

Computer: Learning Session Programming Tool for Teachers

Computadora: Herramienta de Programación de Sesiones de Aprendizaje para Maestros

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ABSTRACT:

In this paper, we show that in an educator's design activity the goal-setting component should be based on the principles of SMART planning with the application of computer technologies. This is significant because modern lesson design must fully correspond to the goals set by the Educational Standard. The potential of the suggested electronic software methodological resource enables teachers to effectively master lesson design techniques.

Keywords: Electronic Model of Content of Education; SMART Planning; Learning situation; Lesson Flow Chart; Information resources.

RESUMEN:

En este documento, mostramos que en la actividad de diseño de un educador, el componente de establecimiento de metas debe basarse en los principios de la planificación SMART con la aplicación de tecnologías informáticas. Esto es significativo porque el diseño moderno de la lección debe corresponder completamente con los objetivos establecidos por el Estándar Educativo. El potencial del recurso metodológico de software electrónico sugerido permite a los maestros dominar efectivamente las técnicas de diseño de lecciones.

Palabras clave: Modelo electrónico de contenido de la educación; Planificación inteligente; Situación de aprendizaje; Diagrama de flujo de la lección; Recursos de información

1. Introduction

The professional training of school teachers within the system of modern higher education puts forward new requirements, connected with the to use innovation approaches to solving the problems of forming professional competences of future specialists. The formation of skills of designing the content of education in compliance with statutory documents has a special importance.

The key document determining goals and contents of education, as well as general approaches to learners' educational achievement assessment in the world educational practice today is the Educational Standard. The educational standard orients teachers to the most effective way of setting education goals through students' learning activities.

This is the approach implemented in the Federal State Educational Standards of General Education approved in 2009-2010 for the Russian Federation's comprehensive schools. The Federal State Educational Standard of General Education (hereinafter the Standard) requires the following results to be achieved by learners of the General Education Core Academic Programme (Federal State Educational Standard of Core General Education, 2011):

- personal results, including learners' readiness and ability for self-development and personal identity formation, well-formedness of their motivation to study and perform a purposeful learning activity, system of meaningful social and interpersonal relations, axiological attitudes reflecting personal and civil positions in activity, social competences, legal awareness, ability to set goals and build projects for life, ability to perceive the Russian identity in a multicultural social medium;
- metasubject results, including inter-subject notions and universal learning operations (regulatory, cognitive,

- communicative) mastered by the learners, the ability to use them in educational, cognitive and social practice, independence of planning and carrying out learning activity and organizing a learning collaboration with educators and peers, designing an individual educational path;
- subject results, including those mastered by the learners during the study of the subject: skills peculiar for the given subject area, types of activity in acquiring new knowledge as part of the subject, its transformation and application in academic, academic project and social project situations, formation of scientific mindset, scientific notions of key theories, types and kinds of relations, knowledge of scientific terminology, key concepts, methods and techniques.

Educational standards should be a means of educational process renewal and development rather than regulate the content of education (Vyazemskiy, 2012). Due to the implementation of the Standard in Russian schools, higher requirements are set for learning session design. G.E. Muravieva has given a concise and quite exact definition of the essence of pedagogic design: it does not consist in an educator's activity planning only but rather in planning the system of "learners' actions that result in certain changes in the learners themselves" (Muravieva, 2002). E.Yu. Rivkin's position is close to this one. He notes that when working by the new standards, the main feature of training is modelling the learners' (and not the teacher's) activity using a system of learning tasks aimed at ensuring planned results (Rivkin, 2013).

Undoubtedly, development of goals for a lesson – the main form of learning session organization – is an important stage in an educator's design activity. There are a number of definitions of the term "lesson" including the following: "A lesson is a controlled (therefore, purposeful, motivated, planned, adjustable, provided with organisational support) systemic process of the teacher's and learners' co-activity in achieving a pre-programmed diagnosable educational result determined by the academic programme, which is provided with adequate resources" (Rivkin, 2013).

