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**NON-LINEAR PEDAGOGICAL SYSTEM OF UNIVERSITY
TEACHER TRAINING IN THE INFORMATION SOCIETY**

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Abstract

This study identifies the pedagogical essence of a non-linear pedagogical system for teacher training and the components thereof and describes methods for creating and implementing a non-linear model of a pedagogical system of university teacher training. Designing and implementing non-linear systems of university preparation are considered as one of the models for modernizing pedagogical education. This study is based on interdisciplinary methodology and competence- and activity-based methods. It is argued that information and communication technologies and the contemporary information and educational environment at universities enable the efficient development of a non-linear pedagogical system at pedagogical universities. Key issues from studies devoted to non-linear educational models in the information community are identified and explored.

Educational content of a non-linear pedagogical system at a university is determined through the adjustment of teaching units according to the educational needs of a given group of students, the goals of the educational programme, local conditions, and the social context, with the identification of invariable (permanent) teaching units and variable components.

Using information and communication technologies together with forms and methods of competence- and activity-based training of future teachers in the context of the contemporary information and educational environment of universities in a non-linear educational system promotes educationally interactive communities.

Mechanisms are described whereby, in the context of non-linear education, a new relational system between universities and their social partners arises. A self-organizing corporate community (the school-and-university community) clarifies the didactic tasks in the non-linear system of teacher training.

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1. Introduction

In introducing changes to educational programmes for teacher training, the aim is to shift their focus to new educational results expressed in skills determined by professional standards for teachers, teacher-psychologists, etc., which reflect the new socio-cultural reality of general education schools. Innovative transformations of the pedagogical system of contemporary universities in general and pedagogical universities in particular are aimed at replacing traditional characteristics of the educational process such as canonicity and closedness with openness, optionality, flexibility, polyphony, and the local interconnectedness of elements as necessitated by the demands of modern society and the labour market.

The relevance of the study follows from the socio-pedagogical transformations of the university pedagogical system, with all its numerous and varied elements oriented toward non-linear (alternative, multiple-choice, functional) development. This tendency creates the need for an accurate, detailed analysis of the developing non-linearity of the university pedagogical system, whose efficiency depends directly on the conditions of the information community.

To achieve the task at hand, system-and-synergy-based, activity-based, interactive, competence-based, and contextual methods may be used in research and in educational practice both on the methodological-philosophical and on the didactic level. In certain research or didactic-methodological cases, the methods may reflect some degree of constructivist methodology. In studying the phenomenon of designing non-linear educational systems and their implementation in practice, Russian and foreign studies have relied on reflexive and cultural-historical methods.

2. Problem Statement

Given the increasing differentiation of the educational environments of schools as classes become less homogeneous in connection with the development of inclusive education, migration processes, and increasing numbers of students with various forms of social disadaptation, teachers at general education schools are having to reject traditional teaching methods using printed workbooks. Instead, teachers are experiencing a growing need for constructive didactics based on pedagogical techniques from reform pedagogy (i.e. progressive pedagogy), and humanistic, humane pedagogy. Such an approach makes it possible to introduce on-the-ground modifications to the content, methods, and techniques of education, forms and methods of monitoring, and criteria for assessing learning results, the classroom environment, and the school, as the situation dictates.

The current situation at general education schools requires that teacher training at universities be improved. The design and implementation of non-linear systems of university training are seen as one model of modernization.

The non-linear nature of an educational system of a pedagogical university involves: learning goals based on the formation of a self-developing personality; a friendly and cooperative style of communication between faculty members and students; the system's independence in choosing development areas; openness of education based on free self-expression of personality with various interaction patterns ("faculty member-student," "student-student," "student-faculty member"); and the general interaction of all elements of the pedagogical system in the context of uncertainty and risks within the the educational

environment (Platonova, Zaitseva, Zemlyanskaya, Bezborodova & Mikhina, 2017). In such a method, the teaching process is arranged according to a "non-linear scheme" with the following features:

- the personal involvement of students in forming their own, individual curriculum providing for independent selection of sections, topics, and disciplines both from among those on offer for study and from among those declared by students as corresponding to their educational needs;
- the provision of all methodological materials in printed and electronic forms for the independent work of students during the educational process, including a combination of on-site and virtual education on the relevant platform of the university's information environment;
- an increase in the number of participants in educational relations and a new kind of interaction among educational subjects;
- changes to the area of responsibility of all participants in the non-linear pedagogical system of teacher training at the university.

