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*Khmelnytskyi Humanitarian-Pedagogical Academy
**Khmelnytskyi National University

LIUDMYLA ROMANYSHYNA*

ORCID ID: https://orcid.org/0000-0002-6026-2614
romanyshyna43@ukr.net

NATALIIA SAMARUK**

ORCID ID: https://orcid.org/0000-0002-4611-8528
samaruk_nm@ukr.net

The Principle of Integration as a Means of Providing Interdisciplinary Connections in the Training of Specialists

Zasada integracji jako sposób zapewnienia interdyscyplinarnych związków w szkoleniu profesjonalistów

STRESZCZENIE

Artykuł dotyczy pedagogicznych podstaw procesów integracyjnych w edukacji. Badany jest problem określania istoty, celów i poziomów integracji. Doceniono rolę interdyscyplinarnych powiązań nauk przyrodniczych jako obiektywnego czynnika kształtowania kompetencji uczniów i aktywizacji ich aktywności poznawczej. Uwzględniono genezę rozwoju tej koncepcji. Podkreślono kwestię znaczenia stosowania interdyscyplinarnych powiązań w procesie edukacyjnym. Stwierdzono także problem związany z definicją funkcji i klasyfikacją połączeń interdyscyplinarnych.

Słowa kluczowe: integracja; procesy integracyjne; integracja wiedzy; relacje międzyludzkie

SUMMARY

Pedagogical foundations of integration processes in education are discussed in the article. The problem of determining the essence, goals and significance of integration in the educational process is investigated. Levels of integration are highlighted (level of interdisciplinary connections, didactic synthesis, integrity). The role of interdisciplinary connections of natural science disciplines

as an objective factor in the formation of students' competence and activation of their cognitive activity is substantiated. The genesis of the development of this concept is considered. The importance of interdisciplinary connections in the educational process is highlighted. In addition, the article focuses on the problem of determining the functions of interdisciplinary connections. The problem of classification of interdisciplinary connections is investigated.

Keywords: integration; integration processes; integration of knowledge; interpersonal relations

INTRODUCTION

The modern human understanding of the real world is formed in a complex system of sciences, each of which cannot develop in isolation from the others. This or that particular phenomenon or object can be the element of study of various sciences. Different sciences are interconnected in the knowledge of one and the same subject. The general connection and interdependence of the matter are manifested at various stages and in all forms of its development. The holistic unity of the world is confirmed by the data of the science of nature, as well as by the universality of fundamental laws (Biletska 2004, p. 38). Strengthening of the integrative processes in scientific knowledge is a trend that has been steadily increasing during recent decades, reflecting, in general, the most significant changes in science and society. The integrative tendencies are manifested in modern education as a desire to form students' coherent picture of the world, to combine knowledge of nature and technology with spirituality and creative inclinations (Martseva 2015, p. 56).

At present, the problem of integration is relevant and actively studied. In psychological and pedagogical literature, it is most frequently considered from the standpoint of a holistic learning process organization, as well as the implementation of intersubject connections (Vasileva 2014, p. 29). The role of integrated information in the flexible thinking development, the universality of knowledge and skills of students in the education system have been determined and proved by many scholars such as: M. Berulava, R. Hurevych, I. Zvieriev, I. Kozlovska, P. Kulahin, D. Kolomiiets, N. Loshkarova, V. Maksimova, H. Fedorets, A. Ursul. The problems of the essence of integration, integration mechanisms, creation of integrated courses have been investigated by Biletska (2004, p. 69).

The precondition for integration is intersubject connections (ISCs). Many scientific researches of Ukrainian and foreign scientists are devoted to the theoretical substantiation of the problem of ISCs. Problems of the ISCs development, integration of educational knowledge from various educational disciplines have been considered in the dissertation researches of: N. Andreeva (ISCs in the teaching of general technical disciplines in the professional training of a handicraft teacher), O. Mishchenko (realization of ISCs in junior schoolchildren physical

education), O. Teslenko, O. Bandura (ISCs in the process of studying Ukrainian literature), L. Kovalchuk (ISCs in the study of chemical and technological disciplines in the economic business college), L. Shapovalova (problems solving methodology of intersubjects content in the process of teaching Physics at general secondary school), etc.