To encourage the teacher's conscious approach to plan educational result formation (personal, metasubject and subject results), it is recommended to design the lesson in the form of a flow chart reflecting the teacher's activity, the students' activity and planned educational process results (Kopoteva, Logvinova, 2013). The term "flow chart" came to pedagogy from the engineering sciences. A flow chart is a form of engineering documentation describing the entire process of product treatment, specifying operations and their elements, materials, production equipment, tools, process parameters, time needed to make a product, employee skill level, etc. Flow chart shows what results can be formed at what lesson stage, by what activity of the teacher, and what kind of students' activity is to be organized (Zabrodina, Kozlova, Fortygina, 2018). The flow chart provides a comprehensive and clear representation of the entire activity process, with quite detailed description of step-by-step individual actions by the teacher and students from goal to result (Kopoteva, Logvinova, 2013).

N.Ya. Moroz distinguishes the following blocks of lesson flow chart structure, which are relevant to the idea of learning process engineering: goal-setting block (what needs to be done or materialized); tool block (by what means it is achievable); organization and activity block (structuring: actions and operations) (Moroz, 2006).

Goal-setting is an important stage in creating a lesson flow chart. According to Th. Ribot, "precise identification of goal and exploration of means appropriate to achieve it are necessary and sufficient conditions for any creativeness" (Ribot, 2002, P.105). Lesson goals must contain a reference to the lesson's results expressed in terms of learning actions which are specific and achievable within its framework, inextricably connected with planned syllabus outcomes and, ultimately, aimed at achieving educational standard requirements for outcomes in core academic programme. The teacher's actions in setting lesson goals must be aimed at selecting "planned achievements" for the subject and universal learning actions that can be formed at this lesson (Mironov, 2013).

Splitting general, global aims into more concrete is quite a challenge in goal-setting in lesson design (Fomin, 2011). The wording of the learning objective is not a description of the teacher's actions performed to complete some learning stage. The wording of the learning objective does not indicate what the student will know, how he/she will think or understand, as we are not able to verify such results directly. It has to indicate only such measures that the teacher will be able to observe, and thus to justify that the learning objective has been achieved (Savchenko, 2015).

Sharing the authors' position on the problem of goal-setting in designing a lesson, we note insufficient attention to the development of tools for setting goals for a modern lesson.

1.1. Theoretical perspective

We believe the following requirements for lesson goal setting shall be considered the most significant:

- accuracy and clarity of lesson goal wording;
- evidence of goal achievement significance as related to educational standard requirement implementation;
- presence of mandatory achievement indicators for the goal set;
- consideration of intra-subject and cross-subject links of learning material;
- identification of basic and advanced level of progress in learning;
- achievability of goals set within a lesson.

The above requirements fit the concept of SMART planning entirely. The peculiarity of SMART planning is that it has clearly defined criteria that goals and objectives set have to comply with: they have to be concrete, measurable, achievable, meaningful, and must have definite deadlines (SMART goals or goal-setting conditions, 2018). These criteria regarding lesson planning are made more specific in a study (Leonova, 2014) and are as follows. Learning goal setting concreteness supposes an accurate and clear wording, as well as an answer to the question 'why?', i.e. why the teacher sets this goal for him/herself and what requirements of the Educational Standard will be met if it is achieved. The criterion of measurability involves mandatory indicators

of degree of achievement of the goal set – planned outcomes in the academic programme, syllabus, and planned results of forming universal learning actions. Achievability is connected with the possibilities of achieving goals. The balance between educational activity intensity degree and planned syllabus outcomes is achieved, for instance, through consideration of intra-subject and cross-subject links of learning material. Meaningfulness criterion consists in the fact that a learning objective formalized in educational standard requirements as planned subject outcomes in the academic programme is divided into several sub-objectives of syllabus outcomes, which are specified in the subject syllabus. It is these objectives that the result of its achievement depends on. Deadline criterion involves achievement of all planned results of syllabus outcomes over the period of study allocated for the subject in the curriculum.

We have made these criteria more precise by means of indicators, considering that a lesson draft contains the goal component and content itself (plan, outline, flow chart) of the class. Therefore, we will distinguish SMART criteria compliance indicators for the goal-based and content-based components of lesson draft. Table 1 provides attributes and indicators for every SMART approach criterion.