Some studies correlate the concept "non-linearity of the university pedagogical system" with the university's need to modernize, which corresponds to contemporary educational goals and the rapidly developing online educational environment. The goal of this study is to determine the functions and roles of the information and communication environment in providing a non-linear model of teacher training at universities.

3. Research Questions

Information and communication technology and the contemporary information and education environment at universities enable the efficient development of non-linear pedagogical systems at pedagogical universities. In this context, the key research issues in providing a non-linear educational model are:

- the determination of educational content in a non-linear pedagogical system in the context of the information and communication environment;
- the choice and use of multimedia technologies and forms and methods of competence-and-activity-based training and developmental education of future teachers;
- the expansion of opportunities to engage new educational partners and arrange interaction among subjects of the non-linear educational model by means of expanded IT capabilities.

4. Purpose of the Study

To discuss problems concerning the scientific and methodological basis of a non-linear pedagogical system for teacher training at universities in the context of the information and educational space.

5. Research Methods

The theoretical analysis of the literature and experience of developing non-linear educational systems. A series of surveys was conducted among faculty members, students in elementary-education sections at pedagogical universities, and supervisors of school practice using questionnaires, including ranking-based assessments.

6. Findings

(1) The determination of the content of education in a non-linear pedagogic system at universities is the most underexplored issue among those being considered.

Some papers note that contemporary educational information technology may provide for the development of non-linear, differentiated adaptive learning. B. Cope, M. Kalantzis (Cope, 2016) propose a transition from didactic pedagogy to reflexive pedagogy and to that end outline seven pedagogical opportunities:

- ubiquitous learning: at any time and in any place;
- active knowledge generation: trainees as generators of knowledge;
- multi-modal value and presentation of knowledge;
- repeated feedback;
- joint intellectual activity;
- meta-cognition: double level of thinking (thinking about thinking);
- differentiated instruction.

S. Hase and K. Kenyon consider adaptive systems and differentiated instruction methods (Hase & Kenyon, 2007). They make a distinction between knowledge and skills (competences) and deep study in the process of developing associations that result in insight, "aha" reactions, and the generation of new ideas. For that, they propose a non-linear design of the instructional process based on heutagogy:

- the recognition of the formative nature of education and the consequent need for a "living" non-linear curriculum which is flexible and modifiable;
- involving the student in the management of their own learning system;
- providing a systematic approach in the acquisition of knowledge and skills;
- the participation of the student in the development of assessment, self-diagnostics, and the application of knowledge to real-life situations;
- joint learning.

We also discovered the positions of the scientific discourse with respect to implementing innovative principles for creating educational content. On the one hand, in the context of global computerization, the constructivist position is becoming increasingly productive: "...[K]nowledge is not a static phenomenon...It is a process - more specifically, a process of continuous designing and reorganizing" (J.-J. Piaget). This position proposes rejecting the sacral value of knowledge. Almost unlimited access to any scientific (and pseudoscientific) information allows students to develop and examine alternative hypotheses about the world and reach their own understanding of the phenomena under investigation.

On the other hand, researchers stress the importance of academic preparation as the basis for the development of cognitive processes, the possession of scientifically substantiated methods of making pedagogical decisions and scientific judgments (Ulvik & Smith, 2011), the involvement of students in the process of inquiry, and the conscious understanding of algorithms, solution techniques, and methods of proof. The educational context is important - that is, the opportunity to use communicative activities as a basis for assessing the suitability of the acquired knowledge, skills, and formed intellectual constructs in real instances in communication with one's social surrounding (the cultural level of possessing knowledge, as opposed to the natural level).

Thus, determining the educational content in a non-linear educational model involves creating pedagogical conditions for successful self-structuring and autonomous knowledge acquisition on the part of students and entails:

- clarifying teaching units according to the educational needs of a given group of students, the goals of the educational programme, local conditions, the social context, etc.
- scientifically substantiating the chosen task content and structuring of the educational material; identifying the main invariable (permanent) and variable components of the learning content;
- forming an information base for planning and implementing didactic tasks;
- introducing navigators for the knowledge area being studied and means of inquiry, and the development of procedures and methods to assess informational content;
- assessing the risks of students' independent inquiry into and assimilation of the variable components of the content;
- modifying available educational supplies.

(2) The use of information and communication technology, forms, and methods in competence- and activity-based training of future teachers in the context of the contemporary information and educational environment at universities is a fairly well-studied issue. Traditional methods of teaching new material and the transfer of information in frontal work with students are based on simultaneity and parallelism: the entire group or all students of the same year listen to a lecturer in real time, and all students look at the same page of a book or presentation slide, perform the same tasks, and take the same standardized tests; in contrast, a non-linear educational system is aimed at creating an educational community of mutually involved learning and inspiring students to think.

