

## DEVELOPMENT OF INTEGRATIVE-TRANSPARENT EDUCATIONAL ENVIRONMENT TRAINING ENGINEERS OF AGRICULTURAL PRODUCTION

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**Abstract.** The present article deals with the research in formation of educational environment on the basis of the principle of integration for formation and development of different levels and kinds of professional competences training the future engineers of agricultural production. The aim of the research is organising the educational environment in education of engineers that helps in formation and development of different levels and kinds of professional competences, acquisition of the teaching material more effectively, acquisition of fundamental knowledge and skills to apply this knowledge. In the research the methods of investigation in the educational environment were used, as well as the methods of analysis studying the pedagogical experience of teachers at agrarian universities, pedagogical experiment, and statistical methods in calculation of the results of pedagogical experiments. The research concept is based on the fact that the professional training of future engineers in higher educational institutions is aimed not only at the acquisition of knowledge, skills and abilities, which are determined by the educational and qualification characteristics, but also at the acquisition of skills and abilities to organize independent work on the study of software material. Achieving this goal is possible under the conditions of the introduction of personally-oriented learning technologies, ensuring thorough motivation of students, providing material and methodological support and developing rational mechanisms for end-to-end programming of individual independent work according to the principle of the “tree of goals”, i.e. end-to-end execution of small independent works: essays, calculation works, graphic, calculation-graphic, creative, descriptive in the calculation of their thematic entry into more capacious independent works - term papers and projects, which, in turn, are included in qualifying diploma theses or projects. The methodology of integrative-transparent organisation of the educational activities of the students at agrarian universities is universal and can be used also for other specialties. The results of the pedagogical experiment showed increase in student success what proves the efficiency of application of the research results. The results of the research showed also the influence of the organised professional orientation activities of students in learning fundamental subjects on the motivation for learning and professional interests. Motivation to acquire the fundamental subjects and interest in profession also had a trend to improve. Improvement of student achievements in studies, motivation level and professional interests prove the efficiency of the results of the performed research in formation of the organisation principles of student activities.

**Keywords:** education, educational environment, competency, professional orientation, engineering education.

### Introduction

European integration in education and culture was and still is for Ukraine one of the priority trends in foreign relations and in the process of development of an independent country [1].

The 21st century requires formation of a uniform European education environment, “European mentality” and European citizenship along with national citizenship. Integration of Ukraine in the world’s educational environment, modernisation of the national education according to the Bologna process require essential changes in training the future specialists on all levels of the teaching process.

There are favourable preconditions in Ukraine for introduction of integration technologies in training future specialists. The specialists should be trained in accordance with the international market requirements in all cycles of teaching at the university, they should understand elementary notions to be able to perform simple operations: from reproduction of professional activities to independent solution of professional tasks. At the present information environment and latest technologies, the ways of application of experience cannot be considered as substantiated. The topicality of the research is the necessity for solution of this problem.

The problems of integration of higher education in Ukraine in European educational environment are addressed in scientific publications of pedagogues and scientists Andrushchenko V.P., Kremen V.G., Lugovoi V.I., Zgurovsky M.Z., Stepko M.F., Bendera I.N., Fedulova L.I. etc. [2-5].

Most often the publications deal with interrelations among different educational environments and between environment and education. Most of the authors compare relations in traditional environments with innovation environments or classes of active learning [6-10].

Many authors stress the importance of teaching and moderation of teacher activities [11-13]. It is important how the relation between the educational environment, pedagogy and latest technologies is formed [14-17].

All these investigations show how the educational environment influences the activities of students. Self-education, ability to learn life-long and ability to choose the necessary information are critical functions which the students living in a social context different from that 100, 50 or 20 years ago need to develop. It is quite a difficult process requiring special educational methods that stimulate development of these competencies in the classroom and later can be used in the process of work [18].

In this context acquisition of competences is a critical element in the teaching program of higher education [19; 20].

In the opinion of the authors, the problem of theoretical substantiation and practical implementation of the integrative-transparent educational environment in higher agrarian technical educational establishments needs to be paid more attention to. In this respect, the problem of introduction of integrative-transparent educational environment in training the future agro-engineers becomes very topical. It requires to specify the content of learning and improvement of the quality of teaching, application of methods and means that help in acquisition of knowledge, formation of skills and competences and intellectual development of personality.

The aim of the research is studying and organisation of the integrative-transferable educational environment in engineering education that helps in formation and development of different level professional competencies, more efficient acquisition of the teaching material and knowledge, and the ability to apply the acquired knowledge practically.