Table 1
SMART Approach Criteria Compliance Attributes and Indicators for Lesson Draft

Item	Criterion	Attributes	Indicators
1	Concreteness	1.1. Accuracy and clarity of lesson goal wording (the presence in the purpose of the study session words denoting the actions of students, which should become its result)	Goal component: - goal wording contains reference to different kinds of learners' outcomes in lesson theme Lesson content: - there is a training situation related to every goal wording item
		1.2. Evidence of goal achievement significance as related to educational standard requirement implementation	Goal component: - possibility of lesson result compliance with requirements of the Standard Lesson content: - Standard requirements are emphasized in the content of assessment actions by the teacher
2	Measurability	2.1. Presence of mandatory achievement indicators for the goal set	Goal component: - goal wording contains reference to the result in the form of an action to be mastered by learners Lesson content: - learning situations allow to evaluate the actions of students in the development of the topic of the lesson
3	Achievability	3.1. Consideration of intra-subject links of learning material	Goal component: - presentation of base knowledge in academic subject Lesson content: - availability of training situations to apply base knowledge in academic subject
		3.2. Consideration of cross-subject links of learning material	Goal component: - provision of base knowledge in other subjects required to study the theme Lesson content: - availability of training situations to apply base knowledge in other subjects
4	Meaningfulness	4.1. Identification of basic and advanced level of outcomes in learning	Goal component: - lesson goal wording identifies to a full extent the role of the lesson in achieving both basic and advanced level results Lesson content:

			- training situations suggest learner activity differentiation
5	Deadline existence	5.1. Achievability of all goals set within a lesson	Goal component: - sufficiency of lesson time resource to achieve planned results Lesson content: - use of teaching methods and aids ensuring achievement of all planned results within a lesson

Do existing learning session drafts meet SMART criteria? What pedagogical tools of designing a modern lesson will ensure the effectiveness of the planning of the educational process in the context of the introduction of the educational standard of the new generation? The answers to the questions posed are disclosed as part of our research.

2. Methods

To implement the objectives of the study, the content analysis method was used as a method of qualitative and quantitative analysis in order to identify and measure the degree of compliance of the goals and the content of lessons with the main SMART criteria. Criteria and indicators of compliance are presented in Table 1. The number of summaries and technological maps of lessons were adopted as units of the account, the goals and content of which, when using indicators, were found to meet the criteria of the Smart-Approach. The unit of measurement was taken as the percentage of the number of studies that meet the requirements of the Smart-Approach, to the total number of analyzed technological maps and abstracts. As a document, a form with a table was used, which served simultaneously as a content analysis form, a coding matrix, and contained a list of the analyzed technological maps. In the process of research, we analyzed 170 abstracts of lessons of elementary and secondary schools. The results are presented in Table 2 and 3.

Table 2
SMART Criteria Attribute Compliance in Elementary School Lesson Drafts

Attribute	Attribute compliance percentage	
	Goal component of lesson draft	Lesson content description
1.1. Accuracy and clarity of lesson goal wording	55%	60%
1.2. Evidence of goal achievement significance as related to educational standard requirement implementation	55%	0%
2.1. Presence of mandatory achievement indicators for the goal set	35%	20%
3.1. Consideration of intra-subject links of learning material	15%	40%
3.2. Consideration of cross-subject links of learning material	0%	0%
4.1. Identification of basic and advanced level of outcomes in learning	15%	20%
5.1. Achievability of all goals set within a lesson	40%	70%

Elementary school learning session draft analysis enabled us to determine the most critical lesson draft requirements within SMART approach. Thus, for instance, lesson goal most often reflects only the teacher's actions. It means non-compliance with concreteness and measurability requirements. An interesting observation is that, for instance, the goal component of lesson draft does not reflect subject matter base knowledge, however, the draft's content part provides the use of required knowledge. It shows that the teacher does consider the significance of learning material revision mentally, but fails to refer to it in lesson goals. Often, there is no reference to achievement of personal results in the drafts. Requirements of the Standard are not emphasized in the content of the teacher's evaluative actions; evaluation is mostly provided for the lesson overall. Exceptions are "lesson notes" which are part of School 2100 academic programme: training situations

include learners' self-evaluation of their achievements by a certain algorithm.

Middle school learning session drafts are provided for different themes of Computer Science school course for different grades. The selection of learning sessions to be analyzed included both those presented at various contests and festivals, including award-winning ones, and ordinary ones available at teaching resources websites. Middle school analysis results are shown as a table (Table 3).

