European Proceedings of
Social and Behavioural Sciences
EpSBS

www.europeanproceedings.com
e-ISSN: 2357-1330

DOI: 10.15405/epsbs.2021.09.02.169

ICEST 2021
II International Conference on Economic and Social Trends for Sustainability of Modern Society

PLATFORM Z - PORTAL "INVERNED" MENTAL RESOURCES ON THE PRINCIPLES OF DIDACTICS

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Abstract

Industry Digital Educational Resources (DER) aims to create a variety of academic information content, learning tools and knowledge control for full-time and distance learning. However, only a small part of the DER meets the real needs of students (generation Z), corresponds to their psycho-physiological preferences. Therefore, there is a need to design new approaches to the creation of DERs that will ensure the maximum effect of their use in education. The article proposes to pay attention to the achievements of cognitive psychology and mental didactics in the field of creating educational content for the development of students' thinking. Purpose of the study- to justify the methodological basis of educational resources portal that focuses on the development of structural and computational thinking as the quality of the competitive expert in the smart society. The Platform Z - portal structurally represents a semantic network of fundamental questions, broken down into a tree of educational questions and tasks. For each question, short and clear answers are developed, as well as tutors for teaching problem solving, which can be arranged in different versions, according to the student's claims. This approach to educational content allows you to organize an individual learning path for each student. As the results of the study, prototypes with a high degree of satisfaction of the trainees and positive assessments of experts are given. The materials of the article may be of interest to DER developers, researchers of learning models, teachers wishing to use digital cognitive and mental learning technologies.

Keywords: Z platform, flipped learning resources, Q&A tree, structural thinking, computational thinking

https://doi.org/10.15405/epsbs.2021.09.02.169
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1. Introduction

The revolutionary scientific and technological progress has caused a number of urgent problems in education associated with the need to significantly update the means and methods of teaching. Recently, educational platforms have become popular, which have formed sets of teaching aids for school disciplines, using the most modern ICT, network and cloud services.

Such platforms have received a powerful impetus for their development, especially in the direction of home education, in connection with the outbreak of the Covid-19 pandemic. However, despite the rapid development of the industry of digital educational resources, the emergence of a variety of educational information content, teaching tools and knowledge control for different forms of education, the quality of the educational process in schools remains unsatisfactory.

There are several objective and subjective reasons here. First, in most cases, learning resources are built on didactic principles for non-digital generations X and Y (Nicholas, 2020).

Paradoxically, but in the information educational space, an “anti-effect” is manifested - the more educational content is created, the less it is consumed by students. Secondly, modern students of “digital generation Z” do not want to receive “knowledge for the sake of knowledge,” they are more interested in finding only specific answers to their questions and requests. And here the negative effect of the number and variety of information materials is manifested - it is more difficult for a student to find and filter out the necessary and useful information.

Even teachers sometimes find it difficult to choose from an avalanche of digital resources better and more suitable teaching aids and techniques. Moreover, the competence-based format of the Federal State Educational Standard creates for them great uncertainty in the choice of certain teaching aids and vagueness in the goals and results of the educational process.

2. Problem Statement

The world educational practice is currently paying close attention to new skills and characteristics of a specialist for the digital economy.

First of all, it is structural and computational thinking (Henner, 2016; Rasiel & Friga, 2007). Structural thinking is one of the most demanded qualities of a modern professional, it is a skill that allows you to determine relationships at all levels, makes it possible to break the whole into components, make decisions, solve problems, think better, more efficiently, and creatively.

The phenomenon of the concept of "computational thinking" appeared in connection with the integration of the human mind with computer technology and determines the ability of a specialist to carry out mental and professional activities using information and communication technologies (Klunnikova et al., 2020; Wing, 2006).

The formation of such styles of thinking in teaching is impossible without the involvement of cognitive educational technologies. In this regard, it is of interest to design new approaches to the creation of digital educational resources that ensure the maximum effect of their use in the educational process of modern youth.

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Educational resources-transformers and inverted textbooks created on the principles of mental didactics have great potential in this direction.

3. Research Questions

- Conduct a critical analysis of educational platforms of digital learning resources for teaching general education students.
- Justify a mental approach to create an innovative platform that maximally takes into account the cognitive needs and psycho-physiological characteristics of generation Z students.
- Develop the outlines of the educational platform Z, designed for self-education of students at home, contributing to the development of their structural and computational thinking.
- Show examples of experienced digital resources of the inverted type and justify the effectiveness of their use in the independent work of students.

