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Future Teachers' Instrumental Metaprofessional Competencies Development as Way of Their Methodical Competence Establishment

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Abstract

Topicality of the research is determined by the main goal of education, stated in the Federal State Educational Standard for Higher Professional Education in Russia, that is mastering both academic and professionally oriented competencies, and universal, metaprofessional (instrumental, interpersonal, general system-based) competencies. Modern higher education makes implementation of competence-based professional standards one of the dominant activities in educational institutions. Raising the level of methodical competencies for undergraduates, as a result of high quality professional education, becomes one of the targets. In this context, the objective of the article is to consider the "Primary Education" methodical competence-based components – theoretic-methodological and technological – through universal metaprofessional competencies development; generalization of scientific methodical data. The material is focused on the theoretical proof and experimental evidence of the methodical competence establishment for future primary school teachers on the basis of fundamental academic disciplines. This research was based on the methods of theoretical analysis of scientific literature, testing, educational experiment and lesson observation, qualitative analysis of students' work. The article presents a theoretical model of the levels for methodical competence among future teachers, with the criteria and their nominative and specific indicators. This model enables teachers to track the dynamics of methodical competence development among students of pedagogical departments at various stages of education. The methodical materials presented in the article will help teachers in designing assignments that ensure instrumental metaprofessional competencies development at lecture classes for students.

Key words: methodical competence; levels of methodical competence; instrumental metaprofessional competencies; implicit learning; future teachers.

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Introduction

The significant component of the professional competence for a future teacher is his methodical competence, which is defined as “the integrative quality of the personality characterized by inner desire and readiness to use methodical, psychological, educational, subject knowledge, skills, experience, personal qualities for creative self-realization in education-methodical activity” (Solovyeva, 2017, p. 37). The challenge is to develop this quality among undergraduates in both methodical and fundamental academic disciplines. However, pedagogical science outlines only directions for solution of this issue, and indicates only the main trends.

Literature Review

Russian and English psychologists experimentally came to the conclusion that students can acquire a certain part of experience unconsciously, on an intuitive level. The knowledge that arises as a result of such implicit training, though non-verbal, can be used to create a real, practical action. This one and the scientific ideas presented below, form the theoretical basis of this research. Integration of fundamental, pedagogical and methodical disciplines at pedagogical faculties can become a basis for creating new pedagogical units of education based on the internal interrelation of academic disciplines and their corresponding didactic justification (Afanasyeva, 2006).

It is extremely important to design educational material identifying similar elements and parts in several previously different units (disciplines, activities, etc.) and natural submission to a single goal and function in a number of disciplines and in a methodology (Svetlovskaya, 1990).

“The developmental effect of the integrated academic disciplines is manifested in improvement of universal learning activities, as there is further generalization of intellectual actions, formation of new semantic structures. Educational material, being mastered in pedagogical universities, should be considered not only as a carrier of scientific content of school education, but also as a carrier of future methodology of its implementation in the classroom at school” (Solovyeva, & Vitkovskaya, 2016, p. 147).

The article “Epistemological foundations of the formations of universal instrumental competencies among students in higher education” (Solovyeva, 2018b) tackles instrumental metaprofessional competencies and their role in cognition, describes their operational components. The author states that “instrumental competences carry an instrumental function, and are “responsible” for functional performance of action. This is readiness to process information (interpret, rephrase, create an associative range, sum up the concept), readiness to organize information (identify, predict, establish a sequence, differentiate, classify), ability to analyze verbal and visual information, ability to find inconsistencies in reasoning, ability to plan” (Solovyeva, 2018b, p. 66).

The article “Course features “Natural-scientific foundations of teacher training” for formation of universal educational actions for younger students” (Solovyeva, 2019) reveals the mechanisms of forming metaprofessional instrumental competencies among students and preparing them for developing universal learning activities in primary schoolchildren at the disciplines of natural science. The author highlights that such a potential appears due to a single epistemological basis and similar operational components of universal learning activities and instrumental competencies of students.

