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The Multimedia Presentation of a Lecture as the Means of Perception, Comprehension, and Memorisation of Educational Information by Students

Abstract

The demand for teachers of Ukrainian universities to create multimedia presentations of lectures and their use in the process of teaching the course “Methodology of teaching mathematics” has been formulated as the result of the experimental research. Taking into account the specificity of the discipline and the peculiarities of the perception, comprehension, and memorisation of educational information by students, what has been determined are the requirements for visual and audio content, for the text presented on presentation slides, and for the design and navigation, and their effectiveness has been experimentally proved. In particular, it has been established that, in order to facilitate students’ perception of educational information, presentation slides should not contain large text arrays. Text slices of presentations should be executed using a certain font, with a certain font size and dominant colours of the headings and main text. To facilitate understanding and memorisation of the content of teaching, the theoretical information should be structured and presented in the form of circuits, tables, diagrams, etc. To stimulate interest in learning, a positive emotional background should be created, and thus a presentation should contain bright colour objects, photographs, and video footage of real mathematics lessons. It is emphasised that, in order to create conditions for the perception, understanding, and memorisation of educational information, presentation design should provide a single style of

design and identical compositions of components; for example, image of the same type of information should be in the form of identical elements of “SmartArt.”

K e y w o r d s: teacher training, methodology of teaching mathematics, lecture, multimedia presentation

Introduction

The current stage of the development of primary education in Ukraine is characterised by the implementation of the concept of reforming general secondary education “New Ukrainian School,” the new State Standard of Primary Education, and new Typical Educational Programmes for 1–2 forms, which brings up to date the problem of upgrading the content and methods of training future primary school teachers, and the effectiveness of this training.

The training of a primary school teacher for teaching mathematics takes place in the process of mastering the course “Methodology of teaching mathematics at primary school,” which provides lectures and practical / laboratory classes. In order to study the teaching tools used by university lecturers in teaching the course “Methodology of teaching mathematics,” we conducted an experiment. Twenty lecturers of this subject were included in the study (South Ukrainian National Pedagogical University named after K. D. Ushynsky in Odessa, Kherson State University, Berdyansk State Pedagogical University, Mykolaiv National University named after V. Sukhomlynsky, Vasyl Stefanyk Precarpathian National University, Chernihiv National Pedagogical University named after T. Shevchenko, Ivan Franko National University of Lviv, Cherkasy National University named after B. Khmelnytsky, Pavlo Tychyna Uman State Pedagogical University, National Pedagogical Dragomanov University in Kyiv, Sumy State Pedagogical University named after A. Makarenko, Hlukhiv National Pedagogical University named after O. Dovzhenko, Khmelnytsky Humanitarian Pedagogical Academy, Lviv regional institutes of postgraduate pedagogical education, Zaporizhzhya regional institutes of postgraduate pedagogical education, Cherkasy regional institutes of postgraduate pedagogical education, Kherson Academy of Continuing Education and Odessa Institute of Teacher’s Training). Questionnaires were suggested in order to make it possible for the academic teachers to indicate which means of information technologies they use during their lectures, as well as to express their views on the need of multimedia presentations of lectures.

The survey results showed that most teachers during their teaching of methodology of teaching mathematics use a lot of educational materials, both electronic and non-electronic: the texts of lectures in paper (70%) and electronic

(60%) form, material visualisation (55%) and schematic visualisation (35%), paper textbooks on mathematics (75%) and methodology of teaching mathematics at primary school (90%), study guides (65%), electronic textbooks on methodology of teaching mathematics (45%) and electronic study guides (50%), paper copies of normative documents (60%) and their electronic versions (65%). They also offer links to the pages of the MONU (65%), and show students the programme of the course in paper (60%) and electronic (50%) form. A significant number of teachers use presentations of lectures (80%) and video materials (80%). Yet these presentations, although being done in MS PowerPoint, mostly represent the lecture theses in the textual form, ready samples of the solution.

All teachers who participated in the survey (100% of respondents) are sure that increasing the effectiveness of students' learning of methodology of teaching mathematics can be achieved by learning materials developed on the basis of information technologies. In addition, most teachers (95%) are sure of the feasibility of using information technologies precisely during lectures. Thus, we confirmed the relevance of the development of learning tools based on IT, in particular, multimedia presentations of lectures with animation, as the result of the experiment.

Proceeding from the fact that teaching mathematics at primary school is realised with the involvement of a big number of distribution materials, with which pupils perform practical actions in the process of studying, and that it is carried out using objective and schematic visualisation, it becomes obvious that during lectures a teacher should demonstrate the method of working with these tools to students. At the same time, the use of distribution materials and visual materials in the material form requires a lot of time and does not allow the lecturer to demonstrate the qualitative method of working with them. Thus, the question of illustrating the work of visualisation appears, which is possible with the use of multimedia presentations of lectures. In a multimedia presentation with the help of animation effects, it is possible to imitate the work of students with distribution materials and other means of visualisation, distinguishing key steps, gradually performing the required entries.

An essential feature of the modern stage of primary education is variability – the variability of forms and methods of teaching and, most importantly, the variability of textbooks, the variability of calendar and thematic plans, the variability of methodological support, etc. Therefore, during the lecture, the teacher has to appeal to valid textbooks, manuals, lesson development, etc., showing their pages. The use of paper books during the lecture does not allow the teacher to demonstrate students the page in an enlarged form or to compare the specific tasks of one textbook consistently, as well as the corresponding tasks from the textbooks of different authors; the teacher has to spend time finding the right pages, and students have no way to look at them in detail. Overcoming these disadvantages is possible by means of using multimedia presentations in which electronic versions of paper textbooks, manuals, normative documents could be replaced by providing hyperlinks to them.

The consideration of methodological approaches to teaching a particular programme issue to primary school pupils should be accompanied by a large number of structural schemes and records of solutions of certain tasks during the lecture. Moreover, colour separations are desirable, which require a lot of time for the teacher to prepare. A multimedia presentation will allow to accelerate the lecture rate significantly, in which records can be similarly deployed with animation, which makes it possible to demonstrate to students only those fragments of the solution which they have already understood. In this way, students' cognitive activity is stimulated by facilitating the perception, analysis, and awareness of the information through the colour highlighting, movements, and other visual effects.

In addition, multimedia presentations can also include audio and video files such as videos of maths lessons, illustrating the methodical reception or implementation of a particular learning technology, etc. Such wide opportunities make the multimedia presentation a universal means of teaching methodology of teaching mathematics.