Table 3
SMART Criteria Attribute Compliance in Middle School Lesson Drafts

Attribute	Attribute compliance percentage	
	Goal component of lesson draft	Lesson content description
1.1. Accuracy and clarity of lesson goal wording	25%	55%
1.2. Evidence of goal achievement significance as related to educational standard requirement implementation	25%	35%
2.1. Presence of mandatory achievement indicators for the goal set	0%	45%
3.1. Consideration of intra-subject links of learning material	10%	70%
3.2. Consideration of cross-subject links of learning material	10%	70%
4.1. Identification of basic and advanced level of outcomes in learning	15%	45%
5.1. Achievability of all goals set within a lesson	40%	60%

The analysis of middle school lesson drafts as viewed from SMART approach perspective has proven that developers define lesson goals just to observe formalities. Lesson goal definition through teacher's actions only does not contribute to identification of desired learning session outcome and, thus, of its efficiency. Disregard of description of the lesson draft goal component leads to unjustified time losses during the lesson and insufficient practicality of using certain information resources. It is also important to have lesson plan content component matching its outcome-and-goal basis. In many cases, it is difficult to relate training situation descriptions in the draft with their role in implementing the goals set and, ultimately, the Standard requirements. Therefore, we have incompliance with meaningfulness criterion.

Consider how to design a lesson according to SMART criteria.

Lesson design techniques studied by students have been developed with regard to problems identified as a result of analyzing the existing lesson session drafts. One of the most problematic is Requirement «Presence of mandatory achievement indicators for the goal set» (Table 1). It suggests that goal wording contains a reference to the outcome in the form of an action to be mastered by learners. In reality, however, lesson drafts most often describe the actions of the teacher rather than those of students, or represent a list of skills that cannot be formed within a single lesson. Besides, they lack planned personal outcomes. The following examples will show how requirements compliant with Attribute 2.1 for measurability criterion can be fulfilled.

Let us assume that the following planned outcomes of Computer Science course have been set for a 2nd grade lesson on the theme "What Is Algorithm."

Subject-related learning outcomes:

S1. Having a notion of the algorithm as a sequence of discrete steps aimed at achieving the goal

Personal learning outcomes:

P1. The graduate will be able to form a distinct persistent cognitive educational learning motivation

Metasubject learning outcomes:

M1. The graduate will learn to build an oral and written utterance consciously and wilfully

M2. The graduate will learn to apply the leading-to-the-notion technique based on object recognition, essential attribute selection and synthesis

The above learning outcomes serve as the basis of defining lesson theme outcomes in the form of actions to be mastered by students. Meanwhile, description of a single action may reflect learning outcomes of different types, as shown in Table 4.

Table 4
Planned Lesson Theme Outcomes

Item	Actions to be mastered by students	Planned course outcomes
1	Explains the concept of algorithm through examples from his/her activity	S1, M1
2	Makes a statement about the algorithm as a sequence of discrete steps aimed at achieving a goal	S1, M1, M2
3	Provides written reasoning about the algorithm as a sequence of discrete steps aimed at achieving a goal	S1, M1
4	Explains the necessity to know the notion of algorithm for his/her academic activity	S1, P1

Formalistic approach to realizing the lesson's educative function is connected with future school teachers' difficulties in describing (decomposing) personal outcomes of the academic programme in the form of actions to be mastered by learners. Such actions can be defined in a way similar to that used in Table 5.