The issue of the methodical competence development is discussed in many pedagogical scientific researches.

As for psychological and pedagogical factors for development of students methodical competence in higher education there can be “making students understand the reasons for their own methodical success or failure as a way of developing their motivating personal function”; “formation of methodic creative abilities among students at setting and problem-solving”; “provoking students to present their opinion”; “development and correction of methodical self-concept”; “formation of students' ability to perform cognitive internal reflection”; “teaching how to use symbolic means of presenting methodical data” (Solovyeva, 2017).

At the same time, methodical competence as a result, and, respectively, the most significant indicator of the level of professional students training at pedagogical departments, requires a substantive description of its levels. Theoretical analysis of the scientific literature has shown that in methodical competence establishment, in general, the following levels are distinguished: “intuitive, normative, active and creative” (Syasina, 2005, p. 6), “practice-imitating, combining-productive, scientific-creative” (Zagrivnaya, 2008); as well as “empirical, constructive, creative” (Lyubotinsky, 2014); “intuitive, theoretical, quasi-professional (practice-imitating), professionally coordinated, professional, scientific-methodical” (Igpulo, 2012).

Unfortunately, these levels of methodological competence manifestation are “tied” to the stages of their formation, and therefore these levels cannot help in diagnosing the quality of methodical training of future teachers, as these levels are not substantively characterized and do not have a set of criteria and nominative indicators.

Methodology

The methodological basis for establishing the methodical competence with development of universal metaprofessional competences in future primary school teachers is acmeological, competence-based and synergetic approaches.

The concept of “acme” in methodical competence establishment is considered by us as “a continuous movement towards self-improvement, with understanding that every future teacher has his own “peak”, and it is important to create conditions in his striving for victory over himself, to achieve his peak of excellence” (Solovyeva, 2018a, p. 300). Competence-based approach in education determines practice-oriented and effective-focused orientation of training. With synergetics we see each student as an individuality, appreciate his importance, we “manage the subject without managing”, in other words, direct the learner towards a productive path of development, ensuring his self-education and self-development.

The study was based on the methods of theoretical analysis of scientific literature; diagnostic (testing); observational (standardized pedagogical supervision of students' activities); experimental (primary and final assessment, control experiment); praximetric (qualitative assessment of activities results); methods of mathematical statistics and graphical presentation of the results. The experiment was launched for the students of the Federal State Budget Educational Organization of Higher Education “Pskov State Pedagogical University”.

The study was carried out in three stages. At the first stage we conducted a theoretical analysis of the existing methodological approaches in philosophical, psychological, pedagogical scientific literature, and dissertation works; we worked out the problem, aim, methods, and the plan of pedagogical experiment. At the second stage, we identified the criteria and their nominative and specific indicators for future teachers' methodical competence development; we framed a theoretical model of its levels. At the third stage, a pedagogical experiment was carried out to prove the effect of developing instrumental

metaprofessional competencies and raising the level of methodical competence for future teachers.

Results

Criteria and indicators of methodical competence establishment for future teachers

Identifying the dynamics of methodical competence establishment among students in developing their instrumental metaprofessional competencies at lectures on fundamental disciplines requires the identification of criteria and corresponding nominative and specific indicators (Table 1).

Criteria	Nominative indicators	Specific indicators
Awareness of methodical incompetence / competence	Unconscious incompetence	Characteristics of methodical self-esteem: "I don't know what exactly I don't know".
	Reflexive incompetence	Characteristics of methodical self-esteem: "I know what I don't know". Students understand the lack of knowledge, skills and experience necessary for the implementation of methodical activity.
	Conscious competence	Characteristics of methodical self-esteem: "I know content and structure of my methodical knowledge, I can apply them effectively".
	Autopsychological competence	Characteristics of methodical self-esteem: "I know the level of my methodical abilities, I see the reasons for drawbacks at work; I know the methods of methodical self-improvement".
Level of subject knowledge in the academic discipline	Low	A student makes factual mistakes in basic educational information, violating the scientific principle.
	Intermediate	A student can present educational information in an incomplete answer, with minor inaccuracies, his knowledge is immobile (unable to transfer information to similar situations) and ineffective (he doesn't use it for educational problem-solving).
	High	A student has extensive, mobile and effective knowledge in the academic discipline, with no mistakes.
Degree of methodical awareness (quality of methodical knowledge acquired in	Low	A student has separate superficial understanding of methodical techniques.
	Intermediate	A student has generalized understanding of standard methods and methodical techniques.