That is why all the interviewed lecturers expressed the need to use multimedia presentations of lectures on methodology in teaching mathematics. However, despite the teachers' awareness of the necessity and appropriateness of using information technologies in the process of teaching mathematics, only 20% of respondents confirm that presentations are always used during lectures. In our opinion, this is due primarily to the fact that not all teachers understand completely the possibilities of using information technologies during classroom work for students' acquisition of the material, and most importantly – many of them lack skills and experience in creating such presentations.

Multimedia Presentation of the Lecture on the Methodology of Teaching Mathematics

The Lecture on the Methodology of Teaching Mathematics

To stimulate cognitive activity of students, we use a problem lecture on the methodology of teaching mathematics at primary school. The problem lecture is based on the principle of personal learning, aimed at developing the creative possibilities of students. The teacher of methodology of mathematics teaching should acquaint students with the available methodological techniques, formed as the result of the functioning of various educational systems and the variability of educational and methodological complexes, in particular, from the initial course of mathematics, to perform their comparative analysis, to outline the problem “What methodological approach is most effective for forming a certain notion, skill,

or ability of primary school pupils?” At the same time, the lecturer must provide the students with the opportunity to choose their personal positions, encouraging them to give their own judgments.

In our study, we follow the plan of the problem lecture on the methodology of teaching mathematics developed by Svetlana Skvortsova and Yana Haievets (2013). This plan covers the following stages: motivation of students’ educational activity; creating a problem situation, outline of the problem; analysis of the given problem, which consists in studying various methodological approaches; forming proposals, expressing a hypothesis. After mastering the content of the lecture by the student, comparing the outlined methodological approaches, drawing up their comparative characteristics, the student must make his or her own decision in choosing the most expedient and effective approach.

It should be mentioned that even despite the problem nature of the lecture on the methodology of teaching mathematics, a number of didactic problems are taken from real situations since they appear in the practice of conducting lectures in higher professional education. This problem is associated with using mainly one channel of perception (“hearing”), with the significant amount of information offered to students in conjunction with the insufficient level of its structuring, with a static form of presentation of information, which complicates the flexible adaptation to changes in the content of education, with a large number of listeners at the lecture and the conservative form of lecture classes, etc. One of the most effective means of correcting the abovementioned disadvantages of the traditional lecture is creating multimedia presentations of lectures on the methodology of teaching mathematics.

Valery Viun, Iryna Huz, Mykola Shyshlakov, and Alexiy Demydenko (2012) found that using predominantly a single channel of perception by a teacher does not ensure the adequate comprehension of the educational material – the main amount of information should be understood by the student “by hearing” (which provides another complexity – inaccurate and fuzzy drawing up of notes). This problem can be solved by means of a multimedia presentation of the lecture, which creates opportunities for simultaneous audio and visual perception of students of educational information, due to the presentation of educational content on its slide. The presentation itself is only an auxiliary means, and the lecturer is free in his or her comments. Also, during the multimedia presentation of lectures, students need to make notes before the lecture disappears, as all the teaching material is reflected in the presentation. We also emphasise that the multimedia presentation of the lecture creates the opportunity for students to repeat the lectures aloud after the teacher, to comment on samples of the lecturer’s instruction in the process of solving tasks with dynamically deployed solutions using animation effects, and thus to try their own strengths, to master certain speech constructions, to accompany the methodological activity of the teacher, to correct all possible inaccuracies, and to obtain the minimal experience of methodical activity, etc.

The form of presentation of information is usually static and cannot adapt flexibly to the changes in the content of traditional lecture (Viun, Huz, Shyshlakov, & Demydenko, 2012). In this context, the possibility to use, during the lecture, the presentation on methodology of teaching mathematics in electronic versions of updated normative support of primary education, hyperlinks to Internet resources, including on the MES website of Ukraine, should be emphasised.

A modern high school lecturer, as a rule, works with numerous student batches – this kind of load also affects the quality of learning (Viun, Huz, Shyshlakov, & Demydenko, 2012). The multimedia presentation creates conditions for reducing the teacher's workload: the presentation is a means for presenting the content of the lecture on the methodology of teaching mathematics, reflecting its main content, and thus the lecturer has only to comment on the slides of the presentation, without putting any effort to write on the board, and therefore is not distracted by necessary notes and keeps the entire student audience in sight.

We also note that in order to implement a differentiated approach to students, it is possible to use video lectures or multimedia presentations of lectures with a sound commentary to each slide. Under these conditions, students are able to master the content of the lecture at their own pace, returning, if it is necessary, to certain content elements.

The conservative form of lecture classes does not contribute to the active work of students and formation of a subjective position regarding the didactic process (Viun, Huz, Shyshlakov, & Demydenko, 2012). The problem character of the lecture on methodology of teaching mathematics, as well as presenting educational content on the presentation slides of the lecture and animation effects (colour separations, movements, etc.), facilitates the students' process of perception, comprehension, and memorisation of educational information, and therefore it promotes the activation of educational and cognitive activities of students during the lecture.

Multimedia Presentation of the Lecture

A presentation as an electronic document is a set of slides (each of which can contain text blocks, graphic elements, and design elements) and special effects that accompany the display on the screen.

There are numerous software tools for creating multimedia presentations (ProShow Producer, MS PowerPoint, OpenOffice Impress, Kingsoft Presentation Free, Corel Show, SmartDraw, etc.); each of them has its own advantages and features (Smyrnova-Trybulska et al., 2015). MS PowerPoint is reasonably considered to be one of the most popular and most used tools. An important argument in favour of MS PowerPoint is the availability of the programme, and lecturers', students', and primary school teachers' elementary skills to work with it (MS PowerPoint is a part of the standard Microsoft Office suite that is used by most government agencies in Ukraine, and it is the subject of study of the school

computer science course). MS PowerPoint was identified as one of the most effective presentation tools in a comprehensive analysis of 20 programmes for creating presentations according to 26 criteria in the study of Eugenia Smyrnova-Trybulska and other researchers (2016).