4. Purpose of the Study

The purpose of this work is to develop and substantiate, from the standpoint of mental didactics, a methodological portrait of a portal of educational resources that have the format of transformers and "inverted" textbooks that contribute to a significant increase in the quality of self-educational activities of generation Z students and the development of their structural and computational thinking, as a quality of a competitive specialist in Smart society.

5. Research Methods

5.1. Literature review

Today, the Internet space offers a huge range of various digital resources for distance learning, ranging from full-fledged course implementation to additional means of supporting the learning process "at a distance". Among some of the most popular forms of knowledge transfer are MOOCs - massive open online courses presented by such well-known platforms as Coursera (https://www.coursera.org), edX (https://www.edx.org), Udacity (https://www.udacity.com), MIT Open Course Ware (http://ocw.mit.edu/index.htm), Khan Academy (http://ru.khanacademy.org), Open Education (https: //openedu.ru/), Lectorium (https://www.lektorium.tv/), etc.

To the merits of MOOCs E.V. Malysheva attributes mass character and openness, regardless of social status, previous education or place of residence of the student, expanding the sphere of communication with all course participants and its teachers, as well as gaining access to the course materials at any convenient time for the student. However, to date, platforms that are not developed in Russia, most of the materials are presented in English (Malysheva, 2014).

Moreover, according to a study by the Massachusetts Institute of Technology for 2012-2018. among 5.63 million students and 12.67 million registrations for online courses, only 4% complete the course, but do not return, and among paid courses for 2017-2018. only 46% received a training certificate (Lederman, 2019).

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One of the reasons for this problem, Artyugan (2020), notes that, despite a number of advantages of MOOCs, such courses require a very high level of self-organization, developed soft skills, without which it is simply impossible to complete the program.

Thus, the majority of MOOCs are presented for an adult audience, because among schoolchildren, the level of self-organization and development of special cognitive qualities for independent mastery of knowledge are only in the initial state of formation.

Organization of training for schoolchildren in a distance format requires different approaches to organizing activities, because this category of listeners, due to their age characteristics, does not yet possess the necessary qualities for productive self-education.

The course must be structured in such a way as to always keep the participant's attention active and keep him motivated. That is why, during the pandemic, schools used special resources of school courses, such as Uchi.ru, YaKlass, Yandex.Textbook, Russian Electronic School (RES), etc.

These platforms contain developments in school disciplines, built in accordance with the school curriculum and meeting the requirements of the classroom system. However, during the analysis of digital educational resources and services for organizing the educational process of schools in a distance form, conducted at the Higher School of Economics, the authors (Frumin et al., 2020; Karlov et al., 2020) note the need to rethink the learning process and the interaction of its participants, to build courses using adaptive and interactive tasks that allow such platforms to act as not just a convenient tool for maintaining the classroom-lesson system, but a full-fledged self-instruction manual with feedback. In addition, in their opinion, most of the existing solutions for educational work in a digital environment are incomplete - they include only a part of the tools necessary for the implementation of a full-fledged educational process, for example, only interactive problem books or educational videos. The need for the ability to integrate resources and tools from different platforms is noted.

So, in the pedagogical practice of any modern teacher, there is already a significant arsenal of e-learning tools: various kinds of reference books, banks of video and audio content, interactive exercises and automated control and evaluation resources.

When referring to a particular resource, the teacher is limited by the scope of the presented content, and the formation of the content of the lesson in the form of a combination of tasks and materials from various sources causes confusion among students. Moreover, many school education portals require registration and authentication, which takes time, which can stop the student only at the stage of trying to enter the site. In this regard, it seems necessary to build such educational resources that have the function of transformation and adjustment to the needs of the educational process. At the same time, educational elements should be built based on the position of the cognitive characteristics of generation Z.

It is becoming more and more difficult to keep the attention of a modern schoolchild within the framework of educational content, when they are ready to spend all their time watching entertaining content, such as videos on Yutube, posts on social networks or just records of famous bloggers (Bessilina et al., 2020). The modern Internet content industry nowadays allows not only to keep the site visitor's attention for as long as the customer needs, but also to force him to act according to the customer's scenario. There are two main formulas that make it possible to implement this principle:

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1. Attract attention, interest, arouse desire, force to act.
2. Identify the problem, exacerbate the problem, show hope, propose a solution (Brazgovsky, 2021).
3. These formulas can be used in the formation of educational content:
4. Creation of engaging educational material through:

- using visualization,
- short blocks of materials, the reading of which will not make you stop in the middle or fluently read further,
- switching the types of activities that are maximally filled with practical independent activity with the receipt of specific visible products of work, which will support the motivation of trainees,
- demonstration of the practical application of knowledge in real life.