educational activities)	High	A student owns methodical information on innovative non-standard methods and methodical techniques.
Type of methodical activity	Reproductive	Reproduction of methodical assignments (performing activities according to the model).
	Interpreting	Activity by analogy, but with a deviation from the sample.
	Creative	Ability to generate new ideas (creativity): offering a strategy for methodical problem-solving, showing “tendency towards the opposite”.
Motivation (desire) to acquire lacking methodical knowledge, skills, experience	No interest in methodical activities.	Refusal to acquire methodical knowledge, skills, experience of activity.
	A student doesn't show special desire to participate in methodical activities.	Often loss of interest in implementation of methodical activities.
	Great desire to be engaged in methodical activities.	Rare interest in participating in methodical activities.
	Desire for methodical self-improvement.	Steady cognitive interest in methodical activity.
Degree of methodical independence	Low	Methodical work of a student is guided by a teacher.
	Intermediate	When performing methodical assignments, a student needs little assistance of a teacher.
	High	When designing methodical tasks, a student shows independence and originality.
Readiness to assess methodical situations, in particular, to see the contradictions, and fix them in a written form	Reluctance	Inability to give qualitative assessment of methodical assignments, even orally.
	Partial readiness	Ability to assess verbally quality of methodological assignments, experiencing difficulties in writing that down.
	Readiness	Ability to concisely and accurately draw up methodical assessment of assignment in a written form.
Ability to take into account age and	Inability	Designing developmental assignments for schoolchildren without considering pupils' intellect and age.

intellectual characteristics in perception of educational material by schoolchildren	Capability	Designing developmental assignments for schoolchildren, focusing on their intellect and age.
Ability to select the content of educational material according to a method or methodical technique	Inability	Serious difficulties in trying to select the content of educational material that is adequate to the method or technique.
	Capability	Content of educational material, relevant to a method or technique, is taken from various sources, including the Internet.
Degree of ability to recognize, set and solve methodical problems.	Unawareness of a methodical problem	A student doesn't realize ("doesn't see") the standard methodical problem.
	Awareness of the problem, but using specific questions	A student "feels" and is aware of a standard (traditional) methodical problem, but he formulates either particular questions or raises a question in a general, indefinite form, which doesn't allow him to create independently an algorithm to solve it.
	Awareness of the problem and ability to formulate the central question	A student is aware of the standard (traditional) methodical problem, can formulate the core problematic issue, makes assumptions about the algorithm for problem solving and carries it out.
	Awareness of a creative problem and determination of an algorithm for its solution	A student realizes and formulates a methodical problem of a creative origin, "outlines" the algorithm of activity for its solution.

Table 1. *Criteria and indicators of levels in methodical competence establishment for bachelor students*

Content characteristic (theoretical model) of the levels for methodical competence establishment among future teachers

Criteria described in the table allowed us to characterize each of the theoretically possible levels for methodical competence establishment among future teachers. The first, lowest, level is characterized by unconscious methodical incompetence; minimal methodological awareness, that is, presence of individual superficial ideas about methodical techniques. Students are dominated by reproductive methodical activity, i.e. design of methodical assignments is carried out according to the model. They do not want to acquire methodical knowledge, skills and experience of activity. There is a low degree of methodical independence, in other words, students' methodical work is carried out only under the teacher's guidance. They cannot assess the methodical situations, in particular, some contradictions, and present it orally. The first level is also characterized by the lack of ability to design developmental assignments for schoolchildren according to pupils' intellect and age. Students face serious difficulties in selection the

content of educational material, relevant to a method or methodical technique. They cannot understand the problem and formulate it.

