

Meta-subject methodology approach in the training of future primary school teachers

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Abstract

The urgent task of higher education is to comprehensively prepare future teachers for the implementation of state educational standards (SESs) for primary general, basic general and secondary full education, as well as mastering the requirements of the professional standard 'teacher'. The key requirements of the SES RK include the formation of subject, meta-subject and personal results of students. The concept of 'meta-subject learning outcomes' acts as an undoubted innovation of SES RK, which is still not highlighted enough in the scientific and educational literature. In this regard, the need arises for purposeful general professional and subject-methodological preparation of the future teacher for work on the formation and development of meta-subject results for students, mastering the basic educational programmes of general education. The topic of this article is related to the pressing issues of the meta-subject content of education at a pedagogical university. Particular attention is paid to the theoretical justification of meta-subject matter in scientific research. On the example of the author's programme of the new variable discipline 'Meta-subject approach in primary education', intended for students of the pedagogical direction of training, the basic conditions for the implementation of the meta-subject approach in network interaction with educational institutions are considered.

Keywords: Meta-discipline, meta-disciplinary approach, meta-disciplinary outcomes, meta-disciplinary skills, educational programme.

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1. Introduction

1.1. Background

In the research about learning, it is seen that the behavioural learning approach loses its effect and cognitive learning gains weight (Theodorou & Meliones, 2019). In this process, the constructivist learning approach directs teaching (Mendelli, 2019). According to the constructivist learning theory, information is provided to the learner in a raw state, and it is supported to produce new information based on the existing information. In this theory, in order to realise meaningful learning rather than one-dimensional learning of knowledge, it is expected that learning will relate to new knowledge with the previous knowledge accumulating, taking into account social interactions (Bagila et al., 2019; Buldu & Armagan, 2019; Zhumabayeva, Kdyrbaeva, Nurzhanova, Stambekova & Uaidullakzyz, 2020).

In the context of the reform for all levels of school and higher education, the introduction of the state educational standard (SES RK), the professional teacher standard, the question of the quality of training of a new generation teacher who knows how to prepare students who can solve the current situation in the context of modern realities and the needs of society and who are capable of cooperation, distinguished by creativity and mobility, remains relevant (Kozuh, Maksimovic & Stosic, 2020). Today, the key ideas of the global education paradigm are to develop and train highly qualified professionals who are ready for lifelong learning and self-improvement, and are creative in dealing with the growing needs of society. They, in turn, need to be prepared for the full development of the learner's personality by organising pupils' initiative and self-awareness. High-quality training of future teachers involves the formation of subject-specific skills related to self-determination and self-realisation of a person, where knowledge is acquired not 'for the future', but in the context of a model of future professional activity as 'learning to live here and now' (Zahaf, 2019). At the same time, the school graduate must have a set of universal skills that will allow them to focus on new situations, solve problems themselves and correctly evaluate the results of their work. In this regard, it is necessary to talk about the need for meta-subject education at a pedagogical university.

The basic concepts of the meta-subject content of training, such as meta-subject, meta-subject teaching, meta-subject approach, meta-subject learning outcomes, meta-methods and meta-skills, are defined in the works of Zhumabayeva et al. (2019), Dammer (2015), Aytac, Demirbas-Celik and Kiracioglu (2019), Gromyko (2014), Khutorskoy (2012) and other scientists. Currently, many aspects of the meta-subject teaching technology in the practice of school instruction are described in studies by Nagimov and Tarasova (2015), among others. In addition, it should be noted that there are a number of works directly addressing the issues of training specialists in the field of higher education (Agranovich et al., 2019; Bissenbayeva, Aurenova, Aubakirova & Uaidullakzyz, 2014; Dammer, 2015; Ratikova, 2014). Despite the fundamental research in this area, it can be concluded that the methodological basis of meta-subject education today is considered as one of the main problems of pedagogical science, especially in the field of professional teacher training. Indeed, one cannot talk about meta-subject teaching in the practice of schooling if the teacher is not competent in this matter. This research, therefore, aims to study the meta-subject approach in the training of future primary school teachers.

1.2. Literature review

Gromyko (2014), Khutorskoy (2014, 2012) and other scientists in this field of scientific research consider the content of training in the context of a meta-subject approach. It is safe to say that Kazakhstani scientists Tezer, Yildiz, Bozkurt and Tangul (2019) and Aziya, Zhumabayeva, Vedishenkova and Yekaterina Nikitina (2016) were among the first researchers to consider the concept of meta-subject education in their works. The meta-subject approach in this concept is the universal approach that ensures the transition from the existing practice of fragmenting knowledge of objects to a holistic imaginative perception of the world, to meta-activity (Khutorskoy, 2012).