RESEARCH RESULTS

Integration entered the pedagogical process in the early 1980s. The adoption of this term by the teachers was prepared by the scientific and technological process, the development of computer technology and the integrative processes in education, which took place over the past decades and led to deep mutual penetration of sciences into each other (Vasileva 2014, p. 29). The notion of "didactic integration" emerged in the early 1990s as "the possibility of constructing a learning model based on one of the general education subjects' profile" (Martseva 2015, p. 57).

In modern studies on didactics and methodology of teaching in higher education, integration is considered as the most important methodological category aimed at ensuring the integrity of the educational process. Pondering the essence of education as a cultural phenomenon, V. Maksimova (1996, p. 17) emphasizes that it is an integrative branch of human activity. While considering the term "integration", it is important to clarify the meaning of the concept. There is an instability and ambiguity in the meaning of this term in modern pedagogical literature (Biletska 2004, p. 48).

The term "integration" (Latin *integratus* – "restoration", "filling", from *integer* – "the whole") has deeply penetrated in the scientific usage, but there is no single definition of this concept today. The Glossary explains integration as "the unification of something into a single entity" (Martseva 2015, p. 56).

The term "integration" in *Great Encyclopaedic Dictionary* is broadly defined as:

a) the characteristics of the convergent process and the unification of sciences, that goes along with the process of differentiation;
b) the notion, which means the state of cohesiveness of separately differentiated parts and functions of the system, the organism as a whole, as well as the process leading to such a state (Biletska 2004, p. 49).

What concerns the integration of sciences is the interpenetration of research methods from one science to another, the development of a common approach for a number of sciences to study, theoretical description and explanation of phenomena (Honcharenko 1997, p. 95). The integration in the learning process is defined as one of its parties associated with the union of disciplines, the result of which is the formation of a qualitatively new, holistic system of students' knowledge and skills that have integrated new features (Biletska 2004, pp. 69–70).

I. Kozlovska (1999, p. 165) defines the integration as a process of "interpenetration, compression, unification of knowledge; the formation of integrity; setting relationships between relatively independent before things, processes", as well as the process of "interaction of elements (with targeted properties), accompanied by the establishment, complication and strengthening of the essential connections between these elements". Integration can be seen as a means of knowledge systematisation.

Firstly, the integration of knowledge in the process of future professionals' training is understood as the creation of students' holistic view of the surrounding world and its future profession, and, secondly, as a process leading to the achievement of the goal, during which there appear qualitatively new trends in the teaching process (Vasileva 2014, p. 39). Thus, in the various sciences and spheres of activity, the concept of integration is treated as a process, form, stage or result.

The need to establish integrative relationships between the elements of the system of educational content has been noted in the research by M. Skatkin (1980, p. 32) according to whom, "the subject structure of the curriculum conceals the danger that the whole will be closed by its separate parts, allegorically speaking, the forest will not be visible due to the separate trees. In order to avoid this danger, it is necessary to provide synthesis, integration, amalgamation of parts into the whole in education".

The theory of self-organization of complex social systems plays an important role in the methodological substantiation of integrative processes. According to Kozlovska (1999, p. 19), basic methodological principles of integration of knowledge are coordinated with the main principles of the society development: the principles of historicism, systematicity, objectivity, scientificity, unity of quality and quantity, dialectical negation, the interrelation of phenomena, the comprehensiveness of the phenomena and processes study, the unity of practical and theoretical activities.

The interrelationship of sciences includes not only "horizontal" integration processes, when the corresponding sciences interact only at the level of fundamental sciences, or at the level of applied sciences, but also "vertical" processes, both within the framework of an academic discipline, as well as the difference between the fundamental level of one and the applied level of the other disciplines. This complex network forms a unified system of integrative processes (Vasileva 2014, p. 31).