5. The study of the material should be started by asking questions. For modern schoolchildren, this method of acquiring knowledge is becoming familiar, starting with the formation of queries in search engines, and ending with the search for headings for posts, formed in a problematic form, making them think about the further content of the material. Schoolchildren, referring to the educational resource, are rather looking not for specific knowledge, but for answers to questions.

Such an approach will allow not only to keep the student's attention, but to develop structural and computational thinking, which today are an essential requirement for a person living in a Smart society.

So the requirements of employers for the training of modern specialists are no longer limited to the competencies of the information society: skills in working with "cloud" and web technologies, digital platforms, the ability to diverse and effective online communication, to use "big data" technologies in professional activities, etc. P.

Today, cognitive and intellectual competences are coming to the fore: the skills of analytical, critical and flexible thinking, the skills of multitasking, complex, creative work in collective communities. According to many scientists, the most sought-after qualities of the specialist of the future are their structural and computational thinking (Henner, 2016; Rasiel & Friga, 2007).

The scientific and technological revolution has allowed knowledge to be augmented with tools and intelligent applications that have greatly expanded the human mind.

In the future, it should be assumed that the differences between human and artificial intelligence will inevitably be erased. We already now, as it were, load our consciousness, mind into a computer and think already at the human-machine level, which corresponds to the future concept of the development of the world wide web, like web 5.0 (Kambil, 2008).

In this regard, the identified problems, principles and ideas, in our opinion, should be reflected in the construction of modern educational content that meets the needs of generation Z schoolchildren.

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5.2. Methodological framework of the portal of educational inverted resources-transformers

The essence of the modern stage of "digitalization" of society is expressed: as the era of big data and technologies based on them; as a stage of penetration of artificial intelligence into all spheres of life; as a new paradigm of thinking, communication with each other.

In education, the digitalization stage involves the digitalization of all educational and methodological materials and the creation on their basis of training courses and knowledge platforms, the fusion of the educational process with the Internet and the active use of mobile and cloud technologies.

Digitalization of education should provide students with personification and the ability to manage their own learning activities, to achieve independently planned learning outcomes.

The existing models of educational support for teachers on a distance platform, according to the above review, require significant costs and efforts of subjects of pedagogical education, do not fully take into account the characteristics of generation Z.

Let's highlight the main characteristics of Generation Z, which should be taken into account in the developed center for educational activities:

1. Striving for personal freedom in everything and for self-education, in particular;
2. Despite the clip thinking, their involvement, conviction and curiosity about everything;
3. Preference for brevity and clarity in communication and learning;
4. Satisfaction with external stimuli, approval from the outside;
5. Lack of global goals, plans for the future, the desire to live today and now.

Traditional formats of CER are consistent and systematic in nature of educational content and involve the development of knowledge to solve possible future tasks and problems of a future specialist. It should be recognized that this nature of educational tools is already in conflict with the above characteristics and preferences of today's youth.

Let us define the principles of mental didactics (Bazhenova et al., 2016) that can “work” to take into account the characteristics of generation Z, and to modern challenges and requirements for the competencies of specialists:

- Personification - due to the diversity of information saturation of the mental schemas of the subject area.
- Visualization of cognitive processes - through the use of mental maps, intelligence maps.
- Self-control of educational achievements - by visualizing the display of the dynamics of educational achievements and failures on the basis of structural and mental schemes.
- Non-linearity and transformability of teaching - due to the semantic network of fundamental (course) questions and the question-task training tree.

Further, special attention should be paid to the need to choose a platform that would contribute to the formation and development of students' structural and computational thinking - as the main result of self-learning.

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Structural thinking is about identifying the connections between objects and how they interact with each other. The widespread use of the term Computational Thinking began with the publication in 2006 of the work of the same name by Professor of Cornell University (USA) Jeannette Wing, who formulated the following definition (National Research Council, 2010): computational thinking is mental processes involved in posing problems and solving them in such a way that solutions are presented in a form that can be effectively implemented using information processing tools.

