Professional development e-course on how to integrate interdisciplinary approach into the learning process in schools that practise multimodality and use interactive educational online services

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Abstract. *Problem and goal.* The problem of implementation and realization of interdisciplinary approach in the learning process at schools is demonstrated. The goal of this research is to create professional development e-course for teachers, which can include practical approaches to integrate interdisciplinarity and to develop multimodality through the application of online services. *Methodology.* The practical research is carried out based on organizing an experimental (93 people) and control (71 people) groups of students in different ages (4–8th grades) and disciplines. The students from an experimental group are taught by the teachers who took part in the designed e-course. These teachers use practice-based methods and strategies to integrate interdisciplinary approach in the lessons of Geography, Mathematics, Russian, English, Social Studies and Literature in a primary school. They apply online services such as Padlet, Zoom and Google Tools as well. Analysis of interdisciplinary skills level is carried out with the help of control diagnostics before and after the experiment. *Results.* The tools for the integration of interdisciplinary approach and the application of online services in educational process have appeared to be effective. The evidence of this conclusion is the toolbox with methodological interdisciplinary materials and resources which has been created for the learning process with the help of online services which can help students develop transfer skills, creative and critical thinking. The tools and services demonstrated in this research allow students and teachers to develop agency, i.e. the ability to be responsible for their life, in particular for their learning, to make a choice and to have a voice. They also help increase motivation to the process of learning. Such tools and online services can play a significant role for informatization of the learning process because they have an impact on the development of students' multimodality. *Conclusion.* The results allow to identify the effectiveness of the implementation and integration of interdisciplinary approach in educational process, especially in the framework of narrow disciplines, with the help of online services. Teachers, who had taken part in a designed professional development e-course, used strategies and tools, online services in practice. The students demonstrated an enhanced level of creative and critical thinking and transfer skills during control diagnostics after the research.

Keywords: online services, informatization of education, interdisciplinary approach, multimodality

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Разработка курса профессионального развития по реализации междисциплинарного подхода в школах с использованием интерактивных онлайн-сервисов, обеспечивающих развитие мультимодальности в образовательном процессе

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Аннотация. *Проблема и цель.* Предлагаются способы решения проблемы внедрения и реализации междисциплинарного подхода в образовательный процесс, в частности в узконаправленные предметы. Цель исследования – разработка онлайн-курса профессионального развития для учителей, в котором могли бы реализоваться практические подходы развития междисциплинарности и мультимодальности через использование онлайн-сервисов с дальнейшим применением и экспериментальным подтверждением эффективности соответствующего подхода в практической деятельности учителя. *Методология.* Осуществлено практическое исследование на основе формирования экспериментальной (93 человека) и контрольной (71 человек) групп школьников разных предметов и возрастных групп (4–8 классы). Обучение школьников экспериментальной группы проводилось учителями, принимавшими участие в онлайн-курсе, с применением практических методов и приемов, способствующих внедрению и реализации междисциплинарного подхода на уроках географии, математики, русского и английского языков, окружающего мира и литературного чтения, а также с использованием онлайн-сервисов Padlet, Zoom Google Tools. Анализ уровня междисциплинарных навыков школьников осуществлялся при помощи диагностик метапредметных умений и критического и креативного мышления. *Результаты.* Показано, что предложенные инструменты и приемы для реализации междисциплинарного подхода и применение онлайн-сервисов в образовательном процессе эффективны. Обоснованием служит создание банка методических материалов и инструментов для уроков с внедрением междисциплинарного подхода и онлайн-сервисов – помощников, способствующих более высокому и эффективному результату в развитии метапредметных умений и навыков критического и креативного мышления школьников. Предложенные инструменты и сервисы способствуют развитию субъектности учащихся, то есть способности брать на себя ответственность за собственное учение, делать осознанный выбор и высказывать свою точку зрения, и развивают мотивацию, что ведет к вовлечению в образовательный процесс. Они могут играть значительную роль для информатизации систем обучения школьников, так как оказывают непосредственное влияние на развитие мультимодальности учащихся. *Заключение.* Экспериментально подтверждена эффективность предложенного подхода к внедрению и развитию междисциплинарности в образовательном процессе в рамках обучения узконаправленным предметам с использованием онлайн-сервисов. Учителя, прошедшие онлайн-курс, активно внедряли инструменты и применяли онлайн-сервисы на практике, а школьники показали повышенный уровень навыков креативного и критического мышления и метапредметных умений в рамках проведения контрольных диагностик.