It should be noted that – according to the survey data dealing with teaching methods and technologies, conducted at Lethbridge College, Alberta, CA in 2012 – MS PowerPoint was selected by 83% of teachers as the programme used in the educational process. The uptake of this programme in the educational process is in part different in Ukraine. Thus, the analysis of the results of the questionnaire of teachers of methodology of teaching mathematics, conducted by us within the framework of the ascertaining experiment, has shown that 100% of teachers use MS PowerPoint to create and view presentations. However, although all interviewed teachers (100%) agree about the necessity to use presentations during the lectures on the methodology of teaching mathematics, most of them do not do this regularly – only 20% of respondents confirm that presentations are always used during their lectures. The majority of lecturers use presentations of lectures, and their presentations contain the title slide with the theme (100%), lecture plan (100%), problem issues (70%), the reference list (85%), the main content of the topic in the form of abstracts (65%) or in full (5%), and reflection (50%). Lecturers often add to their lecture presentations videos of mathematics lessons at primary school (65%), fragments from the current textbooks on mathematics (60%), fragments of normative documents (55%), and examples of ready-made tasks (55%). A significantly smaller number of teachers of the methodology of teaching mathematics use visual means of presentation (40%) or visual means with work simulation with the help of animation effects, with a dynamic demonstration (25%); examples of the teacher's work on individual tasks with a clear fixing of the steps of the teacher (40%) or examples of solving tasks that dynamically unfold in animation (15%); real pupils' photos at mathematics lessons (30%).

In our opinion, this is not an entirely optimal use of the possibilities of presentations during lectures, primarily due to the fact that most of the teachers do not have enough knowledge about Microsoft PowerPoint to create them. So, only 30% of teachers are completely competent in using the programme. The rest use only the basics of MS PowerPoint: use templates (65%); write the text on slides (75%); add tables, graphs, charts (65%); adjust the animation of the transition between slides (50%); adjust the animation of the text (45%); add and format images (45%); add hyperlinks and control elements (45%); use "SmartArt" objects (40%); add video and sound (35%); and apply animation effects in writing mathematical equation (35%). Most teachers cannot customise their animation on presentation slides, but they think that animation effects, illustrating actions with visualisation or the process of solving tasks, increase the rate of lectures significantly, visualise their content, and facilitate better understanding of the educational information by students. In addition, it is concluded that those

teachers who already use presentations at lectures on the methodology of teaching mathematics mostly created them on their own and submitted the main theses of the lecture on the presentation slides, but did not use the means of structuring the theoretical material (tables, flowcharts, “SmartArt” objects, etc.), although 90% of teachers agreed that the structuring of educational materials in a schematic form facilitates students’ perception and comprehension of the educational information significantly.

Thus, taking into account the lecturers’ objective need in existing presentation material for lectures, found during the pedagogical experiment, using as an editor which has the best features of MS PowerPoint programme, and with regards to the didactic features of the course, a multimedia presentation of lectures on the educational course “Methodology of teaching mathematics” was developed.

We understand “Multimedia presentation of the lecture on the course ‘Methodology of teaching mathematics’” as a presentation in which the educational content is presented in a structured form; methodological approaches are illustrated with colour and animation effects; the methodology of work on certain mathematical problems is given by means of dynamic deployment of the solution; the natural visualisation is replaced by the electronic one, and the methodology of working with it is demonstrated with animation effects; hyperlinks to electronic versions of normative documents and textbooks on mathematics for primary school, and to video fragments of real mathematics lessons at primary school, illustrating an appropriate element of the educational content (structure of a lesson, teaching technology, etc.) are given, as well as video fragments with students’ reflections, demonstrating the ways of calculating, work on tasks, etc.

Unlike a regular lecture presentation, which is usually based on linear logic, the multimedia presentation is organised according to the logic of a problematic presentation – it requires a special presentation structure and the presence of hyperlinks (Meixner, 2017).

Developing the structure of the multimedia presentation, we used the problem lecture scheme on the methodology of teaching mathematics of Skvortsova and Haievets (2013), which contains the following compulsory elements: motivation of students’ educational activity; creating a problem situation, formulating the problem; analysis of the problem, consisting in the analysis of various methodological approaches; outline of suggestions, hypothesis offering.

Consequently, the multimedia presentation of the lecture on the topic of methodology of teaching mathematics contains separate slides, which include: the topic of the lecture (Figure 1); problem issues that motivate educational and cognitive activity of students at the lecture (Figure 2); reference (Figure 3); the plan of the lecture (Figure 4); presentation of the main content, in accordance with the points of the plan (Figure 5); the slide directing students’ activity to the reflection of their own educational activities during the lecture (Figure 6).

Methodology of forming calculating skills to subtract and add within 100 without transition through the class

Context of the lecture:
 Doctor of pedagogical sciences S.Skvortsova
 Technical support:
 Candidate of pedagogical sciences M.Haran

Figure 1. The topic of the lecture.

Source: Own work.

Literature

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 Methodology of teaching mathematics at primary school: study guide. – K. A.C.K., 1988. – 352 p. – P.141 - 164.

Figure 3. Reference.

Source: Own work.

Adding and subtracting numbers within 100 without passing through the discharge. The dynamics of presentation of cases of calculation

- Adding a one-digit number to a two-digit (45 + 2).
- Subtracting a one-digit number from a two-digit (45 - 2).
- Adding a digit number to a two-digit (45 + 20).
- Subtracting a digit number from a two-digit (45 - 20).
- Successive addition and subtraction of two-digit numbers (45 + 22 45 - 22).
- Adding and subtracting by parts.

Figure 5. Presentation of the main content, in accordance with the points of the plan.

Source: Own work.

Problem questions

- Why do primary school teachers need to know the teaching technique of adding and subtracting numbers from the first hundred?
- What are the goals and objectives of the topic? How are they implemented?
- Why is it important, first of all, to study narrative documents? What documents determine the content of this topic?
- What is the main means of teaching the topic?
- How is the content of the program implemented in the textbooks of the author's collectives, which are valid at the current stage of development of the primary school?
- What is the peculiarity of the process of forming computational skills within 100?
- What textbook most implements the content of the program?

Figure 2. Problem issues.

Source: Own work.

Plan

1. • Contents and results of studying the theme by new program.
2. • Visual aids and didactic material.
3. • The order of studying the theme under the current textbooks.
4. • Methodology of studying specific issues of the theme:
 - • Add (subtract) a one-digit number to (from) a two-digit.
 - • Add (subtract) a digit number to (from) a two-digit.
 - • Successive addition and subtraction of two-digit numbers.
 - • Adding and subtracting two-digit numbers by parts.
5. • Implementation of the contents of the new curriculum in the current textbooks.