## **Materials and methods**

In the opinion of the authors, one of the main trends in education corresponding to the European requirements is introduction of the transferable approach in engineering education that is based on the integration principle for formation and development of different levels and forms of competencies. Based on knowledge, skills and competences as the content of education the competence approach means not only to supply information for students, but stresses the skills to solve problems which can be encountered in everyday life and professional activities. It requires changes in the structure and content of higher education based on the innovative educational system oriented to solving tasks in educating a specialist who is able to work efficiently in dynamically changing environment.

Competency cannot be formed by giving students tasks solving of which needs reproductive knowledge and a definite algorithm. The student must independently and gradually proceed through the situations that are close to reality what requires more competent activities, reflection of experience that can be acquired at every step of the activity. So, professional, educational and research competency that can be formed in integrated environment as repetition, reproduction, changes of notions, activities in different conditions and situations is a complicated synthesis of cognitive, subject-practical and personal experience of students. The specificity of education in integrative-transferable educational environment is that not ready-made knowledge is acquired, but the conditions of its forming are followed. At such approach the educational activities periodically change from empirical to research activities. Such organisation of educational environment itself becomes the subject of learning. It can be achieved by involving of students in professional activities through the teaching subjects, practical work, and projects increasing the spectrum of student knowledge, skills and possibilities in the system of end-to-end basic research.

The process of training agro-engineers is based on the competence approach in learning all subjects in two cycles of training the future specialists at the higher educational establishment.

Traditionally the subjects of the general education cycle have practically the same methodology for all specialities. The technology of the competence approach requires essential changes in organisation, content and methodology in the educational process. It means, first of all, changing the accent on theoretical training to applied professional orientation. Another direction is transferable formation of professional competency of students through independent and practical work related to the future qualification work, diploma project. This way an essential part of laboratory work, practical and independent work will have elements of professional competency and scientific research.

Transferable performance of independent, practical and professionally oriented work ensures the basis for active and conscious work of students that is related to the real diploma project [2].

The conceptual scheme of organisation of integrative-transparent independent work requires specification of sub-scheme in different educational levels including in them less capacious independent work of descriptive, calculation, graphical etc. character (Fig. 1).

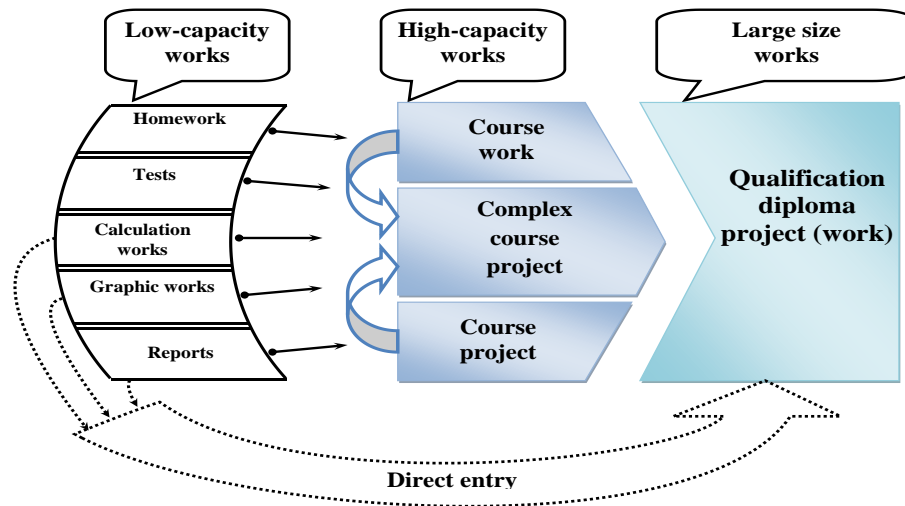


Fig. 1. Conceptual scheme of transferable independent work for bachelor degree programme

The approaches for formation of integrated educational environment of the higher educational establishment require practical work in the whole process of training students. It should start in the beginning courses in the form of elementary functions following independent solutions in the graduation courses, readiness to take responsibility for these solutions, supplementing the existing competency with research skills, non-standard approaches, searching for alternative solution of professional problems in the educational cycle for master qualification. The systematic, theory-based performance of practical activities by future engineers forms in their minds a picture of the integrity of science in their professional activities. The practical aspect of work is the uniting mechanism for integration of the content of teaching subjects (interdisciplinary integration). An important role in this is played by inter-subject links that manifest as application of knowledge in one subject for learning the content of another subject maintaining theoretical and practical unity of both.