Therefore, the meta-subject approach, firstly, assumes that the pupils do not only master the knowledge system, but also master universal methods of action, which can help them to obtain information about the world (Kelkay, 2020). Secondly, it is focused on meta-subject (competency) results of educational activities, i.e., the methods of activity that are used within both the educational process and when solving problems in real-life situations, mastered by trainees on the basis of one, several or all educational subjects. Thirdly, the basis of this approach is subjective–subjective relationships. Fourth, the meta-subject approach makes it possible to change the structure and content of educational material and contributes to the formation of a different type of thinking compared to the traditional system of general education. Thus, in the opinion of Galustyan et al. (2019), the meta-subject approach implies the trapping (and not remembering!) of the most important concepts of a subject, the presence of educational activity, the formation and development of basic subject abilities in pupils and the use of the rediscovering knowledge method on different educational material (repetition of a scientific discovery in the educational process) and the presence of reflexive activity (Guseva, 2019; Truong & Vuong Pham, 2020).

How can one implement the meta-subject approach in the process of preparing a teacher of a new generation? According to the concept of Khutorskiy, meta-subject is present in education in several functions, in particular:

- as an integration principle of the education content at the horizontal levels of academic subjects (interdisciplinary function).
- as the basis for the organisation of meta-subject activity of pupils (Khutorskiy, 2012).

2. Materials and Methods

The subjects of our study are future primary school teachers in general schools; to be more precise, students who are studying in the specialty 6B01301-Pedagogy and the methodology of primary education. To achieve the goal, we used the following methods: analysis of philosophical, social, psychological, pedagogical and methodological literature from the point of view of the research problem, synthesis, generalisation of pedagogical publications and normative documents, advanced pedagogical experience, study, survey, comparative analysis, experiment, practical work, evaluation of its results, generalisation and mathematical processing of results.

This point of view involves the development and creation of meta-subject courses and their application in interactive teaching practices. We give the following example. In the 2019–2020 academic year, within the framework of research work on distance learning programme of the specialty 6B01301-Pedagogy and Methodology of Primary Education for groups of 2, 3 and 4 years in the Kazakh National Pedagogical University named after Abai, a meta-discipline programme of the discipline ‘Meta-subject approach in primary education’ has been developed and included.

The main purpose of the course is to lay the foundations for the preparation of students to work with the methodology that allows them to achieve meta-subject results in the elementary education process.

In this regard, the following tasks were set:

- acquaint students with scientific and theoretical foundations of meta-discipline approach.
- to show students the ways of meta-discipline teaching of elementary education.

The programme, the laboriousness of which is three credits, included five interrelated topics, whose development by students occurs sequentially.

The preparation of the future teacher for the implementation of the meta-subject approach is focused on the following knowledge formation from the field of meta-subjects: the composition of meta-subject education results in the taught subject; the logic and structure of the taught subject

matter; ways of realising intra-course and intra-subject communications as a means of holistic perception of the material studied, and as a result, creating an image of the pupil's world understanding of meta-concepts, which act as 'nodal points of the main educational areas' (Guseva, 2019); understanding of the need for the formation of universal educational actions among schoolchildren as a way to master the key competencies that form the basis of the ability to learn; understanding the need to solve the meta-problem as a way of understanding the world; and understanding of the reflection as a way for schoolchildren to correct their own actions, an instrument of self-development.

At the end of the course, it is assumed that the teacher develops the following skills: designing training for a subject using intra-subject and intra-course relationships, which involves deepening the perception of the internal integrity of the training course; modelling a lesson with meta concept, which involves creating conditions for schoolchildren to perceive a holistic image of the reality being studied, building their own knowledge system; modelling a lesson with meta-abilities, involving the reproduction by schoolchildren of universal educational actions when working with any subject material; modelling a lesson with a meta-component of value, which allows providing schoolchildren with the possibility of personal self-determination in relation to worldview positions in solving educational problems; and modelling a reflection lesson, which allows pupils to form reflection ability.

The meta-subject approach in the study of this discipline, in our opinion, can be implemented subject to the following conditions:

- analysis of key concepts, for example, the main educational programme;
- group forms of work in training technology in collaboration;
- reflection at each stage of work;
- the use of various forms, methods and techniques of work (cluster, discussions, role-playing games, motivational presentations, brainstorming etc.).

