

**DEVELOPING STUDENTS' RESEARCH COMPETENCE IN THE TEACHING OF SUBJECTS IN THE
CONTEXT OF DIGITALIZATION OF EDUCATION**

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Abstract. *This article is dedicated to describing methods for developing students' research competence in the context of digitalization of education. The study provides a brief analysis of the key concepts of "competence" and "research competence," identifies the structural components of research competence, and presents methods aimed at developing all its essential elements. Special attention is given to project-based tasks and web-quests as the most commonly applied methods in the context of digitalized education.*

Keywords: *competence, research competence, digitalization of education, informatics, algorithmization.*

In the modern world, it is important not only to acquire knowledge, skills, and competencies, but also to be able to independently master this knowledge, possess cross-disciplinary (metadisciplinary) knowledge, and develop a stable motivation for continuing education, as well as professional and personal growth. One of the universal competencies in this regard is research competence, as it encompasses all types of universal learning activities necessary for successful education. It should be noted that in the context of digitalization of education, the relevance of research competence has increased, and new tools for its development have emerged.

I. A. Zimnyaya interprets this term as "content that has been mastered but not yet fully actualized, representing a mental structure that includes the image of knowledge content, programs for its implementation, methods, and algorithms of actions". G. K. Selevko, in defining competence, aligns with I. A. Zimnyaya's view, describing it as an educational outcome expressed in a graduate's preparedness; actual mastery of methods and means of activity; the ability to independently solve practical tasks; and a combined form of knowledge, skills, and abilities that allows setting goals and achieving them in order to transform the environment [1].

In turn, A. V. Khutorskoy interprets this term as a predetermined social requirement (norm) for the learner's educational preparation, necessary for effective and productive activity in a particular field [2]. A similar definition is provided by A. K. Markova [3].

E. F. Zeer considers competence as generalized methods of action that ensure the productive performance of professional activity. O. V. Temnyatkina supports a similar approach [4].

Let us now examine the structural components of competence in more detail. Most authors distinguish cognitive and activity-based components within competence; in addition, motivational-personal, value-semantic, and emotional-volitional components are also identified. In our view, the optimal structure of any competence should include cognitive, activity-based, and motivational-personal components.

The cognitive component includes the necessary knowledge related to a specific type of activity; the activity-based component encompasses skills for performing the activity and successful practical experience; and the motivational-personal component reflects confidence and interest in carrying out the activity. Below, the content of these components is detailed using research competence as an example.

Z. N. Apazayeva defines research competence as “the ability that characterizes the process and outcome of creative thinking activity and research-project activity” [5]. A. V. Khutorskoy considers research competence as a part of cognitive competence, emphasizing that it includes “elements of methodological, cross-disciplinary, and logical activities, as well as methods of goal-setting, planning, analysis, and reflection”. Moreover, it serves as a component of personal self-improvement competence aimed at intellectual and spiritual development [2].

Some scholars, such as A. V. Vorobyeva [6], D. V. Kachalov [7], and V. V. Klimentyeva [8], interpret research competence as a combination of personal qualities, knowledge, research skills, and abilities.

In contrast, A. I. Savenkov defines research competence as “a specific functional system of the psyche and associated personal qualities that enable an individual to be a productive subject in research activities” [9].

Thus, research competence can be understood as a personal quality that allows an individual to conduct various research activities based on existing knowledge, research processes, and research methods, as well as to apply research skills and abilities related to reflective, exploratory, and presentation activities.

As noted earlier, the optimal structure of any competence consists of cognitive, activity-based, and motivational components. Below, the content of these components is examined in detail for research competence (see Table 1).

Table 1

Structural Components of Research Competence

Component	Content	Example in Research Activity
Cognitive	Necessary knowledge for a specific research activity: research methods, theoretical foundations, data analysis techniques	Collecting and analyzing data, studying scientific articles and sources
Activity-based	Skills for performing activities and successful practical experience	Conducting experiments, implementing projects, completing web-quests

Motivational-personal	Interest, confidence, and personal motivation in carrying out activities	Interest in the research topic, independent work, readiness to present results
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The cognitive component includes knowledge of research methods and the sequence of performing research [8].

The activity-based component can be divided into three groups: reflective, exploratory, and presentation skills.

The motivational component encompasses interest in knowledge, a desire for inquiry, demonstration of cognitive activity, the transformation of this activity into a cognitive need, striving for independent creative research, and the aspiration for self-improvement.

The role of informatics in developing research competence lies in providing skills for searching and effectively presenting information. Additionally, informatics fosters algorithmic thinking, i.e., identifying patterns, establishing sequences, and formulating conclusions. Competence is developed primarily through practice; therefore, teachers must pay significant attention to the practical orientation of learning materials.

Various methods are used to develop research competence, including laboratory work, case studies, literature-based tasks, project-based assignments, web-quests, and project methods.