Table 5
Planned Lesson Theme Outcomes

Item	Planned personal outcomes of the course studied	Actions to be mastered by learners
1	Development of aesthetic feelings, amiability, emotional and moral generosity, understanding and compassion with feelings of others. Recognition of his/her ethnic and national identity; formation of values of a multinational Russian society;	voices his/her feelings in statements when dealing with works of art
		declares a respectful attitude to other peoples when reflecting and conversing in the course of study of works by representatives of other peoples
		selects works by other peoples, which are similar in their themes and ethical problems
2	Development of skills of collaboration with adults and peers in various social situations, ability to avoid conflicts and find ways out of disputable situations	hears the interlocutor out, does not interrupt, speaks out his/her viewpoint calmly, citing solid arguments and facts
		identifies the reasons of existing conflict situation
3	Formation of aesthetic needs, values and feelings	names favourite authors giving grounds for the choice
4	Acceptance and assimilation of the social role of a learner, development of academic activity motives and formation of personal meaning of studying;	provides examples of 'high learning' from the works read
5	Development of aesthetic feelings, amiability, emotional and moral generosity, understanding and compassion with feelings of others	discerns moral standards, relates them to literary characters' deeds, proves compliance
		suggests variants to solve moral dilemmas
		builds a moral and ethical statement of 5-6 sentences based on moral notions and standards about a deed by this or that literary character

The study has also brought us to the conclusion that using SMART planning principles in lesson design creates certain risks that may lead to an unsuccessful scenario. Primarily, it is the future school teacher's overload due to large time input to learn and use these principles in their design activity. The matter is that the development of a lesson draft goal component suggests the educator's being informed about planned outcomes of core academic programme; analyzing academic subject content in regard to Standard requirement compliance;

identifying a particular theme's potential in ensuring formation of universal learning actions; correlating actual syllabus content with reference syllabus for the subject studied; being able to select academic subject content purposefully, etc.

In connection with the above, the following questions arise: How can existing risks be overcome? Can SMART planning principles designed for economics be applied to plan the academic process? What are the conditions for their application?

We give the following answer to all three questions. In order to minimize the above risks, increase planning process quality, cut its labour intensity, avoid mistakes and failure to observe didactic principles, the lesson should be developed with due consideration of SMART planning principles in a computerized information system.

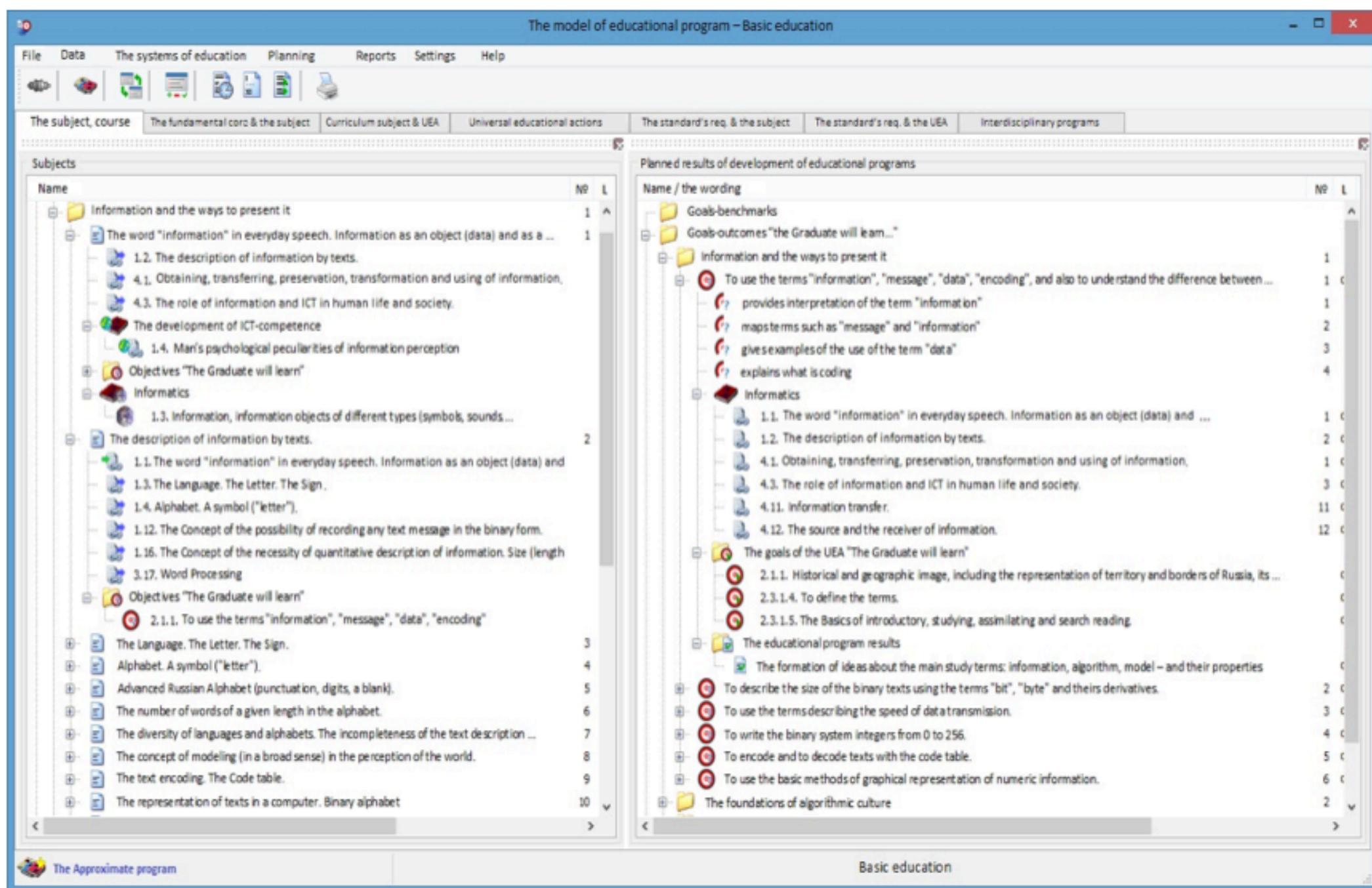
Consider the possibilities of a computer information system as a means of designing a lesson on the example of an electronic model of educational content.