S. Hase (Hase, 2011) highlights the development of the ability to use acquired skills in new conditions, which requires more comprehensive cognition, adherence to experience, adaptability, interaction with other people, emotional stability, and the ability to resolve challenges. Furthermore, this demonstrates the importance of conducting learner pre-assessment; thus, in Hase's opinion, assessment becomes an instrument of learner-centered education. Students can determine their form of assessment and their experience, or what they will focus their attention on (Hase, Kenyon, 2007). The author proposes that instruction begin by setting problems and finding integrated solutions before acquiring elementary knowledge or skills. He also advocates the use of smartphones, tablet PCs, computers, and e-libraries to find answers to inquiries.

N.M. Pavlutsкая (Pavlutsкая, 2015) considers the concept of a non-linear educational track of student preparation and identifies the basic tenets: level-based differentiation of tasks, which allows the individual abilities of students to be taken into account; the use of split-level methods and means of learning; student selection of difficulty level, depending on his or her preparation for an educational subject in general or a particular section or topic; the use of information and communication technology; and choosing and developing split-level assessment of students.

The use of information and communication technology makes it possible to resolve a particular set of tasks when developing a non-linear educational track of student preparation. G.M. Kiselyov proposes organizing the process of forming the cognitive activity of students in the context of the information and

educational space, inspiring them to undertake "independent inquiry, perception, processing, analysis, and systematization of new information" (Kiselyov, 2015).

Similar studies have been conducted by Portuguese scientists. T. Issa and P. Isaias showed that skills related to finding solutions to problems online, active online searching, and well-arranged collection of the necessary information and actual knowledge have a positive effect on a person's cognitive development (Issa & Isaias, 2016). On the other hand, G. Andersson, R. Cover, K. Mann, T.E. Sizikova, and other researchers (Andersson & Cuijpers, 2009; Cover, 2016; Mann, Gordon & MacLeod, 2009; Sizikova, Stunzha, Poveschenko, Agavelyan & Voloshina, 2017) see certain problems in the use of the technological progress, as it creates minimal cognitive strain for the user, which can in turn lead to a decrease in the ability to concentrate while writing and reading, an inability to recall information, a lack of deep thoughts, scattered attention, and isolation.

M. Gordils takes the view that distance learning technologies and e-learning have some advantages as compared with traditional training mechanisms, with their limited infrastructure and high costs, but that when many hours are allocated for independent work, students do not have enough time. M. Gordils (Gordils, 2005) identifies the following advantages: adaptiveness to learners' needs, low instruction costs, varied forms of content and regular updating, access at any time and in any place, and universality.

S.A. Zhdanov, S.D. Karakozov, and V.G. Manyakha consider a combination of traditional and electronic learning methods during teacher training in the context of the information and educational space (Zhdanov, Karakozov & Manyakhina, 2015).

A. Kaplan and M. Haenlein highlight the fact that distance forms of learning in combination with traditional ones make it possible to increase discussion time at seminars, as students study lecture materials on their own. (Kaplan & Haenlein, 2016).

O.G. Kuprina describes the organization of independent work in the distance learning system LMS Moodle (Kuprina, 2016).

(3) The socialization of the results of university education is achieved by expanding the number of participants in educational relations, which becomes possible in the context of information and communication technology and the information and educational environment at universities. In the context of non-linear education, a new type of relations arises between universities and their social partners (e.g., what is called a school-university partnership, in which a school community starts taking part in the training of a future employee).

The new participants in the university community include the following: school teachers and supervisors of student practice, potential employers, etc., who can not only assess students' activity in a traditional manner, but might also post requests for university professors, draw attention to problems in school education, share best practices, or discuss accumulated practice. The self-organizing corporate community helps clarify didactic tasks for a non-linear system of teacher training.

A university's information space, uniform for all participants in the educational process, is a meeting place for all university faculty members to interact with students and each other, as well as a space for continuous joint work of supervisors and faculty members with each other and with students.

E.N. Zemlyanskaya and M.Ya. Sitnichenko give the example of the model of professional-oriented practice of master's students of psychological-pedagogical education in the context of the university

information environment, substantiating principles of students' socio-professional self-determination and network interaction in arranging the interaction of built-in and concentrated practices (Zemlyanskaya & Sitnichenko, 2015).

A strategy for arranging the information and educational space of educational establishments is considered in great detail in an article by Yu.F. Telnov and co-authors (Gasparian, Lebedev & Telnov, 2017). With the support of the Russian Fund of Fundamental Research (Project No. 13-07-00917-a), they elaborated the concept of interaction among key subjects in the information and educational space (Telnov, Pavlova & Protasova, 2015).