Ключевые слова: онлайн-сервисы, информатизация образования, междисциплинарность, мультимодальность

Problem and goal. The modern world, in which technologies are developing much faster than generations are changing, requires us to be flexible, make decisions quickly, and take responsibility for our development.

Until recently, we said that we live in a VUCA world (V – volatile; U – uncertain; C – complex; A – ambiguous). Some time ago, Jamie Cascio, a historian, anthropologist, is among the top 100 global thinkers of our time according to the rating of the magazine "Foreign Policy", proposed a new concept to describe modern realities: BANI world (B – brittle; A – anxious; N – nonlinear; I – incomprehensible[1]).

Linking these two concepts, we can see that constant variability logically turned into fragility, uncertainty gave birth to anxiety, complexity led to nonlinear thinking, and ambiguity turned into incomprehensibility. Such a world forces us to radically change all systems – from global trade networks and information to personal connections [1]. These changes should be based on a deep understanding of the interrelationships and integration of knowledge and skills from different disciplines and fields to solve real life problems. Undoubtedly, the changes should also affect education [2].

For example, new Federal State Educational Standards, unlike previous versions, focus on the development of students' "soft" skills: to perceive a stressful situation as a challenge requiring countermeasures; to assess the level of stress, correct decisions and actions taken; to formulate and assess risks and consequences, to create experience, to be able to find positive in the situation that has occurred; to be ready to act in the absence of guarantees of success; basic research skills; working with information; emotional intelligence. An important role in the new standards is given to the concept of "interdisciplinary approach."[2]

Professor, Doctor of Philosophy B.G. Kapustin in his article for the magazine "Kommersant"[3] mentions that "interdisciplinarity is a method of research and pedagogical work that integrates data, tools, techniques, concepts of two or more specialized disciplines in order to advance the understanding of fundamental problems or answer questions the study of which goes beyond the capabilities of each individual discipline". I.T. Kasavin, a Soviet and Russian philosopher, a specialist in the theory of cognition, philosophy of science, philosophy of language,

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[1] Lerner E. *Simply about difficult: what is BANI world?* (In Russ.) Available from: https://cetre.ru/category/stil_zhizni/prosto-o-slozhnom-chto-takoe-bani-mir-/ (accessed: 03.02.2022).

[2] *Federal State Educational Standards.* Russian Ministry of Education. Available from: https://www.garant.ru/products/ipo/prime/doc/401333920/ (accessed: 10.03.2022).

[3] Kapustin B.G. Interdisciplinarity opens the way to a new state of knowledge. *Kommersant.* 28 July 2017. (In Russ.) Available from: https://www.kommersant.ru/doc/3367606 (accessed: 03.03.2022).

writes that "interdisciplinary interaction is the natural state of any science" [3]. An interesting description of interdisciplinarity is also given by Edgar Morin, a French philosopher and sociologist. He says that "interdisciplinarity can only mean that different disciplines sit down at a common table, just as different nations gather at the UN solely to assert their own national rights and their sovereignty in relation to the encroachments of a neighbor. But interdisciplinarity can also strive for exchange and cooperation, and as a result it can become something organic..." [4].

Interdisciplinary learning is based on academic disciplines, but at the same time expands and deepens them by combining facts, concepts, methods and means of communication [5]. Such integration contributes to the search and creation of new effective solutions to real existing problems. The use of an interdisciplinary approach has benefits for all participants in the learning process [6]. For example, in the International Baccalaureate system, interdisciplinarity and interdisciplinary teaching and learning are very important. The benefits for students, teachers, as well as for the direct development of an educational institution are clearly highlighted.

Benefits for students:
– allows students to use knowledge from different disciplines;
– develops a deeper understanding and high-level thinking;
– develops mental flexibility;
– allows to look at real existing problems from different angles;
– demonstrates the need for collaboration and group work;
– allows to develop and apply transfer skills (i.e. the transfer of knowledge and skills from one discipline to another);
– involves students to look for solutions to real-world local, national and global problems.