At the same time, as an alternative to the old tradition of education, when it was quite enough to confine oneself to the establishment of local ISCs, the idea of identifying common core methodological approaches and their reflection in each discipline is put forward. In other words, we are talking about deep integrative processes (Hrytsiuk 2016, p. 99).

The process of determination in the unified knowledge system of fundamental, generalizing concepts, theories and laws, with the help of which the existing

and identified in the system, cause-and-consequence and correlation relations, as well as main and auxiliary components, are important component for the knowledge integration and systematization.

The principle of intersubjects integration facilitates to deepen interrelationships between academic disciplines, to find a single unifying framework and, as a result, to create of a new integrated content. Intersubject integrative connections as a subsystem of a high-quality educational process should be based on the principles of targeting, flexibility and creativity, according to which, the teachers can strengthen the relationships between disciplines, purposefully using intersubjects educational and cognitive or competence-oriented tasks, aimed at preparing students for social interactions.

Studies that have been conducted by psychologists on the formation of knowledge and the development of thinking also showed that the basis for knowledge acquisition is the formation of associations, constantly expanding and complicating, as a result of which the inter-system basis of concepts is formed, as well as the intersubjects structure of generalized knowledge is created. Thus, the process of the formation of associations is more successful in the case of the permanent ISCs establishment. However, the substantial knowledge acquisition of various subjects, based on the implementation of ISCs is only the first step towards the formation of a holistic knowledge system (Biletska 2004, p. 48).

Thus, the term "integration" in the education system can be considered from the point of view of two semantic meanings:

1) as the aim of learning process – the formation of the students' holistic view of the surrounding world (integration facilitates awareness of the connection of the world's individual parts as a unified system of interrelated elements);
2) as a means of learning process – finding common ground of the subjects' knowledge (integration provides orientation on brain building as well as the development of other personal qualities) (Vasileva 2014, p. 31).

Scholars M. Koziar and I. Kozlovska (2011, p. 55) acknowledge the fact that integrative processes within the theory of education and training have two aspects: cognitive (integration of knowledge) and technological (integration of forms and methods of learning).

It should be noted that various variants of integration are considered in the pedagogical literature. At the level of the educational subjects' development, the integration of the content of learning can be completed by the formation of a new academic discipline that has an integrative character and the subject matter of its own, as well as a new discipline that has an integrative character as a result of the amalgamation (Biletska 2004, p. 68). Of fundamental importance for the essence of integration is the definition of its objectives.

Proceeding from the ISCs objectives, the aims of integration are as follows:

1) *dialectical* – the necessity for the implementation of relations between disciplines;
2) *differential*, which is provided by the dialectical unity of the differentiation and integration processes;
3) *scientific orientation*, which is realized through the increase of motivation, the development of interest in the study of disciplines relating to different sections of scientific knowledge;
4) *system-forming*, presupposing the existence of certain systematic, structural properties of the knowledge;
5) *modernization of educational material*;
6) *the function of developing education*;
7) *humanization*, which ensures the development of a person's cultural identity (Vasileva 2014, p. 31).

The characteristic features of the integrative processes are prior for determining the levels of integration, each of which has its own logical structure. We agree with the opinion of M. Berulava (1998, pp. 112–115) offering three realization levels of the educational content of integration: *the level of interdisciplinary connections* (the source of which are the general structural elements of the discipline content); *the level of didactic synthesis* (involves the integration of training form of the classes); *the level of integrity* (the characteristic features of which are meaningful, typical, procedural and content integration within the framework of the new integral discipline formation).