Structural and computational thinking styles rely on mental schemas (Neisser, 1981) to solve problems, defining their boundaries and ways of decomposing them into simpler components. Thus, thought processes are initially determined by problematic goals, questions and tasks. Consequently, a person has a more powerful motivation for learning and teaching an academic discipline when posing interesting problems and questions that provoke his curiosity. Strengthening the student's activity of the cognitive system is also associated with the desire to remove uncertainty when the questions posed and get pleasure from receiving an answer. If the answer to the question coincides with the existing knowledge of the person, then he can feel his own pride in the level of his intelligence. In this regard, it seems effective to create educational content of the CRC in a question-and-task form (Barkhatova et al., 2020).

Unfortunately, the problem of how to correctly formulate educational questions has not yet been investigated. We propose the following mechanism for compiling a question-task tree of an academic discipline. First, we develop a mental diagram or mind map of a given educational topic. For example, consider the topic "Area of a triangle" (Figure 1).

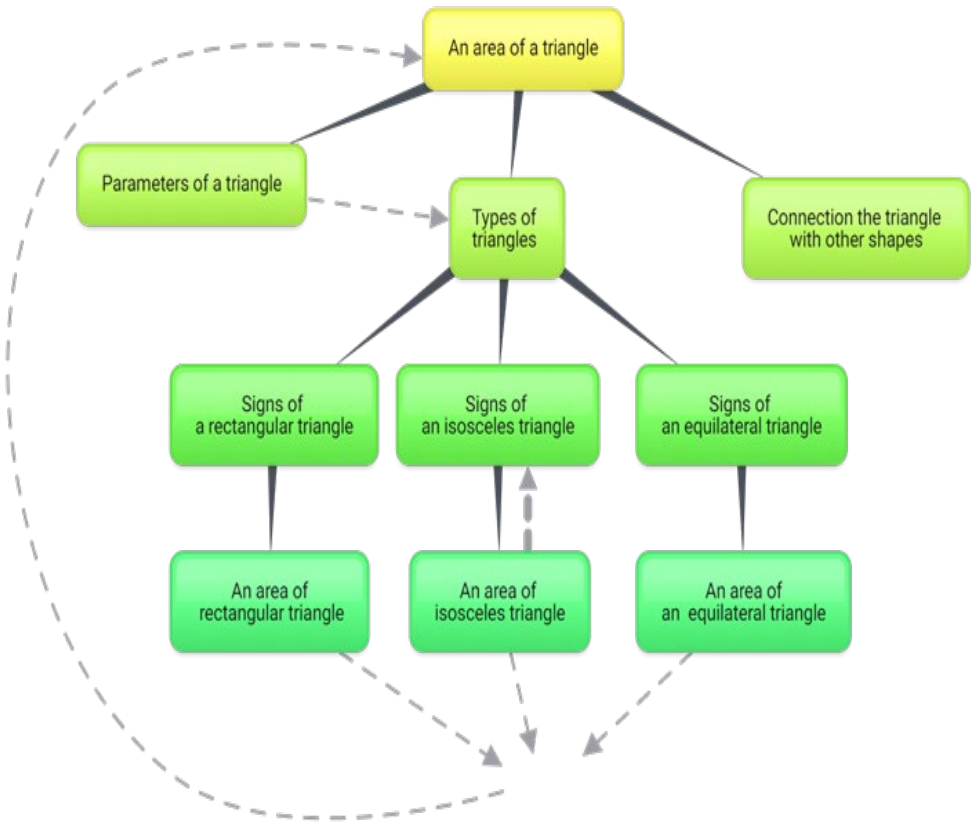

Figure 1. Mental map on the topic "area of a triangle"

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In a mental map, each section of a topic can be broken down into subsections, which in turn can be subdivided into subsections of a lower level, etc.

The visualized map of the topic makes it possible to reformulate it for a questioning character. Figure 2 shows a possible tree of questions corresponding to the mental map of the topic under consideration (Figure 2).