The second, below intermediate, level implies methodical incompetence, which is understood by students, that is, students understand their poor knowledge, skills and experience necessary for methodical activities. Degree of methodical awareness is based on individual superficial ideas about methodical techniques. There is reproduction of methodical assignments on the model, rarely deviating from it. There is no strong desire to participate in methodical activity or loss of desire in implementation of activity. Most of methodical work of students goes under teacher's supervision. Students rarely evaluate methodical situations, though only orally. They take into account age and intellect of schoolchildren when designing educational assignments. They are aware of the methodical problem, but there is difficulty in formulating even particular clarifying questions.

The third, intermediate, level is determined by conscious methodical competence, since students know content and structure of methodical knowledge, and also know how to apply it effectively. There is generalized understanding of standard methods and methodical techniques. Students obtain interpretive methodical activity, since designing of assignments is carried out by analogy, with a slight deviation from the sample. Students wish to participate in methodical activities, showing steady cognitive interest. With the average degree of students' methodical independence, in other words, when performing methodical assignments, they need some teacher's help. Students are partially ready to assess the methodical situations orally, while experiencing difficulties in writing. They can design developmental tasks for schoolchildren, taking into account their intellect and age. Students select the content of educational material according to a method or methodical technique. They are aware of the problem, but they formulate only specific questions.

The fourth, the level above intermediate, includes conscious methodical competence, i.e. students know the content and structure of methodical knowledge, they apply knowledge effectively, and they see the causes of certain drawbacks at work. Also, this level is characterized by profound mastering of methods and standard methodical techniques. Dominating interpretive methodical activity causes creative methodical activity. Students demonstrate steady cognitive methodical interest. When designing methodical assignments, they try to be independent, rarely asking for teacher's help, and they present methodical evaluation of assignments in writing. When designing developmental tasks for schoolchildren, their intellect and age are taken into account. There is careful selection of educational material relative to the methodical technique. Students are deeply aware of the problem; formulate specific questions, experiencing minor difficulties in concretizing the generalized issue.

The fifth, the highest level is characterized by awareness of one's own level of methodical ability, that is, ability to see the reasons for drawbacks at work, methodical knowledge of ways for self-improvement. Students have high degree of methodical awareness about innovative non-standard methods and methodical techniques. They show creative methodical activity, i.e. they follow particular strategy for methodical problem-solving. In addition, they show theoretical interest in acquiring methodical knowledge and skills that they lack. Moreover, this level is characterized with high degree of methodical independence and originality in assignments designing. Students are ready to evaluate methodical situations accurately and laconically in writing. They can extract from various sources the necessary content of educational material, which is relevant to a particular methodical technique, taking into account age and intellect of schoolchildren. Students are aware of methodical problems and formulate generalized issues.

We can speak about the first, second and other levels if there is an approximation to one of the

theoretically possible levels, since the current state of pedagogical diagnostics does not present another variant.

Experimental verification of the leading idea

At the third stage of our research in the classroom on the fundamental course “Natural-scientific bases of teacher training” (“Primary Education” department) a pedagogical experiment was organized, which aimed at proving that development of students’ instrumental metaprofessional (universal) competencies at natural science lectures prepares future teachers for methodical activity and improves their level of methodical competence. Metaprofessional competencies we define as abilities which are based on universal actions of processing the received information (ability to create associative range, convert verbal information into visual, paraphrase, interpret, define), means of information management (ability to identify, predict, define a sequence, differentiate, classify), ability to analyze verbal and visual information, ability to find inconsistency in argumentation, as well as using learning technologies applied in primary school learning process at unconscious, intuitive level (through insight) during the lectures.

Diagnostic stage

At this stage of the experiment, students were tested to determine the degree of their instrumental metaprofessional competencies development, namely, ability to organize and process educational information (about natural science).