Electronic Model of Content of Education software from MS-IOS2010 software suite is an efficient tool for modern educators and future teachers enabling them to do SMART syllabus planning (Matros, Leonova, 2011), built in compliance with requirements for consistent description of educational content elements and formal means of expressing meaningful relations between them.

The electronic model of content of education is an interconnected PC dataset formed and used during educational content design, implementation and outcome control (Leonova, 2011). Computer memory stores both all sorts of data on the content of education and rules for working with these data. Rules for working with educational content elements deal with consideration of their interrelations, which is crucial both in educational content design process and its implementation (Volchegorskaya, Fortygina, Yakovleva, 2018).

The electronic model of content of education (Leonova, 2011) presents educational standard requirements and the content of syllabi and interdisciplinary programmes. Subject themes (didactic units) are connected with each other, planned syllabus outcomes, and elements of scientific knowledge from the fundamental core (Fig.1). Planned syllabus outcomes are linked with the goals of universal learning action formation and academic programme outcomes.

Fig. 1
Main window of Electronic Model of Content of Education software



We have developed methods for designing a lesson based on the use of the Electronic Model of Content of Education (Leonova, Fortygina, 2018). Testing the hypothesis about the effectiveness of using a computer model as a means of implementing SMART planning for lesson design was carried out by questioning teachers who were trained in courses on the implementation of the educational standard of general education. Evaluation of the reliability of the results obtained was carried out using the T - Wilcoxon test. A detailed description of the proposed approach to the design of the lesson, as well as the experimental part of the study is presented in the section "Results".