Pilot work on the formation of meta-subject learning outcomes for undergraduate students was carried out in stages over 2 years: 2018–2020. The experimental group (EG) consisted of students of two to four undergraduate courses in the specialty 'Pedagogy and methods of primary education'. Parallel groups of this specialty were involved as a control group (CG). In general, 295 people were involved at all stages of the experimental work; in the EG there were 146 people and in the CG there were 149 people.

Pilot work in pedagogical bachelor's groups was aimed at the formation of one of the basic components of meta-subject results in students – future teachers: meta-cognitive. The development of students' meta-subject results was considered as a key pedagogical condition for the readiness of future teachers, elementary school teachers, to the formation of meta-subject results of schoolchildren studying at the secondary level of general education in accordance with the requirements of the SES RK. The formation of meta-subject results of students occurred in the process of studying methodological disciplines. Moreover, in the CGs, the teaching of the meta-subject language was carried out according to traditional methods, while in the EGs, the author's meta-subject training course 'Meta-subject approach in primary education' was implemented.

3. Results

Let us consider the experimental diagnostics stages for the formation levels of key meta-subject results of undergraduate students – future primary school teachers.

(a) Formation and evaluation of the meta-subject result of bachelors – future primary school teachers at the level of reflection formation of cognitive processes.

The initial stage of diagnosis was to determine as the level for meta-subject results’ formation at the level of reflection of cognitive processes in students. As a systematic characteristic of personality, the ability to reflect has a complex multicomponent structure. It includes meta-cognitive knowledge, meta-thinking, meta-experience, meta-cognitive activity, meta-cognitive awareness, creativity, the ability to synergy and systemic thinking, among others. All these knowledge, skills and competencies are closely interconnected and, as a rule, are formed in a complex.

Typically, standard test procedures evaluate several interrelated factors. In the process of this study, for the diagnosis of students’ meta-subject results at the reflection-forming level of cognitive processes, a fairly well-known, valid and fairly informative test methodology was chosen; it was developed by Shrow and Dennison (in the adaptation of Karpov). The questionnaire (in the online version) included 52 questions, distributed on two scales: the meta-cognitive knowledge scale (meta-cognition or knowledge of cognition) and the meta-cognitive control scale that allows a person to control his own thought processes: memory, thinking and goal-setting, among others. These are the parameters that allow you to adjust the learning process itself.

Testing results were evaluated on the basis of scores (maximum number – 260 points). The integrated test score was expressed as a percentage. Low and lower levels: 0%–40%; average level: 41%–60%; increased and high level: 61%–100%.

The results obtained in the experimental and CGs at the beginning and at the end of the experimental work are shown in Tables 1 and 2 and in the corresponding diagram (Figure 1).

Table 1. Dynamics of the meta-cognitive results’ formation of undergraduate students in the EG and CG

Person levels /%	Quantitative characteristics of the results			
	EG (n = 146)		CG (n = 149)	
	Ascertaining stage	Control stage	Ascertaining stage	Control stage
Low	32 (22%)	12 (8%)	27 (18%)	20 (14%)
Average	87 (59%)	74 (51%)	86 (58%)	84 (56%)
High	27 (19%)	60 (41%)	36 (24%)	45 (30%)