Figure 4. The plan of the lecture.

Source: Own work.

Reflection

- What have you got to know at the lecture today?
- What information was the most interesting?
- What else would you like to know more?
- What have you understood very well?
- What more should be worked on?
- Are you satisfied with your work at the lecture?

Figure 6. Reflection.

Source: Own work.

The Requirements for Multimedia Presentations of Lectures

Multimedia presentations must meet certain requirements regarding the structure and content of presentation slides, use of fonts and colours, and so on.

The analysis of recent researches has shown that domestic (B. Herasymchuk, N. Morze, N. Dementievska, A. Mokrohuz, S. Ryzhenko, O. Skafa, O. Tutova, Yu. Tkach) and foreign (A. Luzghina, H. Tokarieva, V. Ryzhov) scholars are developing recommendations for the creation of educational multimedia presentations, including presentation of lectures. Existing requirements and recommendations, representing both own experience of the scientists from their developments and the generalised results of individual researches, are mostly general. In this regard, they are not final criteria for creating an effective presentation, since it is not possible to unify a priori recommendations for presentations, related to different branches of knowledge, having different goals, different contingents, etc.

On the basis of the generalisation of the research results (V. Andriievska, N. Olefirenko, N. Morse, N. Dementievska, O. Skafa, A. Tutova, etc.), during the creation of the presentations of lectures on the methodology of teaching mathematics, we have taken into account the general requirements: for the content of the multimedia presentation; for the visual and sound series; for the text; for the design; and for the quality of navigation.

Acquisition of knowledge on any discipline begins with perception, which, as it is known, is affected by the action force of the goad on the senses; thus, it depends on the physical qualities of the object of perception (brightness, dynamism, etc.) and on the physical conditions in which it is perceived (remoteness, visualisation, contrast with the background, etc.). Therefore, the form of representation of educational information and its visual design affect the quality of perception, comprehension, and memorisation of material, and can optimise the understanding of the lecture content.

It is advisable to take into account the peculiarities of the process of perception of information and the means of facilitating the process of perceiving educational information that requires its special design in the process of creating a multimedia presentation (Lin, Leh, Kim, & Baylen, 2018), namely: the combination of the principle of contrast (contrast, according to psychologists, is the main means of enhancing perception) in the colour of the background and colour of the text on the slides of the presentation; using bright font colour (chromatic colours: red, orange, yellow, green, blue, dark blue, violet, purple should be used to transfer emotionally-evaluative components of information; achromatic colours: white, black and all shades of grey – for information, containing mostly cognitive components).

We consider it necessary to take into account another feature of the participants in the process of perception – gender. Scientists understand the differentiation of development by sex. Nina Yerofieieva, Jean Piaget, Igor Kon, Antonina Khrypko, and others prove the existence of physiological, intellectual, moral, emotional, and behavioural differences between men and women, which should be emphasised

during the construction of the educational process. Thus, the physiological features of visual perception are conditioned by the genetic programme of development that motivates the specificity of the duration of mental processes of males and females. For example, women (the students of the direction of training “Primary education” are mostly people of female sex) perceive colours much brighter than men. This confirms that using a wide range of colours in the development of presentations will make it possible to substantiate the content of the training material. In addition, differences in the structure of the brain of men and women prove that women are more emotional and have imaginative thinking more developed than men, so teaching women should be more emotional. One of the ways to create emotional background can be by using bright images, coloured objects, etc. It is possible to cause positive emotions and therefore provide students’ motivation to study methodology of teaching mathematics by using photographs of real mathematics lessons at primary school, which demonstrate brightly the emotions and interest of children in learning mathematics in slide presentations (Figure 7). The particular attention should be paid to including video fragments of real mathematics lessons that relate to the topic of the lecture in the presentations (Figure 8).



Figure 7. Fragment of the lecture on the topic “Methodology of teaching numeration of the first hundred numbers.”

Source: Own work.



Figure 8. Fragment of the lecture on the topic “Modern Mathematics Lesson at Primary School.”

Source: Own work.

Such intersections create the atmosphere of significance and practicality of the acquired knowledge, which is an impetus for more productive and conscious activity of students and contributes to the formation of the values-based attitude to the received information.

Psychologists state that the brightness and emotional colouring of objects affect spontaneous memorisation – one of the main processes of memory. As it is known, cognitive activity begins with sensations and perception, but all the necessary information is kept in memory. It has been proved in psychology that involuntary

memorisation is possible even when a phenomenon or an object appears in contrast to the general background, confirming the necessity to choose the colour gamut for the background of the slides and objects, placed on it very carefully.

Yuliia Tkach emphasises that choosing the colour of the presentation background should also take into account the fact that information will be perceived from the screen (TV, interactive whiteboard, projection screen, etc.) during the presentation at the lecture. In the case of a large screen size, it is not recommended to use chromatic colours as background. Typically, lectures on the methodology of teaching mathematics are conducted for the whole students' batch in a large lecture classroom, where there is a large screen. Considering this, it is advisable to choose achromatic colours as a background, namely the black colour for the slide title and the white colour for its working section. The main colour of the font is black, and other colours should be used to highlight the definitions and key concepts, and with a methodical aim (as the illustration of the process of solving tasks, etc., Figure 9).

Writing text information on presentation slides, in addition to the colour of the font, as well as its type, size, etc., it is necessary to follow certain rules, concerning the form of its image, the volume of text blocks, and syntactic features, as work with texts is especially difficult for human eyes.

For example, it is not desirable to use more than two types of fonts on one presentation slide. The Times New Roman and Arial fonts are considered to be the most acceptable, while the use of art fonts can lead to the negative students' reaction due to difficulties in reading, resulting in the weakening of attention and perception (Luzghina & Tokarieva, 2007). Choosing the font size, we should be focused on the audience size, screen size, age audience features, etc. We consider it appropriate to use for titles such properties as: 36 ctrl for the title slides, 24 for the main text (Figure 10) in the process of creating lecture presentations on the course of the methodology of teaching mathematics.

It is well-known that a solid text, even in the case of voice-over, cannot hold the attention of a listener-viewer for a long time. Instead, attention, or focus on the subject of the study, gives the student the opportunity to use power of thinking and memory to master educational content and ways of action, to ensure successful educational activity. It also should be mentioned that attention is a "weak point" in students' activity. According to the analysis of age characteristics of students, in the age period of 19–21 (the academic subject "Methodology of teaching mathematics" is mainly studied in 2–3 years, the average age of students who master it is 19–21), the cognitive sphere is characterised by a relatively high level of thinking and memory development, while the level of attention development is not high enough then. As noted above, there is a need to stimulate attention when presenting theoretical data, in particular through the structuring and selection of information.