In the later courses the interest of students in transferable design is more expressed. Many students from these courses studying some material together with students of first courses become their advisers in preparation of their course projects. It helps teachers have more time for solving more important problems in the process of education. The offered project technology has higher requirements for project advisers in course and diploma projects. They need to choose real themes for course projects and the way how they will be included in diploma projects.

To achieve these aims the following tasks should be solved:

1. To analyse the existing transferable programs of student scientific work in different systems of education. To understand common regularities, positive moments, trends of development.
2. To understand the main trends and conditions for introduction of the transferable principle of scientific work in the process of studies.
3. To develop the transferable principles of student scientific work in gradual professional training of specialists of agro-engineering profile.
4. To offer methodology and programs for implementation of the transferable principle of scientific work in theoretical, practical and production forms where all subjects of the educational process are involved.
5. To prognosticate the possible complications in implementation of the technology, find ways how to solve them and plan further research.

The authors of the article offer some ways of implementation of transferability.

Variant 1. Transferability in some subjects needed for one course project. In this variant independent work in some subjects that are taught in parallel in one course had themes corresponding to the trend and content of the course project (Fig. 2).

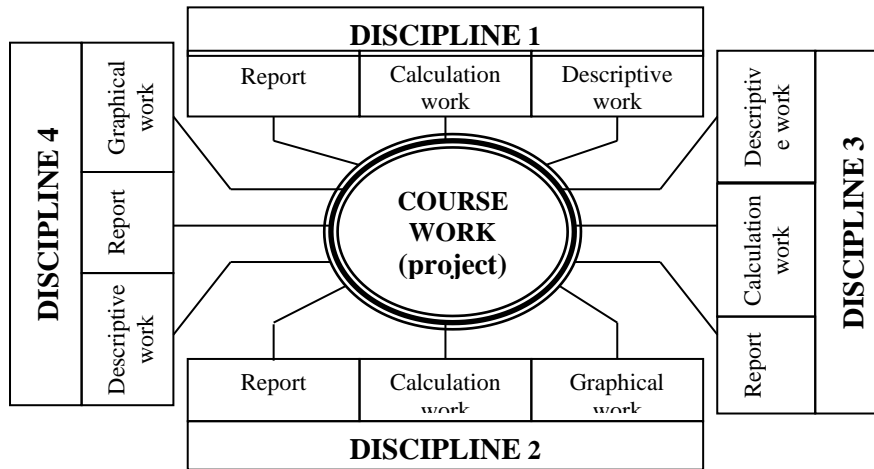


Fig. 2. Transferability within several disciplines aimed at one term paper

Variant 2. Transferable independent work within several course works (projects) aimed at the graduation project (work). In this case course works (projects) were elaborated in different courses but having the themes maximally close to the diploma project (Fig. 3).

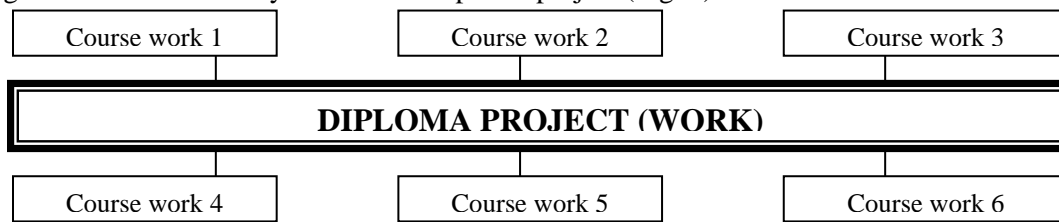


Fig. 3. Transferability within several course works with themes close to the diploma project

Variant 3. Transferable independent work in course projects with the themes corresponding to the diploma project. In this case the themes of the course projects are corresponding to the themes of the diploma project. If necessary, individual tasks in subjects not having course projects are also a part of the diploma project (Fig. 4).