Benefits for teachers:
– develops a holistic understanding and vision of the educational program;
– expands cooperation between teachers of different disciplines, thereby developing a common vision and values of education;
– allows teachers to integrate the content of different subjects, thus developing deeper authentic (close to real life) and challenging tasks for students;
– encourages teachers to reflect and process content, methods, strategies, technologies to achieve high results.

Benefits for schools:
– creates opportunities for the development of an effective broad connected and integrated educational program;
– creates an atmosphere in which diversity of viewpoints and opportunities are recognized;
– contributes to the development of an educational program dedicated to conscious service;
– creates opportunities for the development of agency of the school community (the concept of agency includes three components: the ability to express your point of view, the ability to choose and the ability to take responsibility);
– encourages cooperation between a school and learning communities;
– forms a unique school culture.[4]

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[4] *Middle Years Programme Interdisciplinary teaching and learning in the MYP (for use from September 2021/January 2022)*. Geneva: IBO; 2021.

However, despite the obvious benefits of an interdisciplinary approach, the key position of interdisciplinarity in educational system, the new requirements of the Federal State Educational Standards, the opportunities of international education systems, will require a serious growth in the professional level of a teacher not only in the field of broad horizons and the ability to lead students to new understandings at the intersection of disciplines, but also the highest level of information literacy, since due to the large flow of online services products that can be used for educational purposes, the main problem is to choose the most effective tools that could be adapted to any goal and age group [7]. Thus, there is currently insufficient experience in creating online advanced professional development courses for teachers of different age groups, considering the interdisciplinary approach and effective use of online tools for educational purposes for the development of multimodality of schools.[5]

Methodology. The research described in this article was based on several basic assumptions. Digital transformation, scientific and technological progress, and the active growth of the IT sphere require the teacher to immediately and continuously develop and adapt his practical activities and strategies to modern realities, which means constant improvement of his qualifications

While researching the market offering a variety of courses, including online, advanced training for teachers, the following problems were identified: the duration of the course did not always correspond to the possibility of mastering the material (too short and saturated or too stretched, filled with not always useful information that can be applied), a large amount of theoretical base without the possibility of practical application, complex online resources in English that are not always available to a Russian-speaking teacher.
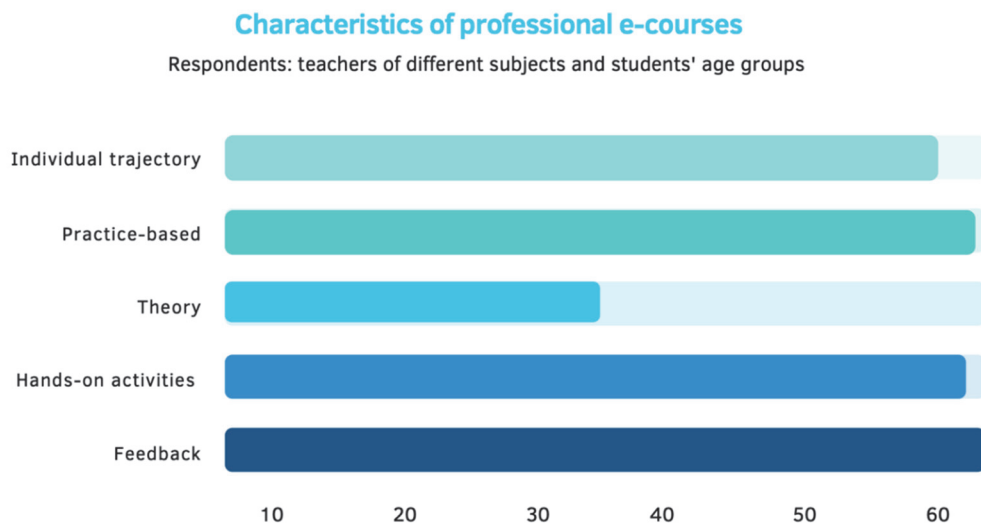
Figure 1. Results of a survey among teachers on crucial characteristics of professional e-course

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[5] Temmen M. *BANI vs VUCA – a new acronym for a new world*. Available from: https://marian-temmen.medium.com/bani-vs-vuca-a-new-acronym-for-a-new-world-59c7be2dddce (accessed: 10.03.2022).