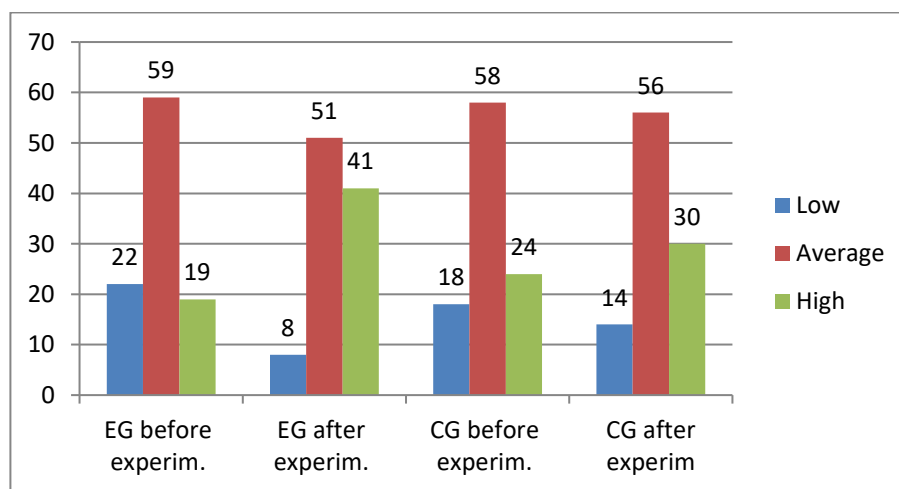


Figure 1. Measurement results in the experimental and CGs

Table 2. Statistical analysis of the test results in the EG and CG

Matching sample characteristics	Cramer–Welch test values(T_{emp} and T_{crit})
KG before the experiment/EG before the experiment	T_{emp} . 0.739, T_{crit} . 1.96. The characteristics of the samples coincide for $p = 0.05$
CG before experiment/EG after experiment	T_{emp} . 2.2255, T_{crit} . 1.96. Significance of differences $p = 95\%$
KG after experiment/EG after experiment	T_{emp} . 1.3707, T_{crit} . 1.96. The characteristics of the samples coincide for $p = 0.05$
KG after experiment/EG before experiment	T_{emp} . 1.7822, T_{crit} . 1.96. The characteristics of the samples coincide for $p = 0.05$
KG before experiment/KG after experiment	T_{emp} . 0.9272, T_{crit} . 1.96. The characteristics of the samples coincide for $p = 0.05$
EG before experiment/EG after experiment	T_{emp} . 3.172, T_{crit} . 1.96. Significance of differences $p = 95\%$

Statistical processing of empirical data was carried out using the computer programme ‘Statistics in Pedagogy’, developed under the guidance of Professor Novikov. When processing the test results, the relationship scale was used. To test the statistical hypothesis, the considered samples were compared on the basis of the classical non-parametric Cramer–Welch test (Welch’s t -test) (Bissenbayeva et al., 2014; Khutorskoy, 2012; Vanichvatana, 2020). It is proved that in pedagogical and economic studies in many cases the application of the Cramer–Welch criterion to test the hypothesis of mathematical expectations’ homogeneity is no less justified than the application of the classical student parametric criterion, it has a transparent meaning, allows you to evaluate two independent samples of different sizes and check whether the hypothesis belongs to a single distribution without a significant loss in power, compared with the student criterion, for which it is necessary to conduct a complex control for data normality of 260.

The empirical value of this criterion is calculated by the formula:

$$T_{emp.} = \frac{\sqrt{M \cdot N} |\bar{x} - \bar{y}|}{\sqrt{M \cdot S_x^2 + N \cdot S_y^2}}$$

Based on information about the volumes N and M of the samples x and y , the sample means \bar{x} and \bar{y} , and the sample variances S_x^2 and S_y^2 of the compared samples. Moreover, the considered criterion best defines the alternative if the difference between the mathematical expectations does not exceed 0.05.

The algorithm for determining the reliability of differences in the characteristics of the compared samples by the Cramer–Welch criterion includes the following steps:

- (1). Calculate the empirical value for the compared samples of

T_{emp} —the empirical value of the Cramer–Welch criterion using the corresponding formula.

- (2). Compare this value with the critical value $T_{0.05} = 1.96$: in this case, if $T_{emp} \leq 1.96$, it can be concluded that the characteristics of the compared samples coincide at a significance level of 0.05; if $T_{emp} > 1.96$, then it can be conclude that the reliability of differences in the characteristics of the compared samples is 95%. Analysis of the test results revealed statistically significant differences in the samples. The empirical value of the Cramer–Welch statistical criterion in the CG at the final stage of the experiment was 0.9272, critical = 1.96 (the characteristics of the compared samples coincide at a significance level of 0.05). The empirical value of the Cramer–Welch test in the EG at the final stage of the experiment is 3.172, the critical value is 1.96. At the same time, the reliability of differences in

the characteristics of the compared samples was 95%, which confirms the regular nature of the changes in the studied parameters in the EG, which we associate with the implementation of the meta-subject training course aimed at the formation of meta-cognitive skills in the process of foreign language preparation.

4. Discussion

The process of introducing the meta-subject approach in the EGs served as a factor stimulating the formation of meta-cognitive results in students through both the introduction of meta-subject teaching technologies based on intra-subject integration of the natural sciences disciplines and the humanities and the development of exercises on specially selected authentic material that stimulate the formation of ideas about the role of paragraphs or the use of non-verbal means secondary to the language, including graphical tools (pictures, graphs, charts etc.) offered to students to be used in the project activity in academic situations (2^d-3^d course), professional and business-oriented communication (4th year). This finding is in corroboration with the research finding of Abdi and Sharyati (2019).

