of the range of professional interests of narrow specialists, sometimes understanding each other; the birth of everything new and new on this basis.

The results of many years of pedagogical practice have confirmed that students, and later graduates, who receive training in certain academic disciplines, cannot apply the knowledge and skills gained to another area. They lack independent thinking, and the ability to transfer their arsenal of knowledge to similar or almost different situations. All this is due to the mutual inconsistency of classes in different academic disciplines, or the imperfection of the training plan [32-34].

At the same time, the regularity that integration is not a change of activity and a simple transfer of knowledge from one academic discipline to another. Instead, it is the process of creating updated didactic equivalents reflecting modern scientific knowledge integration trends that is ignored. In addition, one of the mandatory and basic requirements of integrated learning is to increase the role of students' independence, because integration inevitably expands the subject of the material taught, and requires a deeper analysis and generalization of phenomena, the range of which increases due to other disciplines, for the assimilation of such a volume of material [35; 36]. Students will cope with such work only if they know the methods of research activity and how to organize their study time. The moderator here is the teacher, who is responsible for understanding the problem of integrating the course content at a specific stage of training.

A survey of first-year students who took part in the integrated program experiment shows their positive attitude toward the course. Also, in a study with graduate students studying sociology showed that integrated courses had a positive impact, as students better mastered sociological processes and other skills necessary for further work and perceive integrated learning as useful for acquiring knowledge and skills [37-39]. Also, A. C. Zumwalt and I. Dominguez [40] developed a curriculum for doctoral students to teach integrated curricula to compare the effectiveness of the methods, their focus, and pace of teaching compared to typical teaching. They found that the integrated curriculum contributed to the development of doctoral students' teaching skills and a better understanding of the discipline than the traditional teaching of separate disciplines.

For a qualitative assessment of the effectiveness and overall perception of integrated models by teachers, it is necessary, firstly, to gain more experience in teaching different models of integrated learning, and secondly, to develop a questionnaire that meets the necessary assessment needs. Evaluation of such education models is carried out using many different questionnaires, one of which was developed by Havice et al. [41]. The survey allows educators to evaluate the effectiveness of the model and also to understand the nuances of further development of integrated learning models and teaching of integrated

learning models. The sequenced model of integrated learning was used in this study, due to the choice of teachers from certain educational institutions in Ukraine. When making their choice, the teachers were guided by their development and teaching capabilities and the specifics of the curriculum of a particular specialty [42; 43]. The development of curricula based on other models of integrated learning can have an even better effect on student learning. However, this requires high-quality work from the administration, teachers, and an effective training organization. Much effort and resources should be put into the success of the integrated learning model. This is done by making sure that the educational process participants (mostly educators) are sufficiently prepared to use such a model.

In addition to the advantages of integrated learning models, there are some disadvantages as well, such as insufficient textbooks and curricula development [15; 44; 45]. D. V. Hoeven et al. [46] found that the main two barriers to the integration of fundamental and applied sciences were the lack of cross-skills of teachers and the lack of time to explore the links between basic and applied sciences due to the amount of information to learn. Therefore, quality preparation for integrated learning should include the skills of teachers, the cooperation of teachers from basic and applied sciences, the goals of the institution, and a particular course, and also the readiness of students to learn in an integrated model [47; 48]. At the same time, the experiment with first-year students showed a generally positive attitude towards the integrated model.

## Conclusions

Students and graduates need to interact with knowledge from fundamental and applied disciplines to be effective in their chosen professions. To this end, integrated courses can be developed, which allow for better learning of the disciplines in their interaction. These courses can facilitate better understanding and application of knowledge to solve problems.

To select the integrated learning model, consultations and discussions were held with and among the faculty. The features of the integrated learning approaches that could be used were considered in detail. After a two-stage vote, the sequenced model of integrated learning was selected. The teachers considered their ability to teach with this model, develop high-quality teaching material, and other nuances. The teachers developed the course based on the current

curriculum. The section on theoretical mechanics fundamentals introduces students to the methods of calculating and designing general-purpose parts that perform the same functions on different devices. The technological and material science block of the cycle of technical and technological disciplines of professional training allows students to master the knowledge of the design of materials and their properties, methods of their production, and basic engineering principles for forming parts.

The pilot implementation of the integrated course during three academic semester shows a positive perception of this model and collaborative learning in general. The student's perception of the integrated course is as follows: the integration of research was rated by students at 2.34 points (out of 5 maximum), reflection – 3.05 points, participation – 1.95 points, current research – 2.84 points, motivation – 2.69 points. Teaching quality in the form of integrated learning is 3.55 points, and conviction is 3.47 points. It is necessary to increase students' participation in research activities during the integrated course. However, this may be due to the peculiarity of educational material for second-year students.

Further research should focus on the development of integrated courses based on other models of integrated learning, the acquisition of experience by teachers and students in integrated learning, the development of questionnaires for teachers that allow a comprehensive assessment of the quality of the developed courses, students' perceptions and their performance in integrated learning.

In this article, authors are in no way trying to oppose the fundamental sciences to the applied sciences or vice versa, authors just wanted to emphasize that any science, no matter what level of development it is at and no matter what tasks it sets for itself, will always deal with a certain system of concepts, laws and theoretical ideas, which was demonstrated in the developed integration course "Fundamentals of Fundamental and Applied Sciences".

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## Conflict of Interest

None.

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## **Особливості проектування інтегрованого курсу з основ фундаментальних і прикладних наук для бакалаврів середньої та професійної освіти**

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## **Анотація**

**Актуальність.** У сучасному суспільстві стрімко зростає попит на фахівців з високим рівнем теоретичних знань, які вони можуть застосувати на практиці. У статті розглядаються особливості та значення розробки комплексного курсу фундаментальних і прикладних наук для бакалаврів загальноосвітніх та професійно-технічних навчальних закладів. Цей курс поєднує в собі теоретичні основи та практичне застосування.

**Мета.** Метою цього дослідження є дослідження особливостей інтеграції фундаментальних і прикладних наук у курс бакалавра середньої та професійно-технічної освіти.

**Методологія.** Для досягнення цієї мети використовувалися методи аналізу наукової літератури та емпіричного дослідження. Крім того, опитування спеціалістів, моделювання пілотного курсу, його впровадження, оцінка та доповнення. У дослідженні взяли участь 58 викладачів фундаментальних і прикладних дисциплін та 157 студентів першого курсу.

**Результати.** За результатами опитування педагогів було обрано послідовну модель інтегрованого навчання. На цій основі розроблено та впроваджено пілотну програму для студентів першого курсу. Використовуючи міждисциплінарний підхід, практичний досвід і проблемне навчання, цей курс підкреслює ключову роль інтеграції фундаментальних і прикладних наук для покращення критичного мислення студентів, покращення навичок вирішення проблем і підготовки їх до успішної кар'єри та практичних навичок.

**Висновки.** Опитування студентів свідчить про позитивне ставлення до інтегрованого курсу навчання. Результати дослідження використовуються для ознайомлення та розробки інтегрованих курсів для студентів різних спеціальностей викладачами та адміністраторами вищих навчальних закладів.

**Ключові слова:** інтеграція; вища освіта; вибір професії; кооперація; прикладні поля; навчання.