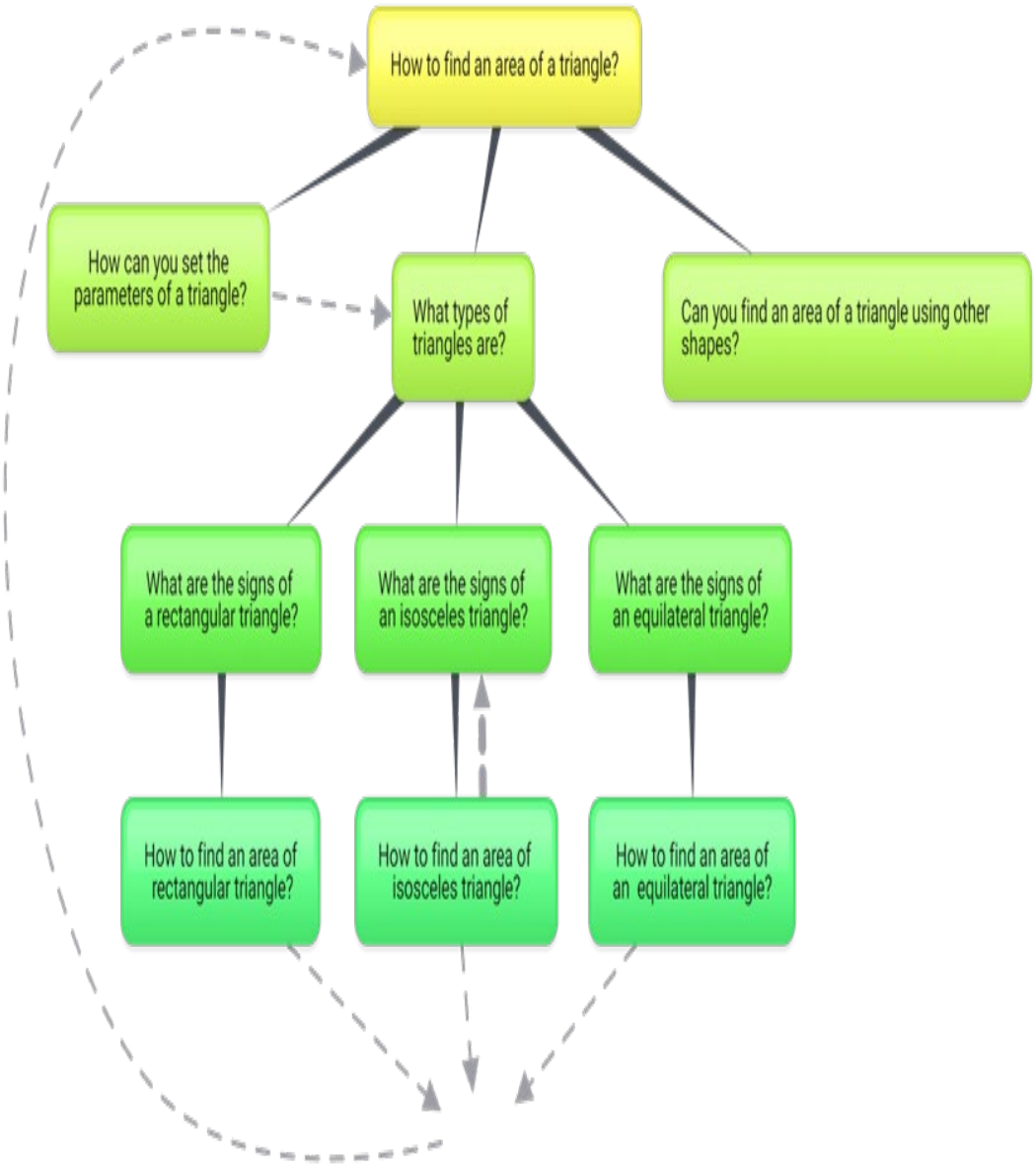

Figure 2. Question-problem tree on the topic "area of a triangle"

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The next step is to create individual answers to the posed questions and tasks in the form of concise, visualized content.

If you follow the path "bottom-up", then from separate trees of questions of topics, you can create a semantic network of discipline. The main apex of the web contains a foundational question (global course question). From such main questions of different disciplines, you can create a network that provides interdisciplinary connections, the structuring of knowledge from different subject areas. Moreover, these questions can be linked according to the "star" topology (in the centre is a general question, for example, the artistic and aesthetic cycle, or the natural science cycle, etc.), or according to the "bus" topology (a global question, for example, “how and when people will be able to colonize Mars?”, Figure 3). Bus and star topologies can be combined into more complex snowflake structures.