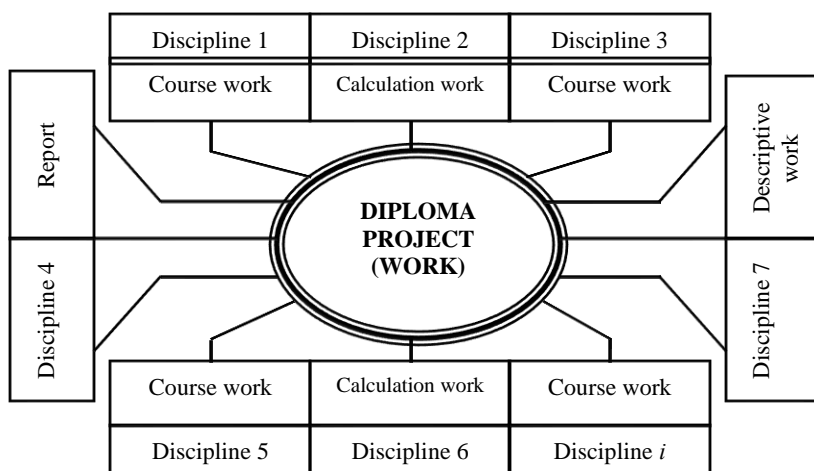


Fig. 4. Transferability within course projects and individual tasks

The idea of transferability is further developed in elaborating course projects [3]. For the main subjects in the education plan in which course projects are included subject transferable schemes are developed in which individual tasks in other subjects are envisaged (Fig. 5).

To prove the effectivity of implementation of the integratively-transferable educational environment in professional training future agro-engineers the results were analysed using statistical methods. The integrative-transferable educational environment was introduced in experimental groups. In control groups teaching was done using traditional methods.

All other conditions that could affect student learning we tried to balance.