In the course of studying the meta-subject course 'Meta-subject approach in primary education', exercises were developed that allow for the implementation of interdisciplinary connections on a variety of language material, enhance systemic and creative thinking, develop creative skills and make wider use of the meta-cognitive, linguo-cognitive and linguistic cultural experience of trainees. In the working process on sources of methodical disciplines, problem situations for the development of analytical and critical thinking, training cases, test methods in English and Russian were widely used, allowing students to independently evaluate not only their language achievements, but also determine the level and direction of meta-cognitive skills development. In parallel with this work, students developed academic reading, speaking and writing skills, which also contributed to the development of meta-cognitive skills, similar to the research of Aziya et al. (2016).

In the course of mastering the training course, well-known foreign methods of meta-cognitive skills developing such as 'Six Thinking Hats' by Edward de Bono were used, tests for the development of creative abilities (for example, the PST test – an adapted version of the personnel selection test by E. F. Vanderlik, and other foreign and domestic tests of general intelligence, which are used not only for diagnostic, but also for educational and developmental purposes). A variety of linguo-didactic agents contributed to increasing the motivation of students to self-education and self-actualisation, in general. This was supported by the research of Turalbayeva et al. (2017). Thus, the rather high indicators of the dynamics of meta-subject results' development in the EG, in our opinion, were not a fortuity, but were the result of the general purposeful work of the teacher and students to introduce a model for preparing future teachers for the development of meta-subject results of primary school pupils (Tugelbayeva, Eleupanovna, Tokkulova, Nizamova & Kulzhanovna, 2020).

The formation of meta-subject results of primary school trainees relates to the priority requirements of the SES RK. In this regard, the task of preparing bachelors – future primary school teachers – for work on the formation of meta-subject results of mastering the basic educational programmes of primary education is becoming especially urgent. Based on the hypothesis that in order to create readiness for work on the formation of meta-subject results of primary school trainees, future teachers should have their own experience in achieving meta-subject results in the process of studying at a university, a study was conducted which aimed to identify pedagogical features of the training of future primary school teachers to the formation of meta-subject results of students mastering the basic educational programmes of general education. In the process of theoretical and experimental research, it turned out that the meta-subject approach in the process of preparing future elementary school teachers can be an effective tool for generating the meta-subject results of pedagogical undergraduate students needed for their future professional and pedagogical activities, as evident in previous studies (Agha & ELDaou, 2018; Alkan, 2020).

5. Conclusion

Based on the study of psychological and pedagogical literature and analysis of the practice of teaching methodological disciplines in universities, meta-subject opportunities were established; the teaching of which was considered in the context of the formative potential of traditional and innovative educational technologies. As a result of an experimental study, it was proved that both traditional and innovative educational technologies can be aimed at the formation of meta-subject competencies of students through inter-subject integration, as well as discursive and lexical–semantic technologies based on various methods of working with educational material.

However, the use of special methodological tools (elements of communication technologies; developing and heuristic technologies that contribute to the development of trainees' analytical, critical and creative thinking skills; the latest information and communication 'hypertext' technologies, including Web 2.0. technologies, Wiki technologies, CLIL technologies, technologies Flipped learning 'inverted class125') as well as the author's special training and methodological course 'Meta-subject approach in primary education' shows that the best results have the students included in the EG, which has been proved statistically.

In the course of the experimental work, a set of pedagogical features were identified that formulated the criteria for the readiness of pedagogical education bachelors to implement meta-subject methods and teaching technologies in elementary school. The totality of the considered features included: (1) multidimensional goal-setting; (2) the problematic presentation and development of educational material; (3) integrativity, a wide context, interdisciplinary and meta-subject communications; (4) innovativeness, creativity, nonlinearity of perception of problems and situations; (5) orientation to the formation of a holistic worldview and professional–linguistic picture of the world of trainees; (6) the use of interactive 'hypertext' learning technologies; and (7) the introduction of alternative methods for the diagnosis of meta-subject learning outcomes.

A promising area for further research is the methodological justification for the implementation of the meta-subject approach use to achieve meta-subject results at various levels of multilevel higher education in the training of humanitarian specialists.

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