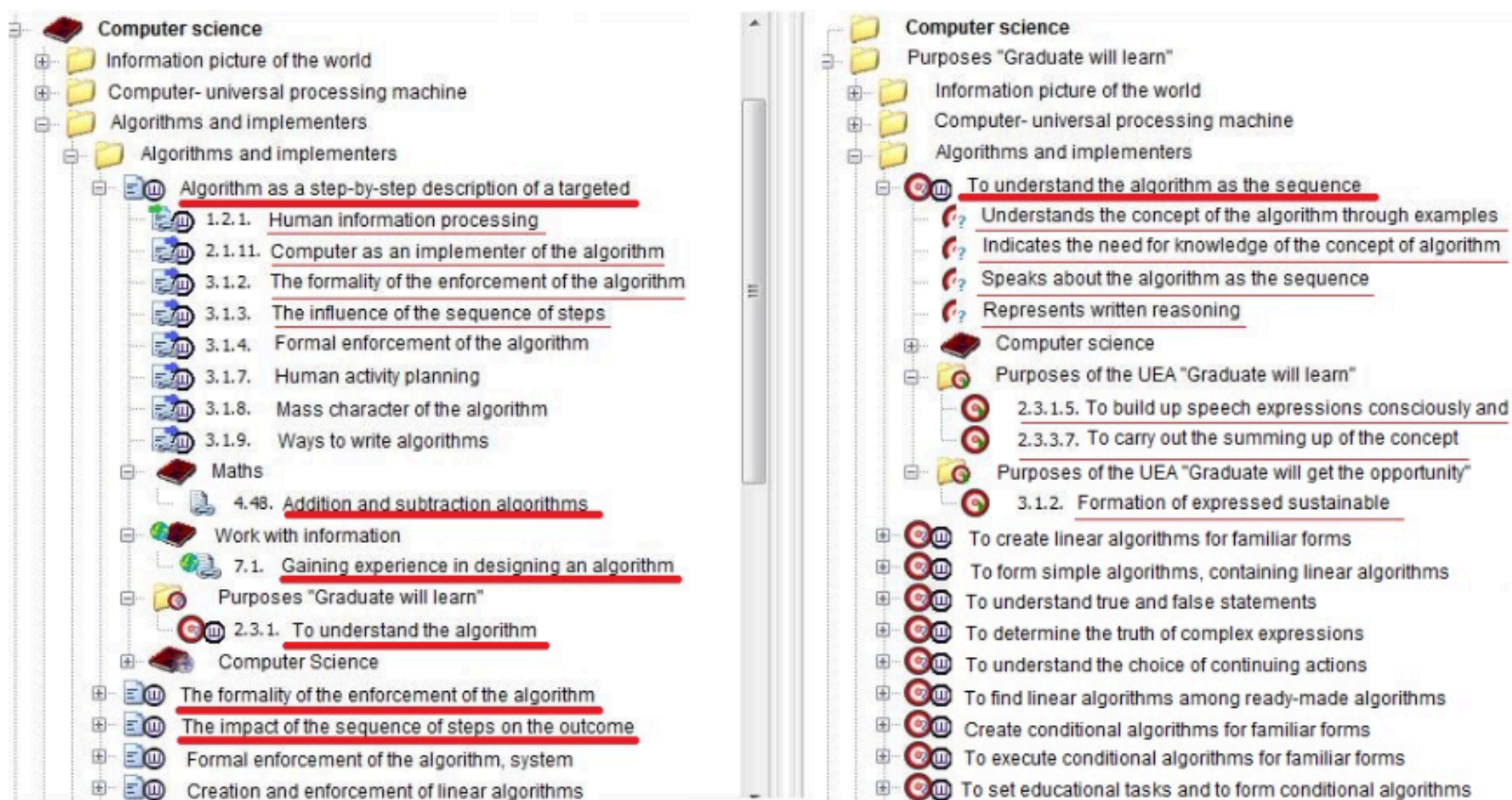
3. Results

Electronic representation of the content of education makes it possible to implement certain SMART planning items. In Figure 2, underlined are academic course content elements (Computer Science course is taken as an example) which refer to outcome-and-goal basis of lesson design. The effective target design basis of the lesson includes the following information:

- personal, metasubject and subject outcomes of a particular academic subject or course;
- main types of academic activity;
- planned syllabus outcomes at basic and advanced levels;
- requirements of interdisciplinary programmes including those aimed at forming universal learning actions;
- intra-subject and cross-subject links of the lesson theme.

Automatically acquired components of outcome-and-goal basis of lesson design encourage the student, firstly, to articulate lesson goals in the form of actions to be mastered by learners with consideration of various outcome types; secondly, to provide knowledge base both for the academic subject under consideration and for other subjects; thirdly, to ensure learning outcome planning of the basic and advanced level.

Fig. 2
Computer Science educational content model fragment



Electronic Model of Content of Education can be used in integration mode with the Web application Lesson Flow Chart. In this case, lesson flow chart components are:

1. Lesson passport and key information: theme, type, educational technology used, specific features of the class or individual students, main elements (units) of lesson content.
2. Outcome-and-goal basis of lesson design (as per syllabus).
3. Planned lesson outcomes in the form of actions to be mastered by learners.
4. Information resources ensuring completion of planned actions (material of the manual, electronic educational resources).
5. Lesson stages and their content.