Multiplication and division round numbers to single digits number

- The method is based on the rule of multiplying or dividing the product by the number:
 $50000 \cdot 5 = 5 \cdot 10000 \cdot 5 = 25 \cdot 10000 = 250000$
 $50000 : 5 = 5 \cdot 10000 : 5 = 1 \cdot 10000 = 10000$
 $3600 \cdot 3 = 36 \cdot 100 \cdot 3 = 108 \cdot 100 = 10800$
 $3600 : 3 = 36 \cdot 100 : 3 = 12 \cdot 100 = 1200$

Figure 9. Fragment of the lecture on the topic “Methodology of teaching numeration of the multiplate numbers.”

Source: Own work.

Visual aids and didactic material

- Set of geometric shapes of different colors and sizes:
 - triangles;
 - quadrangles (including squares);
 - circles;
 - pentagons;
 - cubes.



In the demonstration and distributing versions.



Figure 10. Fragment of the lecture on the topic “Methodology of actualization of first-grade pupils’ knowledge at the beginning of the school year.”

Source: Own work.

Some scholars (Luzghina, Tokarieva) consider the principle of multilevel font-colour marking as the most appropriate way of highlighting the text, which makes the content of the slide conventional. Thus, during the lecture the audience is taught to respond to a certain colour and font as markers of typological series, for example, a certain colour means the definition of concepts, another colour means the keywords of the text, etc. (Luzghina & Tokarieva, 2007). According to the content of “Methodology of teaching mathematics,” which to a lesser extent involves consideration of definitions of concepts but mainly presents significant features of methodological approaches, we consider it appropriate to use, apart from highlighting of information in colour and font, its presentation with the help of “SmartArt” graphic elements. Thus the same type of information (for example, the theoretical basis of the calculation methods) can be depicted in the form of the same “SmartArt” objects, which will help not only to submit the material in the structured form, but also to provide “recognition” by students of known structural elements (Figure 11). In addition, this way of presenting information will make it easier for them to perceive and memorise. It is known that familiar information is easier for memorising. In addition, psychologists note that the memory and reproduction of verbal material can be more successful if it is mediated, that is, basic points are created for that: the image of objects, charts, tables, means of visualisation.

Figure 11. Fragment of the lecture on the topic “Methodology of teaching numeration of the multiplate numbers.”

Source: Own work.

It should be noted that the perception of visual images facilitates the use, within the whole presentation, of the same component compositions and general style of the presentation, which in its turn it does not require additional psychological efforts during transiting from one slide to another (Mokrohuz, 2012). In addition, compliance with the requirements for organising information inside a single slide significantly increases the effectiveness of the presentation as a whole. For example, a presentation slide should not contain more than 9 different elements (text fragments, graphic objects, etc.), as it is well-known that a person is able to hold in a short-term memory 5–9 logically unrelated objects. The spatial organisation of the slide elements is projected on the basis of the analysis of the perspective trajectory. Information objects should be placed on the slide in a such a way that minimises visual paths along the screen (the placement of the information, perceived consistently, should not cause a transference of the view more than 20°) (Mokrohuz, 2012). Returning to gender specifics, we note that the structure of the visual analyser helps women to reach the sight of the sector at 45° from all sides, unlike men, who are characterised by tunnel vision.

Scientists (Ryzhov, Kornienko, & Demidovich, 2002) describe the following principles of creating a composite solution for the presentation of visual information which should be taken into account, in particular when creating presentations of lectures on the academic subject “Methodology of teaching mathematics”: conciseness (the slide contains only the necessary elements for informing the student about the essential information, the form of information presentation corresponds to the level of awareness of students); generalisation and unification (the main forms of graphical representation of the information on the slide are enlarged, the non-essential details of objects are eliminated, their form is rationally generalised; within the whole complex of presentations, the elements that designate the same objects are unified); the emphasis is on the main semantic elements

(changing their size, form, colour is expedient and methodically motivated); autonomy (parts of the presentation showing relatively autonomous messages are clearly separated from the other parts); structuring (each part of the presentation having a central position has a distinct structure that is easily memorised and differentiated from others); and sequence (depending on the presentation stages, certain information is presented sequentially inside the slide).

The images of perceived things and objects are the result of perception, and using various visual material contributes to creating images. As mentioned above, it is the multimedia presentation that helps clarify the content of the lecture on the academic subject “Methodology of teaching mathematics” due to using dynamic visualisation, etc. (Figures 12, 13).

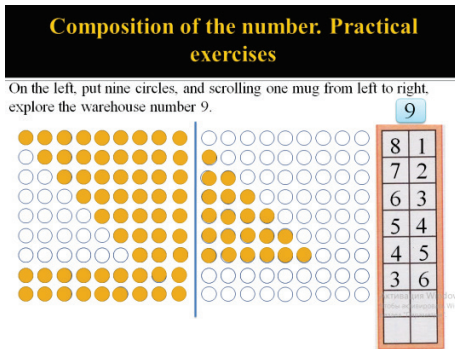


Figure 12. Fragment of the lecture on the topic “Methodology of teaching numeration of the numbers of the first dozen.”

Source: Own work.

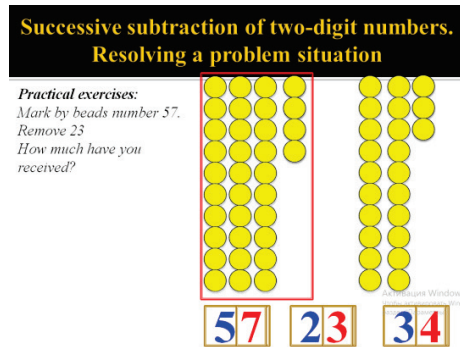


Figure 13. Fragment of the lecture on the theme “Methodology of forming calculating skills to subtract and add within 100 without transition through the class.”

Source: Own work.

Perception is closely connected with the comprehension of educational information, which results in understanding the studied information and forming concepts. Psychologists state that at the stage of comprehension of the educational information it is necessary to induce students to isolate the essential elements in it, to find out the causal relationships, to compare the analysed phenomena, facts, and events.