In addition, a number of courses have been found, offering mass training for all students, often without feedback and individualization in the learning process. The conducted survey (Figure 1) among teachers of different age groups and disciplines showed that such courses are less in demand, because today, despite the fact that we are all involved in the learning community, teachers work in completely different school contexts and often absolutely identical teacher questions require an individual approach, taking into account the characteristics, context and contingent of the educational institution in which a particular teacher works [8].

On the other hand, what courses could attract a teacher today? It was revealed that the requirements for advanced professional development courses are as follows: flexible, diverse content, the use of practice-based approach, the development of an individual trajectory of each participant, considering his individual characteristics: the level of knowledge, the style of educational activity, etc., individual feedback, the ability to ask a question not in a chat, but in an online conversation in real time, etc. In addition, one of the main reasons for choosing an online course by a teacher was the online platform on which the course was developed.

Criteria of different online-services

Online board, tools and products 1-10
(where 1 is having many challenges to apply the service and 10 is very effective and convenient to use)

Criteria	Google Classroom	Edmodo	Moodle	Padlet
Usage	3	1	4	6
Price	Free for participants but you need an account	Middle and you need to register	Low and you need to register	Free for participants
Language	English	English	Russian	Russian
Feedback and access after course	7	3	5	9

Figure 2. Comparison of different online services

The survey results show that the online platform should be in Russian, accessible and intuitive to use, the structure of the course should be traced, as well as the possibility of long file storage and easy access to materials after completing the course. This request was included in the development of criteria of choosing an online course platform. Further, a study of several online services for the design and main platform of the e-course was conducted. Google Docs toolkit, including Google Classroom, Padlet online service, Edmodo platform, Moodle service are included in this study. Figure 2 represents the results of identifying the advantages and disadvantages of these online services and platforms, decomposed by criteria.

The next step is the choice of the topic of our e-course. As we have revealed earlier, educational standards call the teacher to use an interdisciplinary approach in the basis of the educational process. However, when searching the Internet,

a small number of online courses were found aimed at a deep understanding of interdisciplinarity, and most importantly, including practical tasks [9]. Basically, such courses are offered in English, including workshops and trainings from the International Baccalaureate Organization. However, these courses are quite specific and are aimed at mastering this approach in the context of this international educational system.
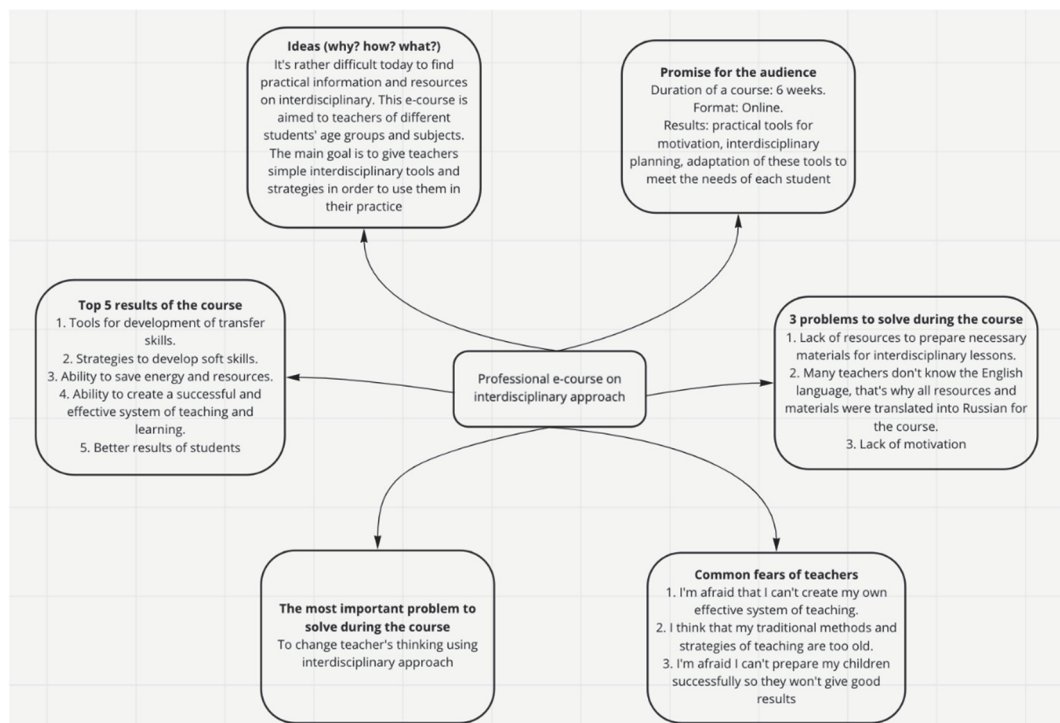