At the first level, the interaction between disciplines is carried out in the form of intersubjects connections. ISCs are built into the academic subjects' content. Reflecting the inter-scientific areas of knowledge, they are general parts of the cognate academic disciplines. Superimposed on one another, they have a cyclic nature, that is, they mutually penetrate into educational subjects (Biletska 2004, p. 55). Integration at the level of intersubjects connections allows to identify interdependencies, to establish the content aspects functioning. Thanks to the integrative structure, one of the main issues of professional training is solved, which is related to the practice-oriented training. The development of ISCs can increase the students' motivation, deepen and broaden their knowledge of future professional activity, prepare for the study of theoretical mechanics and other specialized disciplines, and acquaint them with the general operating provisions of scientific research (Hrytsiuk 2016, p. 103).

The second level of integration is the level of didactic synthesis, which presupposes the simultaneous study of interrelated concepts, laws, theories from various disciplines during one integrated lesson. There also exists a possibility to carry out integrated days that create conditions for the formation of students' global and professional thinking.

The advantages of this level involve the compression of related learning material, the deepening of knowledge of applied nature (Martseva 2015, p. 58). This is

an intradisciplinary synthesis combining different theories within the framework of a single subject, that is, the synthesis of interacting sciences on the basis of a particular basic discipline.

The third level of didactic integration is the integrity level that is characterized by the creation of a new educational discipline of an integrative nature and its inclusion in the list of studied disciplines. The integrated course has a distinctly expressed ideological, methodological and reflexive character: the student does not simply reproduce the previously acquired definitions, laws, facts, but understands them at a higher level of generalization, systematization, understanding of the role of scientific methods in the study of environmental processes and phenomena. So, at this level, the problem of the logic deployment and interpenetration of educational topics and personality development during the preservation of elective and multilevel learning is solved (Martseva 2015, p. 58). The examples of such courses include special courses at higher technical educational establishments, for example, integrated courses in machine science, radio and electrical engineering, construction materials engineering, etc.

In accordance with the stated aims of the article, let us dwell upon the consideration of ISCs as the main means of integration in education.

The origin and development of the pedagogical idea about ISCs and its transformation into an independent didactic problem are connected with the theoretical and practical searches of progressive teachers of different epochs – J. Comenius, J. Pestalozzi, K. Ushinsky and others (Biletska 2004, p. 56).

An important stage that determined the study of the problem of ISCs, from the standpoint of their role in the system of knowledge formation and the scientific outlook basis, were the investigations conducted during the 1950s and 1960s (Biletska 2004, p. 56). The problem of intersubjects connections becomes one of the central in didactics during the 1970s. Approximately from the mid-1970s, the teachers focused on the problem of the educational process integrity, caused by the needs of practice (Martseva 2015, p. 56).

Let us consider the issue of the definition of ISCs. One of the first contemporary interpretations of the concept of "intersubjects connections" has been given in the *Pedagogical Dictionary* from 1960, where it is interpreted as the mutual coherence of curricula that are caused by the system of sciences and didactic objectives (Kruhliak 2005, p. 28). Pedagogue S. Honcharenko, in the *Ukrainian Pedagogical Dictionary* (1997, p. 210), interprets ISCs as a mutual agreement of curricula that reflect the integrated approach to education and training, performing upbringing, developing and determining functions through the integration of knowledge, increasing the productivity of the course of psychological processes.

Under interdisciplinary connections, a system of relations between knowledge and skills is understood. They are formed as a result of consequent reflection in the means, methods and content of educational disciplines of those objective

relations that exist in the real world. In the broadest sense, ISCs is a pedagogical equivalent of dialectical relations, implemented in the educational process (Eremkin 1984, p. 9). ISCs characterize the interaction of subjects, which allows to consider them as one of the forms of knowledge integration, as well as a particular system.

Scholars M. Berulava (1998) and I. Kozlovska (1999) consider ISCs as a certain level of integration, I. Kolomiiets – as the first level of integration, A. Shakyrzianov – as a didactic condition of integration, and V. Maksimova (1996) – as a means of inter-scientific integration.