In particular, they were asked to organize graphically information on the topic “Animal Cell” by constructing a denotate graph; to identify main ideas of the cell theory by T. Schwann and M. Schleiden, and find some mistakes of the scientists; to interpret the text on the theory of preformation with arguments to confirm the theses, to draw a conclusion based on formulated ideas, draw a conclusion about the main idea of the text; to differentiate the concept that students support, referring to some phrases or statements of the famous biologists. Ability to rephrase was also diagnosed: students were asked to create a table of true and false statements, etc. Unfortunately, before the course “Natural-scientific basis of teacher training”, students showed a low level of universal cognitive actions that is the basis of instrumental metaprofessional competencies.

In order to determine the actual level of methodical competence establishment among undergraduates, diagnostic work to determine the level of standard methods knowledge was carried out; we analyzed how students select the content of educational material, taking into account age characteristics of junior pupils; how they assess submitted assignments in writing.

72% of students (among 36 students) demonstrated that prior to the course of “Natural-scientific bases of teacher training” the first (lowest) level of methodical competence establishment, 22% of students were at the second (below intermediate) level, 6% of students were at intermediate (third) level of methodical competence. Not a single student reached the fourth and fifth level (Figure 1).

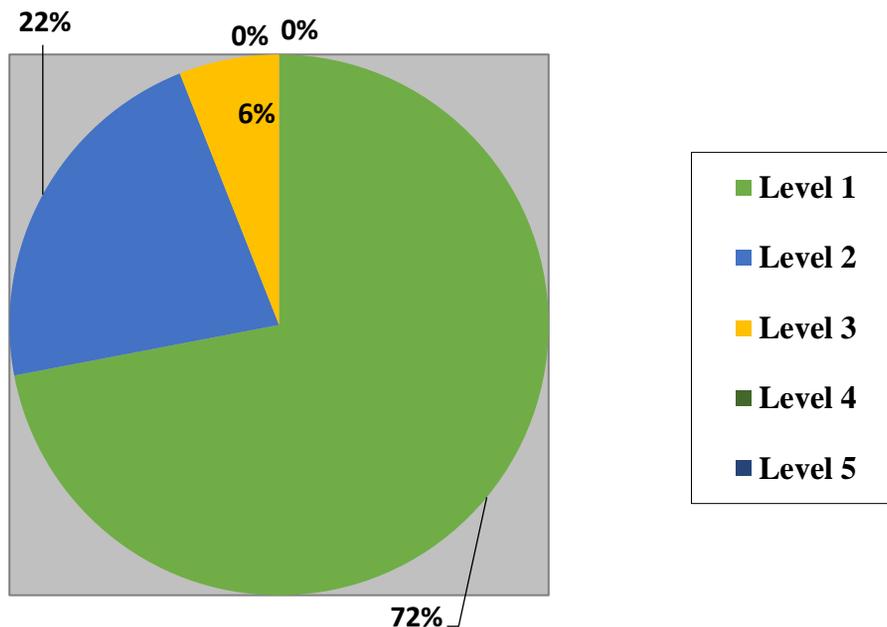


Figure 1. Results (levels) of the methodical competence establishment of students at the diagnostic experimental stage

Experimental implementation

At the stage of experimental implementation, five integrated interactive lectures on biological topics were worked out and conducted (“Type characteristics of arthropods”; “Class characteristics of reptiles”; “Type characteristics of amphibians”; “Superclass characteristics of fish”; “Type characteristics of mollusks, or malacoid”) and four integrated lectures on Earth studies and regional studies (“Natural zones of Russia”; “Orientation on the terrain. Plan and map”; “The most important minerals and rocks composing the surface of the Earth. Minerals”; “Solar system”).

Our initial scientific task – formation of instrumental metaprofessional competencies at lectures on basic disciplines (that is, instrumental knowledge and related methods of cognitive activity) - determined fundamentally new requirements for organizing classes on natural science training of future primary school teachers. Namely, transformational, integrating and coordinating functions of the lecture were presented in printed text materials offered to the students.