Figure 3. The constructor of the e-course

Within the framework of the conducted research, new methods and a set of tools for an e-course were developed, based on an interdisciplinary approach in teaching and learning and using convenient and effective online services for the development of multimodal skills and the integration of this experience into the learning process. A constructor of e-course was developed in the framework of this research (Figure 3).

The main objectives of the course were:

– formation of an understanding of a holistic interdisciplinary system;

– development of an action plan for the formation of an interdisciplinary atmosphere;

– application of a cycle of interdisciplinary inquiry in practice;

– creation of a planner for interdisciplinary inquiry.

The following services were selected for the design of the e-course: Padlet, and when developing the course, we will take into account the possibility of adding a Zoom video conference service, since we need to organize group practical online work, as well as real-time communication to answer questions and exchange opinions; Google Tools (in particular, Google Docs and Jamboard) will be an integral part of the online course.

The main idea underlying the research is the use of a practice-based approach, which will allow the participants of the e-course not only to get involved in the study of theoretical material, but also to take a part in the development of interdisciplinary inquiry. The use of this technology can allow teachers taking part in the course to immediately transfer the experience gained into their professional activities.
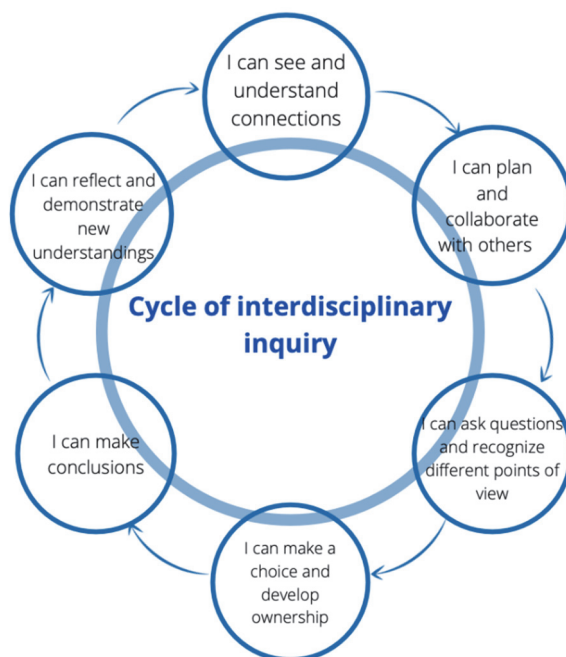
Figure 4. The cycle of interdisciplinary inquiry

During this research and design of the course, the cycle of interdisciplinary inquiry (Figure 4) was created, which became the basis for the modular system of the online course (that is, each stage of the cycle was one module of the course). A planner for interdisciplinary inquiry has also been designed, which participants will have to fill out during their own group and individual practice within the course. The result of the course will be the development of an interdisciplinary inquiry by the participants using a cycle and a developed planner. This result and the materials obtained can be immediately put into practice as part of their lessons.

Experimental studies of the effectiveness of this online e-course were conducted in several schools in Moscow with students of different ages (4th, 6th and 8th grades). In general, 5 teachers in the following disciplines took part in the experiment: Geography, Mathematics, Russian and Literature, English and Social Studies, as well as 164 schoolchildren. During the experiment the planner, interdisciplinary cycle and the materials developed during the course were applied, as well as the online platform used for the development of students' multimodality.

Results and discussion. During the experiment, students were divided into control and experimental groups, for each of which separate data were collected and processed during all stages and types of experimental verification.

The control group included a total of 71 students, the experimental group – 93 students. All types and stages of experiments, as well as the methods used,

educational and control materials were aimed at identifying transfer skills of the student developed during the collaborative design of interdisciplinary inquiry in the areas of Mathematics, Russian and Literature, Geography and English, Social Studies in primary school, as well as using selected online services that will contribute to effective individualization, the development of multimodal skills and high-quality timely feedback.