Determination of the role and place of ISCs in the educational process requires their classification. Nowadays, there is a large number of approaches to the classification of ISCs. Their types can be divided on the basis of various features:

a) according to the way of assimilation relations in various kinds of knowledge: *reproductive*, *search*, *creative*;
b) according to the intended coverage of implementation: *intercourses connections*, *intracohort groups*, *intercohort groups*;
c) according to the time of implementation: *inherited*, *concomitant*, *perspective*;
d) according to the method of the disciplines interrelations: *unilateral*, *bilateral*, *multilateral*;
e) according to the implementation stability: *occasional*, *systematic*;
f) according to the level of the educational process organization: *by-the-lesson*, *topical*, *"cross-cutting"*;
g) according to the forms of the students and teachers' work organization – communicative relationships: *individual*, *group*, *collective* (Biletska 2004, p. 62).

Very often, ISCs are classified according to the chronological (temporal) criterion. Accordingly, ISCs are divided into:

1) *prior*, *concomitant*, *perspective*. Prior ISCs – are the connections, which, when studying the course material, rely on previously acquired knowledge of other subjects. Concomitant ISCs are the connections that take into account the fact that a number of issues and concepts are studied simultaneously. Perspective ISCs are implemented, when studying of the material is far ahead of its usage in other subjects (Samaruk 2008, p. 66). Perspective ISCs involve the accumulation of certain knowledge on special subjects before studying their scientific backgrounds during lessons on fundamental disciplines (Biletska 2004, p. 59).
2) *Synchronous* and *asynchronous connections*. During the usage of synchronous connections, there are mutual exchange as well as complementarity of studied subjects within one semester, or the academic year.
3) *Horizontal* (connections between disciplines of one year of study), *vertical* (connections between disciplines of different years of study) (Samaruk 2008).

Different types of ISCs perform a number of functions in the educational process of higher educational establishments. Three of them reflect the functions of the learning process (educational, upbringing, developing), and the rest are preconditioned by the specificity of the ISCs category.

Educational function – ISCs contribute to the formation of such qualities of knowledge as systematicity, depth, awareness, flexibility.

Upbringing – ISCs promote all areas of students' upbringing, the formation of their culture and literacy.

Developing – ISCs promote the development of systemic and creative thinking, formation of students' cognitive activity, independence and interest.

Didactic function – ISCs ensure the absence of educational material duplication, the united approach to the definition of concepts (Eremkin 1984, p. 88).

System-forming function – ISCs promote the systematicity of various types of reality reflection and transformation and ultimately a manifestation of universal systemic matter and its properties (Samaruk 2008, p. 58).

Constructive function lies in the improvement of the content of education. This function presupposes the selection, design and coordination of learning material, the mutual coherence and integration of knowledge, skills and abilities.

Psychological function – the implementation of ISCs ensures the creation of a favourable psychological microclimate, arouses interest in the study of educational material, positive motivation, development of cognitive activity, the desire to master new knowledge (Samaruk 2008, p. 58).

Methodological function – it contributes to the unification of the incomplete structures of knowledge, acquired during the study of various disciplines, which are not reduced to their simple summation, but while undergoing internal processing, generalization, gradually turn into a qualitatively new system, which is the basis for the formation of a holistic system of general scientific and professional knowledge and skills.

Logical function – ISCs presuppose structure consistency of knowledge and its components (concepts, facts, phenomena, laws, theories, etc.) about specific academic disciplines, the clarification of the mechanism of interaction of these disciplines, the discovery of intersubjects knowledge and their integration into the logical system (Samaruk 2008, p. 60).

CONCLUSIONS

Thus, the analysis showed that the efficiency of the future professionals' training can be improved by the integration increasing at the level of intersubjects connections. Integration of sciences in various forms of the synthesis of interdisciplinary investigations is important for both the process of the future specialists' professional competence formation during the learning process as well as for their

further professional activity (Hrytsiuk 2016). Integration ensures the consistency, continuity and unity of general and professionally-oriented disciplines in the process of competent specialists' training.

Consequently, the integrative approach presupposes the transformation of the traditional content of education, structural reorganization of teaching and methodological support for the acquisition of the integrated knowledge, which is important in the professional training of specialists.

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