Logic of description of the experimental implementation stage requires considering technological tools for the lectures.

Thus, for actualization of previous knowledge, students were offered some assignments requiring recalling the basics of a biological or geographical concept: using a set of proposed definitions of various authors, they had to write down essential and non-essential features of a concept, and then present their scheme; or find (underlining with different colors) important similar parts in the definitions, select the most successful definition and mark it; or name strong points in definitions. Such assignments facilitate later work of graduates with concepts at lessons in primary school.

For introductory part of the lecture we can effectively use exercises on interpretation, where students agree or disagree with conclusions, made on a comparison of concepts, which are borrowed from the monograph “Biology. Biological processes and laws” (Villi & Detye, 1974), the Brockhaus and Efron

encyclopedia, dictionaries and textbooks on biology for higher education.

For the first minutes of lectures, students were offered assignments for transforming verbal information into visual. Let's give an example.

“Judging from description given in the text, name the representative of animal world, and complete the topic of the lecture “Type characteristics of ... ”.

Assignments during lectures in the higher school where students recode some educational information allow to foresee an image when a student perceives material before he clearly sees it, and prepare future teachers to use these training exercises in the classroom in primary school.

In order to interconnect students' sensations, ideas, thoughts, feelings we constantly used at lectures the method of associations, which is crucial for organizing transition from presentation to original concept in junior schoolchildren. During interactive lectures the methodical “table of true and false statements” was actively used, the purpose of which was to develop students' skills of thoughtful and conscious perception of new information. This technique is very popular at lessons in modern primary school.

At lectures we constantly used the technique of “mental dialogue with the text”. The idea of the technique is that the lecturer regularly pauses after raising another problematic issue, giving each student opportunity to mentally make an assumption, and then compare his guess with the position of the lecturer. After getting acquainted with this method, future primary school teachers can easily transfer it into practice, teaching children to formulate the hypotheses.

By introducing into educational process the assignments for making conclusions on analogy, the lecturer creates the conditions for preparing future teachers to form this logical universal learning action for junior pupils. Students intuitively learn the difference between *widely-spread analogy*, where similarities of phenomena result in similarities of reasons (with conclusions according to analogy, where similar reasons lead to a conclusion about the similarities of actions), and *simple analogies* (when similarities of objects in some characteristics cause their similarities in other characteristics).

For processing of information, a lecturer invariably used assignments for construction of clusters, denotation graphs, which allowed to graphically organize educational information; assignments for reading histograms, graphs, diagrams, developing the ability to analyze visual information, transform it into verbal. In future, they will serve as a “tracing paper” for assignments intended to form universal educational actions for junior schoolchildren, since they have single epistemological basis with the teaching techniques used in primary school.

Most of lectures ended with home-assignment – to find interesting material on the topic being studied and to design developmental exercises for junior pupils. Throughout the experimental implementation stage, we carried out standardized pedagogical observation with record protocols of students' desire to acquire the necessary methodical knowledge, skills, and experience during interactive lectures. The following criteria and indicators were employed to analyze the results:

1. Types of students' questions being asked:
 - a) open-ended questions in order to get detailed answer;
 - b) only closed questions in order to identify true or false ideas;
 - c) a student does not ask questions.
2. Initiative in implementation of methodical activities:
 - a) a student takes initiative;
 - b) rarely takes initiative;

- c) never takes initiative.
3. Successful inclusion of debating points into methodic discussion:
- a student always takes part;
 - rarely takes part;
 - never takes part.
4. Eagerness to express the opinion, to share methodical knowledge or experience:
- a student shows eagerness;
 - rarely shows eagerness;
 - never shows eagerness.
5. Completing of methodical work:
- a student completes his work;
 - rarely completes;
 - “quits” the job as soon as he faces difficulties.