A survey of faculty members showed that they support the idea of a non-linear educational model in the context of the computerization of the university educational space. The 90% of respondents said that individualization and implementation of individual curricula are best carried out in the context of computerized education. The non-linear educational model successfully secures the split-level start in master's programmes (95% of teachers) and makes it possible to take learners' differentiated educational needs into account. The survey revealed the concerns of some faculty members about the mass implementation of non-linear learning models connected with an increase in labor costs during the implementation of educational programmes (ongoing revision of resources and courses, development of catalogues and navigators, etc.), and the practical structuring of non-linear educational trajectories.

A survey of students about the prospects and development of non-linear university education demonstrated that they generally support this idea. They identified the following advantages of such a form of education: the possibility of shortening the learning period (50% of students); the possibility of choosing disciplines and teachers (50% of students); choosing an individual progress strategy to achieve a goal (40% of students); the ability to determine an individual area of education (40% of students); choosing alternative and independent paths (30% of students); achieving different levels of education (30% of students); choosing educational techniques (20% of students); choosing levels of difficulty for homework, including creative tasks (20% of students); and choosing individual tools and techniques (10% of students). However, no respondents expressed the desire to assume responsibility for the independence of their choice and for making a responsible decision.

A large part of the students from elementary education sections (80%) said that e-resources from the university information environment help them study different disciplines more deeply. They support placing theoretical materials for each discipline in the information environment. Learners actively use information and communication technology to arrange and optimize the individual learning process. Moreover, the 100% of students use social networks to increase their professional skills; the 90% perform joint tasks and projects or prepare for classes using wikis, Google Drive, and analogous technologies; the 70% work with presentations, video lectures, video conferences, and speeches of faculty members and specialists in their areas of interest. Learners are less active in using e-mail, instant messaging systems, or group calendars to exchange educational information (50% of respondents) or university e-libraries (40% of students).

The reasons for using information and communication technology in scientific work was revealed: the 40% of students expressed a wish to participate in conferences, video conferences, or webinars as

listeners or speakers, while not more than 30% of them had actually participated in such events. However, only 10% of students were interested in access to scientific publications in scientific magazines.

The main reason for students' use of information technology in education is having convenient access to educational resources at all times (100% of students), providing feedback for faculty members from students (80% of students), being able to use practical materials (70% of students), expanding their theoretical base of preparation (60% of students), receiving information on relevant processes and events on education (40% of students), and basing themselves on the experience of practitioners of elementary education (40% of students).

In response to the question: "In your opinion, are there enough information, resources, and materials online to allow an individual to cope, remotely and independently, with the theory and practice of higher pedagogical education without the aid of faculty members?" the majority of students (80%) responded in the negative, justifying their answer by saying that "living" communication with faculty members is required, "to become a teacher, practice is required," "an experienced practitioner should teach how to become a teacher," "not only is theory essential, but so is practice," and that "one can not find all of the information necessary for education online." Those who responded in the affirmative (20%) said that a theory may be studied independently, while practice cannot. Similarly, they noted that everything necessary can be found online, but the help of a faculty member is still required.

Conclusions: Students have a positive attitude towards distance learning forms, use them mainly to read theoretical materials, use social networks to enhance their professional skills in the context of searching independently for additional information, and perform joint tasks using wikis, Google Drive, and analogous technologies. Students note a lack or insufficiency of presentations, video lectures, video conferences, and speeches of faculty members and specialists in their areas of interest, and they would like to use the university e-library more often, as well as participate in conferences not only as listeners, but also as speakers. Characterizing the non-linear approach to instruction in the e-learning context, the majority of students highlighted such criteria as pace of instruction and choice of discipline and faculty members. Students are more interested in choosing disciplines and faculty members, alternative and independent tracks, and individual instruments and techniques

7. Conclusion

A non-linear educational system for training teachers is a system that enables students to implement individual educational routes created on the basis of the incorporation of differentiated educational and research experience into the system of school-university partnerships or in the areas of their mutual influence. The non-linear higher education model makes graduates more competitive and flexible on the labor market.

The computerization of education permits the efficient implementation of non-linear pedagogical systems at different levels – content-related, technological, and social.

The main obstacle for contemporary universities in choosing such a development model lies in the practical design of a non-linear educational trajectory for its learners.

The study affirms the theoretical and practical value of the non-linear development of the pedagogical system in interaction between the educational environment of modern universities and the Internet.

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