In our opinion, successful comprehension of the educational information in “Methodology of teaching mathematics” presented in the format of a multimedia presentation will facilitate the presentation of information in the structured form with the help of tables, diagrams, charts, etc. (Figure 14), as well as using animation effects, for example, during the transfer of a known method of action to a new situation (Figure 15).

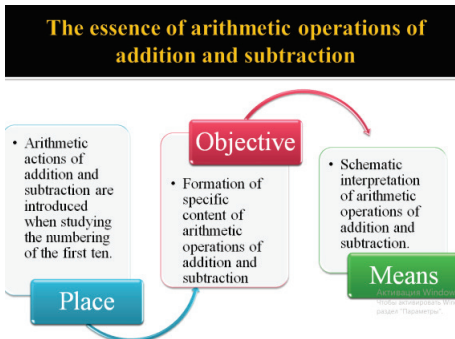


Figure 14. Fragment of the lecture on the topic “Methodology of forming calculating skills to add and subtract within 10.”

Source: Own work.

It should be noted that the MS PowerPoint programme allows us to apply animation effects both to objects, placed on the slide, and to the slides themselves during transition to the next slide. Such effects, on the one hand, can contribute to the aggravation of perception, but, on the other hand, they can serve as a serious obstacle for perception. Using animation should be didactically reasonable and substantiated. In this case, the effects of the transition between the slides are unjustified because they do not carry meaningful load, but are only the factors that can distract students’ attention. Instead, the ability to customise the animation of slide elements is perhaps the most important advantage of using presentations in general. Applying the effects of appearance, selection, disappearance, movement of objects helps reveal the methodological aspects of the lecture. In addition, using animation effects in textual information facilitates the implementation of two-way communication and attention activation due to the gradual appearance of text fragments, in the process when a lecturer or the students themselves comment on the material. Using animation makes it possible to submit the teaching material dosed, which optimises the perception process and at the same time structures information (Figure 16).

Sometimes, for the concentration of large volumes of illustrative material, scientists recommend using the technique of “scrolling” (“paging”) of illustrations. “Paging” simulates reading the book and helps trace the deployment of the plot, the order of presentation of the material, etc. This technique was used during the inclusion of fragments of mathematics textbooks for primary school in order to analyse the order of studying the topic and comparing the methodological approaches (Figure 17).

COMPARE:

The first inverse problem

	Price (UAH)	Quantity (pcs.)	Cost (UAH)
I	?	9 pcs.	63 UAH
II	?	?	49 UAH

Solution:

- $63 : 9 = 7$ (UAH) - the price of 1 pencil, **the same value**;
- $49 : 7 = 7$ pcs. - the number of pens that can be bought for 49 UAH.

Third inverse problem

	Price (UAH)	Quantity (pcs.)	Cost (UAH)
I	?	?	63 UAH
II	?	7 pcs.	49 UAH

Solution:

- $49 : 7 = 7$ (UAH) - the price of 1 pencil, **the same value**;
- $63 : 7 = 9$ pcs. - the number of pens that can be bought at 63 UAH.

Figure 15. Fragment of the lecture on the topic “Methodology of forming skills to solve tasks in finding the fourth proportional.”

Source: Own work.

of teaching mathematics” and from the analysis of age-related physiological and psychological characteristics of the students of the direction of training “Primary education.”

According to the general requirements for the content of the multimedia presentation, presentations of lectures on methodology of teaching mathematics should not contain large text arrays, but the theoretical information should be structured and presented in the form of charts, tables, diagrams, etc.

Requirements for the visual and sound series of multimedia presentations of lectures on methodology of teaching mathematics include using vivid colour objects, photographs, and video fragments of real mathematics lessons.

Among the requirements regarding the text given on the presentation slides of the lectures on the topic “Methodology of teaching mathematics,” using the following should be mentioned: the font Times New Roman, size 36 for the headings, 24 for the main text, the dominant colour of the text is black (using other colours for the main text is allowed if it is necessary to highlight the keywords), the colour of the title text is yellow.

Requirements for the design of the presentation of lectures on methodology of teaching mathematics include: a single style of designing and same components compositions; image of the same information in the form of identical “SmartArt” elements; using black for the slide background in the header part, white for the slider working space; methodically motivated representation of the animation of slide objects, the absence of transition effects between slides.

Requirements to navigating presentations of lectures on the academic topic “Methodology of teaching mathematics” are connected with expedient and rational hyperlinks, both on separate elements of the presentation and on other objects (normative documents, textbooks, video fragments, etc.) (Skvortsova & Haran, 2016).

Compliance with all abovementioned requirements made it possible to create high-quality multimedia presentations of lectures on methodology of teaching mathematics, capable to increase the efficiency of the educational process in view of the following facts: increasing the informativity of the lecture; stimulating learning motivation; improving visualisation of learning; intensifying students’ attention through the use of animation and colour effects; accessibility in perception of information due to the parallel representation of information in various modules (visual and auditory), etc.

Organisation and Results of Experimental Teaching with the Use of Presentations of Lectures

The effectiveness of the introduction of multimedia presentations of lectures on the methodology of teaching mathematics in the educational process was verified in the process of methodical training of future mathematics primary school teachers

during the formative experiment that took place during academic years 2014–2015 and 2015–2016.

In order to choose the control and experimental groups that participated in the forming experiment, in the academic year 2014–2015 an initial test of students' knowledge of the methodology of teaching mathematics was conducted.

Since subject-mathematical and didactic-psychological knowledge and skills form the basis of methodological competency, the initial test consisted of two parts, each of which contained 20 closed-ended questions to choose the correct answer, each evaluated with one score. The first part of the test was aimed at verifying didactic-psychological knowledge of students. The questions presented in this part of the test envisaged the verification of general didactic knowledge (10 questions) and were related to the normative documents of primary education, forms, methods, and teaching methods used in primary schools; verification of psychological and pedagogical knowledge of students (10 questions); and the psychological patterns of education, age, and psychological characteristics of primary school pupils, etc. The second part (20 questions) of the test aimed at testing students' knowledge of the mathematics course. This part included questions on logic, set theory, combinatorics, the theory of divisualisation, solving equations and inequalities, the basis of geometry, etc.

Testing was carried out by 325 students. They were: 84 students of the 3rd year (PNPU named after K. Ushynsky), 70 students of the 2nd year (KSU), 50 students of the 2nd year (MNU named after V. Sukhomlynsky), and 121 students of the 3rd year (UNPU named after P. Tychna).