At final, control stage of the experiment, students were again offered diagnostic work, similar to that of the diagnostic stage. Out of 36 students at the first (lowest) level of methodological competence establishment there remained only 11%, at the second (below intermediate) level - 33% of students. 44% of future teachers were at the third (intermediate) level of methodical competence, 6% achieved the fourth (above intermediate) level and 6% reached the highest, fifth level.

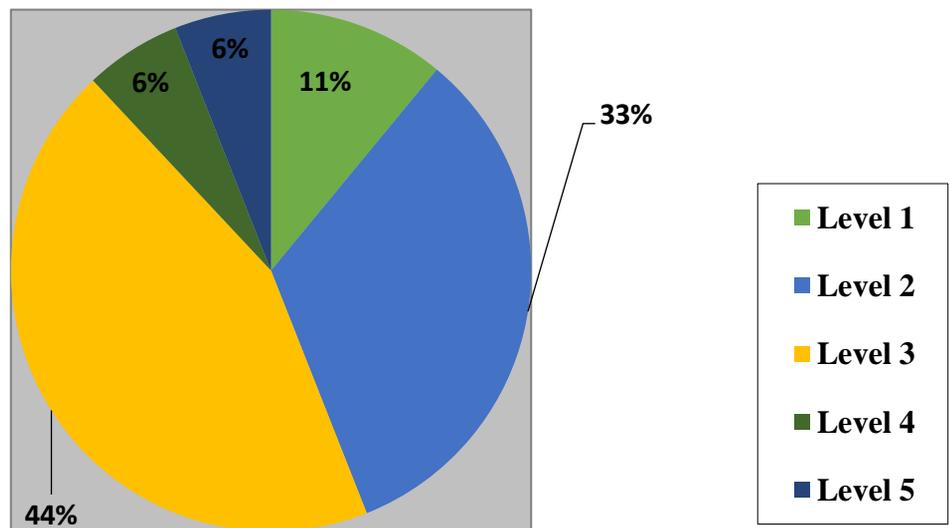


Figure 2. Levels of students' methodical competence establishment at control stage of the experiment

Statistical reliability of observed positive dynamics of methodical competence establishment among students during experimental work was proved using non-parametric Z-criterion at a significance level of $\alpha=0,01$, which indicates validity of our hypothesis.

Discussion

Still, there are some debatable questions about implementation of *integrative approach* to organization of educational activities for students, which is methodical foundation for managing methodical competence establishment among students at pedagogical departments. In our opinion, the position seems promising (Starshinova & Ivanov, 2009, p. 156), according to which the result of pedagogical integration is in new competencies emerging in the process of professional training.

The question about structure of lectures for metaprofessional competencies development is not completely solved. It seems to be quite promising to evaluate the result of a lecture not by the amount of information given, but by the depth of its understanding by students, the level of instrumental competencies development that determine ability for further independent education. Unfortunately, at present time there is a lack of necessary educational and methodical literature that would help educators who teach fundamental courses to develop instrumental competencies among future primary school teachers.

Conclusion

Basing on our research, it can be concluded that instrumental metaprofessional competencies development at lectures on basic (fundamental) academic disciplines contributes to implicit training of future teachers for methodical activities at primary school classes. This is explained as follows.

There can be intuitive transfer by pedagogical university students of obtained instrumental knowledge and universal actions of organizing and processing information onto teaching primary schoolchildren, since they have a single epistemological basis, similar operational components with cognitive universal educational activities that are necessary to be formed in children at primary school according to the Russian state educational standard of primary education.

When subjecting the content and methods of mastering the lecture material on fundamental disciplines to a single goal – methodical competence establishment in future teachers, subject knowledge acquired by students of the taught discipline becomes mobile and effective, in other words, acquired information can be used for educational and cognitive problem-solving. Thus, in higher education the development of methodical competence in future primary school teachers should be started at lectures on basic academic disciplines that integrate subject and methodical knowledge in students' minds, forming universal instrumental educational activities for students (transcoding, interpretation, identification, paraphrasing, forecasting and others).

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