A crucial part of lesson flow chart is the outcome-and-goal basis formed automatically thanks to connection to the model of the content of education when the user selects course or lesson theme. Lesson goals containing reference to the outcome in the form of actions to be mastered by students are presented as a separate group. This part of lesson flow chart reflects all types of planned outcomes and contains clear and unambiguous wording of students' academic achievements, which serve as a clear guideline in lesson design process during the selection of learning material, electronic educational resources and learning situation design. Such an approach in SMART planning concept makes it possible to ensure specificity of learning goal setting, measurability criterion and meaningfulness criterion.

Fig. 3
Web application Lesson Flow Chart

Steps in developing lesson flowchart

Lesson passport

General information

Formation of effectively-targeted bases

The selection of educational material and information resources

Description of the stages / learning situations

Description of the stages / learning situations

Reference:

Expected outcomes of the curriculum
Universal learning activities: personal results
Topics to repeat
Topics for propedeutics
Interdisciplinary communication

Stages of the lesson:

1 2 3 4 5 6 7 8 9

Self-determination in the activities. Organizational issues

activities:

required:

- The notion of algorithm through examples of its activities
- Points to the need to significance the concept of algorithm for its training activities
- It speaks about the algorithm as a sequence of discrete steps. Direction of the goal

potential:

- It explains the concept of the need to know the algorithm for its training activities

Pattern learning situation:

Formulation of the problem

Select

Note (used methods of teaching, individualization techniques, and others.)

Preview

Detailed requirements for theme outcomes serve as a guideline in learning situation design. A learning situation is a differentiated part of the lesson, which includes a set of conditions ensuring planned concrete outcomes (actions to be mastered by learners). Specificity of learning situation design in Lesson Flow Chart web application environment is shown in Figure 3. The designer (a student - a future teacher) singles out students' particular actions to be mastered at the selected lesson stage, and designs the activity of the teacher and students accordingly by using a custom (for the educational technology specified in the passport) or common template. With this said, it is important to note that the outcome-and-goal basis of the lesson is always available to the developer.

In order to test the hypothesis of the effectiveness of the Electronic Model of Content of Education to implement the requirements of the Smart-planning of the lesson, a survey was conducted, which was passed by 48 teachers of primary and secondary schools.

To assess the capabilities of the Electronic Model of Content of Education in the teacher's design activities, the following activities were selected:

- detailed elaboration of subject results of mastering the educational program;
- justification of compliance of the objectives of the designed lesson with the requirements of the Standard;
- definition of intra-subject links of educational material on the subject;
- identification of interdisciplinary connections of educational material;
- determination of the basic and advanced level of development of educational material.

Respondents had to evaluate the degree of convenience and efficiency of two different ways of performing the above actions: 1) using the Electronic Model of Content of Education; 2) using only work programs in the traditional text form. To assess the degree of convenience and efficiency of each of the activities was selected 3-point scale. The respondent should circle the corresponding point according to the principle: 0 - the method requires sufficiently large intellectual and temporary resources; 1- method causes intellectual difficulties or takes a lot of time; 2- the method is effective: the desired result is achieved quite quickly without intellectual difficulties.

The final integral characteristic of the lesson's teacher's actions allowed the proposed methods to be compared in both activity and motivational aspects.

Evaluation of the results of the study and their reliability was performed using the Wilcoxon T-test, which is used to compare the indicators measured in two different conditions on the same sample of subjects. The Wilcoxon test makes it possible to establish whether a shift in performance in one direction is more intense than in another. Statistical processing of experimental data confirmed the hypothesis about the effectiveness of

4. Conclusions

Discussing an approach to the design of educational content, based on the integration of SMART planning and ICT, the conditions for its mass use should be determined: 1) organizing and conducting workshops for teachers to discuss the use of SMART planning in lesson design; 2) increasing the ICT competence of teachers; 3) the motivation of teachers to develop professional competence.

A modern teacher, undoubtedly, should use a computer as a means of creating and using in the educational process a beautifully shaped visualization, as a means of conveniently storing educational and methodological information and effective interaction with students and their parents. However, an important direction in the use of computer technology in educational activities should be to improve the management of the educational process. The article presents some ideas about using a computer as an intelligent tool of a modern teacher for effective lesson planning.

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