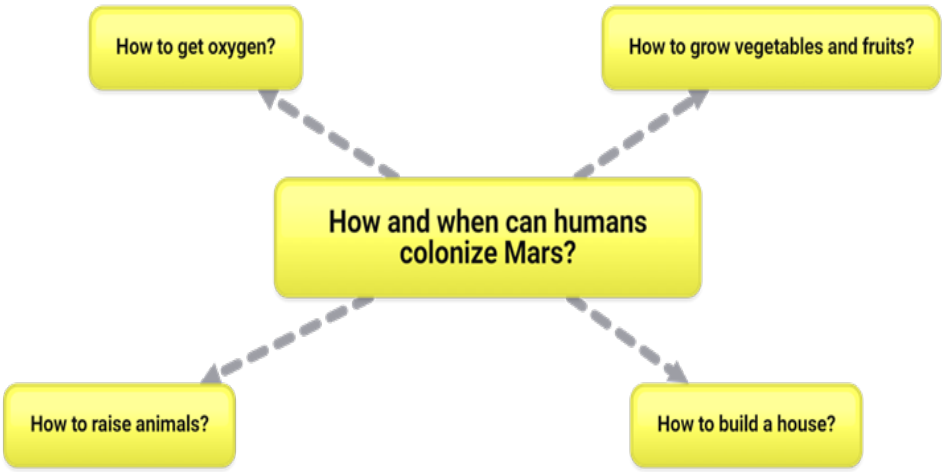

Figure 3. Semantic network of cross-subject foundational questions

Note that in addition to the answer part, the tree of questions contains tests for each question to check the assimilation of educational material. At the same time, the selected colour scale for the tree tops can serve as a dynamic and visual self-controller of the success of training. When working effectively with tests, the corresponding tree vertex is painted, for example, in green, otherwise - red. Thus, the proposed structure of educational content in the form of a mental semantic network can serve as the basis for the formation of Platform Z. The created portal of Platform Z has clear advantages over educational platforms developed on the classical principles of didactics and electronic services.

6. Findings

Let's consider the implementation of the proposed approach on the example of the topic "Number systems". The fragment tree of questions is shown in Figure 4.

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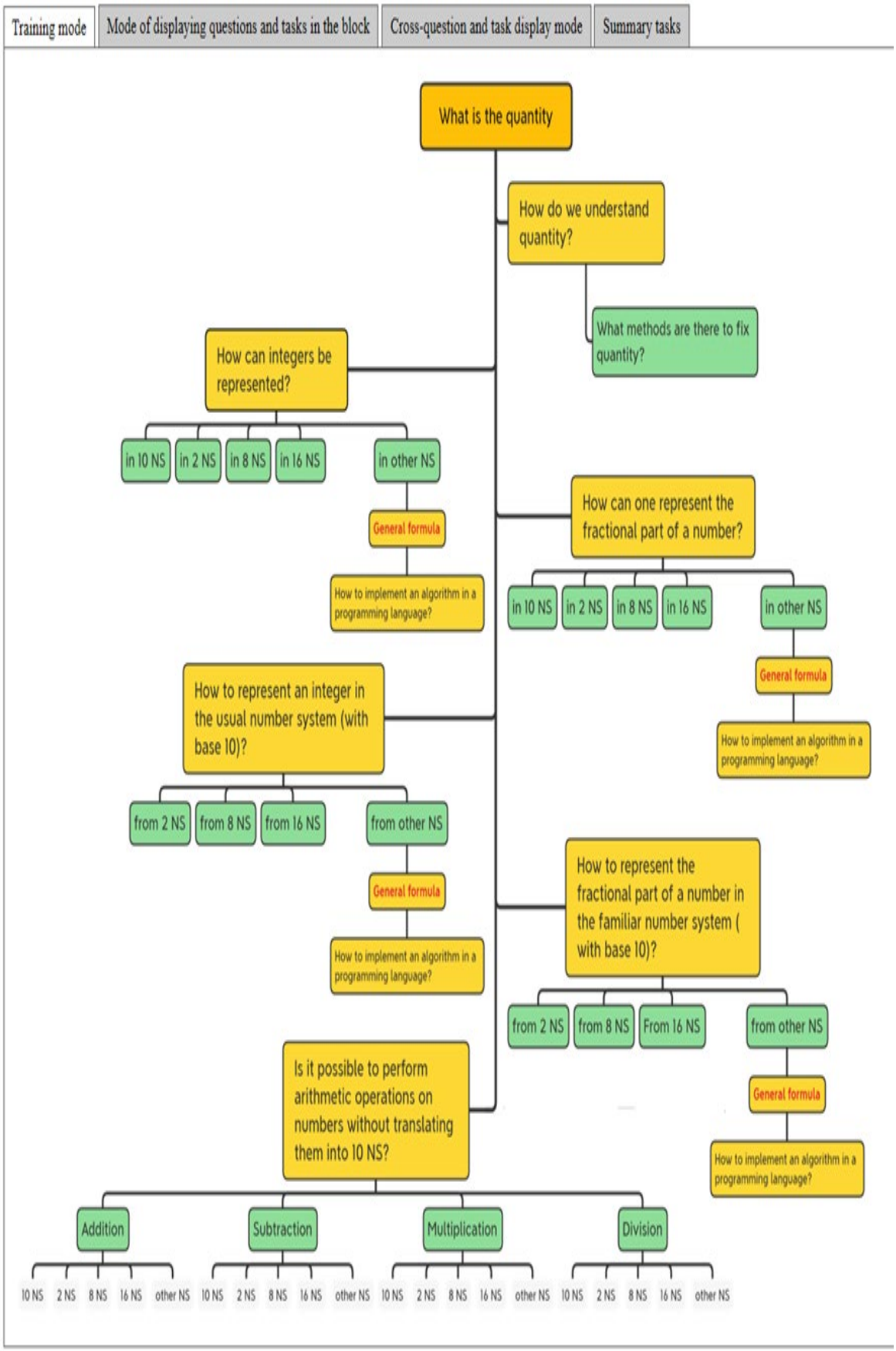