It should be noted that in the context of digitalization of education and the necessity of using various distance learning technologies, the implementation of these methods changes significantly. For example, project-based tasks, which are aimed at applying generalized methods of action in situations close to real-life problem solving, can be partially or fully transferred to an online environment. Various online services and messengers can be used to enable discussion of intermediate results.

A. B. Vorontsov explains a project-based task as: "...a situation in which a system or a set of tasks purposefully stimulates a system of children's actions aimed at obtaining a result ('product') that has never existed in their practice, and during the completion of the task, a qualitative change occurs in the student" [10]. Each project task has its own idea, which forms and develops the student's cognitive interest, broadens their worldview, and directs them toward independent research. The result of such a task is always a real product – a text, a diagram, a device model, or an analysis of a situation presented in tables, charts, or graphs – created by the students. This product can later exist independently of the original task.

A project-based task may consist of several assignments, linked by a common plot, which serve as guidance for completing the tasks. Before setting the task, a specific practical-problem situation should be described, which is defined in the task formulation and implemented through the system of assignments. These assignments may require different strategies: in some cases, tasks must be completed sequentially; in others, they

can be completed in any order; and sometimes the required sequence is hidden and must be determined by the students themselves.

Thus, project-based tasks shape students' research competence, improve the quality of education (by applying subject-specific and interdisciplinary knowledge in conditions close to real life), and teach independence, collaboration, and the ability to distribute responsibilities within a group. At the same time, this method can be easily implemented in a digitalized educational environment and allows students to simultaneously develop ICT competence, which is expected to become an integral part of universal learning activities in the near future.

Another method that enables effective development of research competence in the context of digitalization is the web-quest. This is a modern method of e-learning that engages students in processing and presenting new information in the form of an interactive, game-based journey.

A web-quest is a problem-based task that includes elements of role-playing and didactic games and requires the use of Internet resources to complete. Although there is a sufficient number of web-quests available today, not all of them are suitable for developing research competence.

By summarizing the theoretical foundations of web-quest creation, their main characteristics can be highlighted:

- ❖ Presence of a general goal;
- ❖ A global task based on a specific plot;
- ❖ Definition and distribution of roles;
- ❖ Differentiation of tasks for each role;
- ❖ Links to external information sources that assist in completing the tasks.

Based on the content of this method, a web-quest develops the following components of research competence:

- ✓ Activity-based component: the ability to perform basic logical operations, draw conclusions, and formulate hypotheses;
- ✓ Motivational component: demonstration of cognitive activity, curiosity, readiness for sustained effort, as well as skills in forecasting and conducting experiments.

As an example, students can engage in a web-quest with the plot "trapped in a mystery room". This room is implemented using the Learnis educational platform. The teacher explains the task: to leave the room, students must find and complete the tasks that reveal the code. The correct code can only be obtained after all tasks are successfully completed (see Figure 1).



Figure 1. Mystery Room (Web-Quest)

Instructions for locating tasks in the web-quest are pre-configured within the educational platform. For example, when students click on the corkboard above the laptop, a message appears on the screen: “Something is written on one of the stickers...”. The student is then prompted to find this sticker and complete the task assigned to it.

The web-quest is an excellent method for increasing student motivation. The interactive environment stimulates interest in searching for tasks. An advantage of this web-quest is that the tasks are non-linear and independent, allowing them to be completed in any order.

Thus, a web-quest is one of the easiest and most accessible types of e-learning resources. The plot and game elements of the quest activate students’ cognitive activity and curiosity.



Rasm 2. Raqamli ta'lim resursi

For practical convenience, all the tasks described above have been placed in a digital educational resource on the topic of “Algorithmization” (see Figure 2). This resource was developed in a short period using the SITE123 website builder. SITE123 allows all materials to be placed on a single page or to create a multi-page resource under one domain.

The service is free and offers several advantages: a large number of templates, a user-friendly interface adapted to Russian, and automatic mobile device compatibility.

On the website's main page, the resource name, a brief description, and the possibility to contact the site author (via an integrated form or email) are provided. The educational resource is divided into several pages: main page, theoretical materials, practical block, and assessment block. In the page header, a pop-up window indicated by an envelope icon allows users to contact the author.

In the theoretical materials block, a brief overview of the studied topic is provided. The information is presented in the form of text, diagrams, and videos. The practical block contains all the tasks, while the assessment block includes tests and control assignments on the topic of "Algorithmization", as well as materials for diagnosing students' research competence.

In conclusion, the comprehensive application of the methods and approaches described above allows for the full development of research competence in the context of digitalization of education and the necessity of using distance learning technologies.

Furthermore, studying informatics requires practical actions in the subject, including skills in searching and presenting information, as well as advanced algorithmic thinking. Therefore, applying methods and approaches aimed at developing research competence in informatics classes provides students with a solid foundation for active research activity and enables them to apply the acquired knowledge, skills, and competencies across various fields of activity. As a result, students become more adaptable and competitive, enhancing their prospects for success in future life, which underscores the importance of developing research competence.

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