As a result of processing the students' responses to the test questions, the ratio of the total number of scores received by the students during the performance of the test tasks to the maximum number of points for the test (test run rate) was calculated. The generalised results of the initial test, reflecting the level of didactic-psychological and mathematical preparation of students, are shown in Table 1.

Table 1.

Generalised indicators of the level of didactic-psychological and mathematical training of students before beginning the study of methodology of teaching mathematics

Name of the university	Average score	Coefficient of the test run
PNPU named after K. Ushynsky	26.2	0.66
KSU	26.8	0.67
MNU named after V. Sukhomlynsky	26.4	0.66
UNPU named after P. Tychna	26.0	0.65

Source: Own work.

Almost equal results of the initial test were observed. Taking this into account, the students of MNU named after V. Sukhomlynsky (50 respondents) and the students of UNPU named after P. Tychna (121 respondents) became the control group (CG). The experimental group (EG) includes students of PNPU named after K. Ushynsky (84 respondents) and students of KSU (70 respondents). Thus, the sample was 325 students: 154 in the experimental group and 171 in the control group (Haran, 2016).

In the experimental groups, during the lectures the teachers of the methodology of teaching mathematics used multimedia presentations during the formative stage of the pedagogical experiment in the educational process. Teaching methodology of teaching mathematics in control groups was traditional, without using presentation materials.

The educational subject “Methodology of teaching mathematics” provides the formation of methodological competency of future primary school teachers; therefore, the experiment was aimed at studying the influence of the developed presentations of lectures on the level of forming these personal qualities in them.

In order to determine the level of forming methodical competency of the primary school teacher in teaching mathematics, the technique of Skvortsova and Haievets (2013) was used. In the structure of every component of methodological competency (normative, variational, special-methodical, technological, design-modelling, control-evaluation), the researchers distinguish the motivational-value, cognitive, activity, and reflexive-creative components. Thus, the researchers suggest to characterise the state of formation of all components of the methodological competency of the primary school teacher in teaching mathematics to students through motivational, content, and operational-activity criteria. Effectiveness of multimedia presentations of lectures should be verified by examining the cognitive component of methodological competency precisely according to the content criterion, which characterises the degree of mastery of future teachers of methodological knowledge on teaching mathematics to primary school pupils.

The formation of the cognitive component of the methodological competency of future primary school teachers in the teaching of mathematics to pupils was characterised by the following levels:

- the low level, which is characterised by fragmentary, superficial methodological knowledge that is insufficient for the performance of professional functions;
- the average level, which is characterised by the partial possession of methodological knowledge;
- the sufficient level, which is characterised by the availability of complete, generalised knowledge of the methodology, and the ability to apply it independently in educational, cognitive, and practical-oriented situations; and
- the high level is characterised by a creative approach to teaching mathematics to primary school pupils and the ability to create innovative methodological approaches.

In order to determine the level of formation of methodological competency of future primary school teachers, a control section was conducted according to the content criterion. Students of the control and experimental groups were offered to undergo a test on the methodology of teaching mathematics. The control section consisted of six tests, each of which foresaw determining the level of formation of normative, variational, special-methodical, technological, design-modelling, control, and evaluation components of methodological competency. Each of the tests included tasks of the closed type that contained a selection of one or several correct answers (mostly reproductive and partly productive) and open type (partially productive, productive, and creative levels). Each test contained 2 options for 5 questions.

Summarised results, obtained according to the content criterion, are presented in Table 2. The table shows the number of students of EG and CG and the levels of formation of these criteria. The distribution of students according to the levels of formation of the content criterion in the percentage is clearly represented in the diagram (Figure 18).

Table 2.

Levels of forming of the content criterion of the components of methodical competency of the students of control and experimental groups

Groups	Distribution of the students according to the levels of forming criteria			
	Low	Average	Sufficient	High
EG	19	79	56	0
CG	51	83	37	0

Source: Own work.

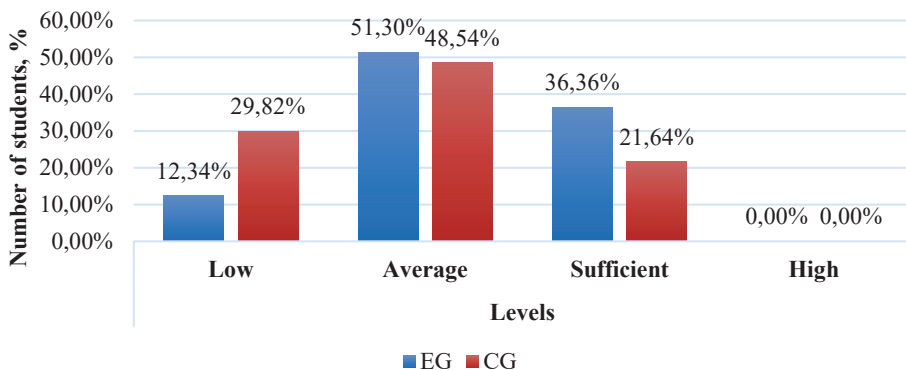


Figure 18. Distribution of students of the experimental and control groups by the levels of the formation of methodological competency.

Source: Own work.

The Pearson criterion is used to substantiate the differences in student distributions statistically. As a result of the calculations, the value of $\chi^2_{\text{exp}} = 17.77$ was obtained, while $\chi^2_{\text{cont}} = 5.99$. Hence, $\chi^2_{\text{exp}} > \chi^2_{\text{cont}}$, it shows that the differences in the distribution of respondents in the control and experimental samples are statistically significant.

Consequently, the analysis of the study leads to the conclusion that the use of multimedia presentations – developed in accordance with the abovementioned requirements of the methodology of teaching mathematics, which became the basis of experimental training – gives significantly higher results than traditional training.

Conclusion

Application of information technologies, in particular multimedia presentations, is one of the ways to increase the efficiency of lectures. Teaching with the use of a presentation stimulates cognitive and creative activity of students, and helps them master the teaching material better.