Figure 4. Model of an inverted textbook on "Number systems"

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The textbook, built on the basis of a topological question-task knowledge tree, has three modes: training, control, training. In all modes, the student can reveal the content of the blocks.

Another example of an inverted educational resource can be found at the link: https://hist-inf.kspu.ru/history/. This is the site "History of Informatics", created by students of the KSPU. V.P. Astafiev. It contains 6 topics related to the main content lines of informatics: theoretical foundations of informatics, electronic computing devices, programming and algorithmization, software, information transfer, information systems.

Each topic is presented in several questions. For example, in the topic "Programming and Algorithm":

- "What programming language did Google create?";
- "What old programming languages are still in use?";
- "When the new programming language from Apple was created, which was developed to combine C, C ++ and Objective-C? ".

It should be noted that the students, creating the considered teaching tool, themselves were trained to pose questions and form laconic answers to them. They turned the boring process of learning the history of computer science into a creative and exploratory learning project. The questionnaire survey showed that 98% of students believe that such a format for presenting educational content will be in demand and interesting to students. Many experts (teachers, teachers) also highly appreciated the didactic qualities of inverted resources and expressed the need to create a portal for such developments.

7. Conclusion

Little experience in the development and experimental testing of "inverted" electronic textbooks has shown that with their help it is possible not only to automate the learning process without real contact with the teacher, but also to achieve a significant increase in student motivation for self-study due to the principles of mental didactics, based on mental strategies of visualized question -response learning algorithm.

One of the ways to create an "inverted" electronic textbook can be presented as follows:

1. We build a mental scheme of the topic (in the form of a mental map).
2. For each terminal vertex, we form control questions and tasks.
3. For each question, we create an answer in the form of an informational message, using links to the materials of related training elements. The information material is built in an “upside down” form: from the answer to the question to the general theory along the ascending line.
4. For each task, we build a mental scheme for solving the problem. According to it we develop "Solver", "Simulator", "Controller".

The concept of a semantic network of question-answer trees of topics and sections of subject and inter-subject areas provides the basis for the development of structural thinking in learners. A high degree

of interactivity and personification of inverted resources, which obliges the student to use ICT competently and as efficiently as possible, contributes to the development of their computational thinking.

Thus, the creation of the Platform Z portal will significantly increase the quality and satisfaction with the self-educational activities of modern students, achieve the effectiveness of independent educational work at home, and develop their structural and computational thinking.

The materials of the article may be of interest to CRC developers, researchers of educational models of learning, teachers wishing to use digital cognitive and mental learning technologies.

Acknowledgments

The reported study was funded by Krasnoyarsk Region Science and Technology Support Fund according to the research project № 2021011106914 «Educational transformational platform of «inverted» learning resources for distance training of schoolchildren».

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