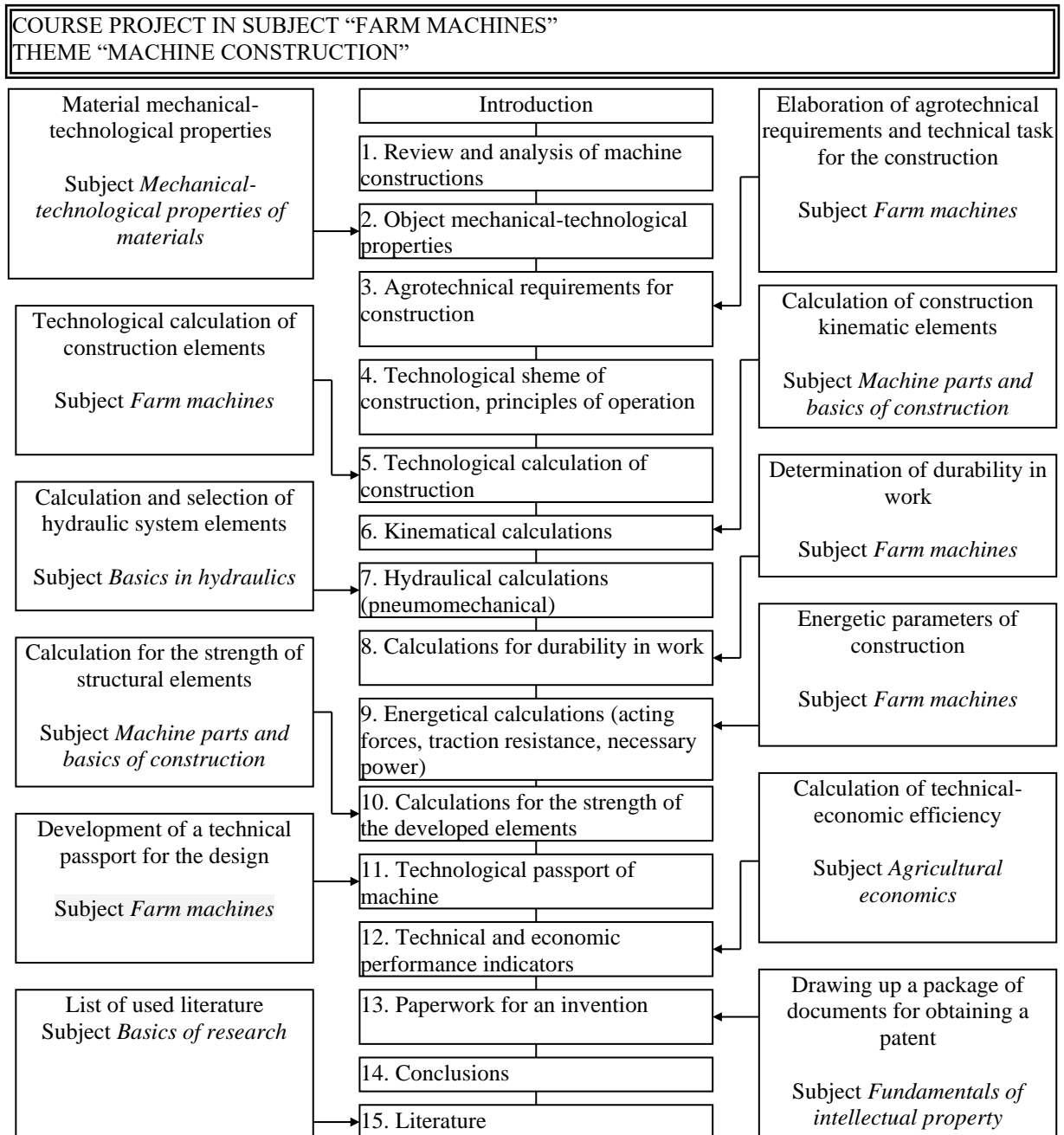


Fig. 5. Transferability scheme of a course project in the subject "Farm machines" (example)

**Results and discussion**

The technology of end-to-end programming was implemented according to the following principles: availability, individual and personal orientation, independent activity, visibility, modelling, theory and practice correlation, motivation, problem solving, universality. The experiment results showed that usage of the traditional and integrative-transferable methods produces essentially different results. The pedagogical experiment was carried out with 2, 3 and 4 year students of higher education in the specialty "Agroengineering" in the number of 560. For the evaluation parameter, the average score for evaluating the knowledge of students was selected.

In the first stage of the experiment, the control groups and experimental groups did not differ in the level of formation of professional skills. After the experiment the formed competency of the students from the experimental groups was 1.8 – 2.2 times higher than of the students who learned using the traditional methods.

During the research it was observed that in the experimental groups there were more students having a high and sufficient level of agro-engineering professional skills, 29.2% and 28.4%.

At the same time, the number of students in the experimental groups with average and insufficient level of professional agro-engineering skills reduced, 24.8% and 32.8%. In control groups essential changes were not observed (Table 1).

Table 1

**Experimental and control group test results before and after the experiment**

Formation levels	Number of students, %			
	Control groups		Experimental groups	
	Before exp.	After exp.	Before exp.	After exp.
High	2.3	6.1	2.4	31.6
Sufficient	8.2	12.2	8.4	36.8
Average	45.1	42.0	45.3	20.5
Insufficient	44.0	40.0	43.5	10.7

Qualitative and quantitative analysis of the experiment (using the method of testing statistical hypotheses according to the Pearson criterion) showed that the developed technology of end-to-end programming of future agricultural engineers in agricultural technical universities is quite effective. The critical values of the statistical criterion were taken for the significance level  $\alpha = 0.05$ . Therefore, with an accuracy of 95%, it should be considered that the hypothesis of the research was proved.

It can be concluded that in the result of the performed research the tasks stated at the beginning of the work were solved; analysis of the research results proves the correctness of the hypothesis and shows the perspective of introduction of the offered integratively-transferable methodology at agrarian and technical institutions of higher education for professional training of future agro-engineers.

## Conclusions

The basic conditions for organising the process of education with the offered system of integrative-transferable educational environment are as follows:

- organisation of quasi-professional activities at practical and laboratory work modelling complex acquisition of knowledge;
- understanding of the importance of interdisciplinary integration at all stages of teaching subjects, first of all, systematic usage of tasks modelling situations for application of interdisciplinary knowledge;
- creation of conditions for personal and professional self-development of students, development of the necessary abilities considering individuality of student thinking (for instance, abilities to analyse situations and their emotionality, pragmatic “engineering” thinking or creative thinking);
- creation of prerequisites for motivation of future engineers to learn the contents of subjects, increasing student cognitive and learning activity (rating system, preparation of reports, elective courses, project method, etc.).

The pedagogical technology of end-to-end programming and the developed applied models are universal, taking into account their application after professional adjustment of the content for any technological specialties, in particular the specialty: “Agronomy”, “Technology of production and processing of livestock products”, etc. Consequently, the pedagogical model of the integration through educational space should include a set of conditions aimed at developing the student skills to apply, to a greater or lesser extent, knowledge in various academic disciplines in future professional activities. These skills can be developed within the framework of educational and cognitive activity only if special didactic conditions are met, for example, when a student applies knowledge in a discipline, firstly, in

the process of studying it, to objects related to future professional activities; secondly, in the study of other disciplines - in new, "withdrawn" from this discipline, situations.

#### Author contributions:

All the authors have contributed equally to creation of this article. All authors have read and agreed to the published version of the manuscript.

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