The students of the control group studied for five weeks according to traditional educational program without using an interdisciplinary approach as a fundamental one. The students of the experimental group created interdisciplinary inquiries where they explicitly and implicitly applied skills and knowledge from different disciplines and created new understandings. They applied the planner for interdisciplinary inquiry, which allowed them to structure the information obtained during the process of learning, as well as a cycle of interdisciplinary inquiry, which contributed not only to the integration of knowledge and skills from one subject to another, but also provided the opportunity to develop emotional intelligence, personal qualities, empathy, as well as the proposed online services that allowed involve students in the inquiry with their interactivity and develop information literacy skills and multimodality [10]. After the inquiry, students of the control and experimental groups were asked to undergo control diagnostics. The diagram shows the generalized results of the experiment (Figure 5).
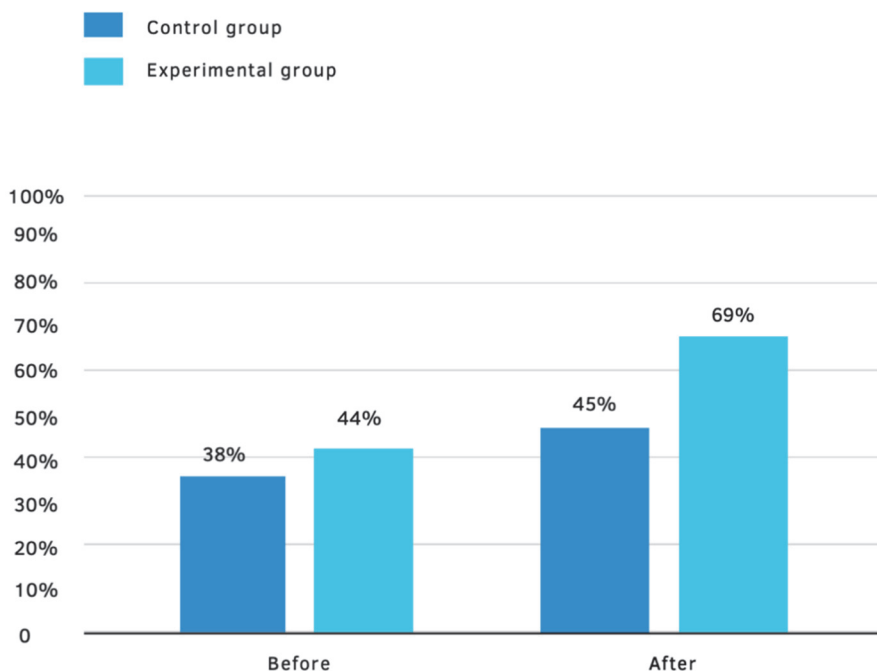
Figure 5. The diagram showing the generalized results of the experiment

The experiment showed that the students of the experimental group demonstrated a significant advantage in the development of transfer skills as well as creative and critical thinking compared to the students who made up the control group. The students who conducted the inquiry using the materials of the e-course passed the control diagnostics better. It was revealed that the students of the ex-

perimental group formed a deeper understanding of the studied material. In addition, according to expert assessments of teachers who conducted an interdisciplinary inquiry with their students, an increase in motivation and involvement in the learning process of students was demonstrated.

Conclusion. A professional development e-course for teachers on how to integrate an interdisciplinary approach into the learning process, materials developed during the course, selected online services have shown their effectiveness. To be more precise, the application of an interdisciplinary approach in narrowly focused lessons, the collaborative planning of teachers, the use of convenient online services in the learning process can significantly increase the effectiveness of students in school disciplines, develop transfer skills, as well as creative and critical thinking, better understand subjects and their diversity, apply the experience gained to solve real life issues, student involvement in the learning process. It is reasonable to develop a cycle and a planner for interdisciplinary inquiry, which allow structuring the educational process in this context, as well as the choice of online services, which contributes to the development of multimodality of students and increase the process of informatization of schools. An effective method is when the participants of the online course are involved in practical activities and take a role of students who develop a particular inquiry, use a cycle and planner, try online services. The developed e-course for teachers on how to integrate an interdisciplinary approach into the learning process, using selected online services, can play a significant role in the development of approaches for informatization of teaching at schools, as well as the implementation and realization of an interdisciplinary approach.

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