During a survey of teachers from 18 universities in Ukraine, we stated that there was a need for creating and using presentations in the course of teaching the course “Methodology of teaching mathematics” for future teachers of primary school. The research revealed the need to develop multimedia presentations to lectures in which: the educational content is given in a structured form; methodical approaches are illustrated with the use of colour and animation effects; the method of work on certain mathematical problems is given by means of dynamic deployment of the solution; natural visuality is replaced by the electronic one, and the method of working with it is demonstrated with animation effects; hyperlinks to electronic versions of normative documents and textbooks of mathematics for primary school, to video footage of real mathematics lessons in primary school illustrating an appropriate element of educational content (structure of a lesson, teaching technology, etc.), as well as video footage with students’ reflections demonstrating ways of calculating, work on tasks, etc. are present. We call such a presentation a multimedia presentation of a lecture on the topic “Methodology of teaching mathematics,” which its teacher can use during the entire training session and manage it interactively.

In order to create a multimedia presentation that is an effective means of teaching students, we have analysed the characteristics of the course of cognitive processes of 19–21-year-olds. Based on the specifics of the course “Methodology of teaching mathematics” and based on the characteristics of perception, comprehension, and memorisation of educational information by future students, primary school teachers formulated the requirements concerning content, visual, and sound series,

the preparation of the text presented on the slides of the presentation, design and navigation. Since the very form of presentation of educational information and its visual design affects the quality of perception, comprehension, and memorisation of material, and optimises the absorption of the content of the lecture, presentation slides should not contain large text arrays, while the theoretical information should be structured and presented in the form of circuits, tables, diagrams, etc. Moreover, the presentation should contain bright colour objects, photographs, and video clips of real mathematics lessons. For text slices of presentations, the font, font size of the headings and main text, the dominant header colours and the main text are defined. Design of presentations should include a single style of design and identical compositions of components; images of the same type of information must be presented in the form of identical elements of “SmartArt,” as well as the use of animation should be methodically motivated, and there should be no transition effects between slides.

Compliance with the above requirements makes it possible to create high-quality presentations of lectures, which, in turn, allow to increase the efficiency of the educational process, namely: to increase transmission of information and to improve the presentation of the content of the lecture; to stimulate students’ motivation to study the course; to intensify their cognitive activity; to focus and keep students’ attention; to facilitate their understanding and memorisation of the content through its submission in a structured form using animation and colour effects, and the parallel presentation of information in various modules (visual and auditory), etc.

The results obtained convincingly prove the efficiency of the use of information technologies – in particular in the form of presentations – during the preparation of future primary school teachers for the study of mathematics, compared with the traditional one.

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Svetlana Skvortsova, Maryna Haran

Multimedialna prezentacja wykładu jako środek postrzegania, rozumienia oraz zapamiętywania informacji edukacyjnej przez uczniów

Streszczenie

Istniejący na ukraińskich uniwersytetach wymóg tworzenia prezentacji multimedialnych wykładów oraz ich użycia w procesie nauczania kursu „Metodologia nauczania matematyki” został sformułowany na podstawie wyników badań eksperymentalnych. W oparciu o cechy szczególne dyscypliny i specyficzne prawa rządzące postrzeganiem, zrozumieniem oraz zapamiętywaniem informacji edukacyjnej przez uczniów, zostały określone wymagania dotyczące wizualnej i dźwiękowej zawartości, a także tekstu zamieszczonego na slajdach prezentacji oraz projektu i sposobu poruszania się po prezentacji. Efektywność zastosowania tych praw została dowiedziona eksperymentalnie. Ustalono, że aby ułatwić postrzeganie informacji przez studentów, slajdy prezentacji nie powinny zawierać dużego obszaru tekstu, tekst powinien być napisany odpowiednią czcionką, odpowiedniej wielkości, nagłówki oraz tekst główny powinny być w kolorach podstawowych. Aby ułatwić zrozumienie i zapamiętywanie tekstu, prezentowanej informacji teoretycznej powinno nadać się strukturę schematów kołowych, tabel, diagramów, itd.. Aby pobudzić zainteresowanie uczeniem się, należy wywołać pozytywne emocje poprzez wykorzystanie rysunków obiektów wykonanych w jasnych kolorach, fotografii oraz filmów wspierających lekcje matematyki. Podkreślono, że w celu stworzenia sprzyjających warunków do postrzegania, zrozumienia i zapamiętywania informacji, projekt prezentacji powinien wykorzystywać jeden styl oraz identyczne kompozycje elementów, na przykład przedstawienie tego samego typu informacji za pomocą identycznych elementów schematów „SmartArt”.

Słowa kluczowe: szkolenie nauczycieli, metodologia nauczania matematyki, wykład, prezentacja multimedialna

Svetlana Skvortsova, Maryna Haran

Мультимедийная презентация к лекции как средство восприятия, понимания и запоминания учебной информации студентами

Аннотация

В результате проведенного эксперимента была выявлена необходимость создания мультимедийных презентаций к лекциям и их использования в процессе преподавания курса «Методика преподавания математики» педагогами украинских вузов. Экспериментально доказана эффективность таких презентаций. Эффективность основана на специфике дисциплины, особенностях восприятия, понимания и запоминания учебной информации учащимися, требования к содержанию, к визуальным и звуковым материалам, к тексту, представленному на слайдах презентации, к дизайну и навигации. В частности, для облегчения восприятия учащимися образовательной информации было установлено, что слайды презентации не должны содержать больших текстовых массивов; текстовые фрагменты презентаций должны быть выполнены с использованием определенного шрифта, доминирующими цветами заголовков и основного текста. Для облегчения понимания и запоминания содержания обучения теоретическая информация в них должна быть структурирована и представлена в виде схем, таблиц, диаграмм и т. д. Чтобы стимулировать интерес к обучению, создавать позитивный эмоциональный фон, презентация должна содержать яркие цветные объекты, фотографии, видеоматериалы реальных уроков математики. Подчеркивается, что для создания условий восприятия, понимания и запоминания образовательной информации, дизайн презентации должен предусматривать единый стиль оформления и идентичные композиции компонентов; изображение однотипной информации - в виде схожих элементов «SmartArt».

Ключевые слова: подготовка учителей, методика преподавания математики, лекции, мультимедийная презентация

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La presentación multimedia de una lección magistral como medio de percepción, comprensión y memorización de la información educativa por estudiantes

Resumen

La demanda de los profesores de las universidades ucranianas de crear presentaciones multimedia de sus lecciones magistrales y usarlas en el proceso de impartir el curso “Metodología de la enseñanza de las matemáticas” es el resultado de la presente investigación. Desde las especificidades de la disciplina y teniendo en cuenta las peculiaridades de la percepción, comprensión y memorización de la información educativa por parte de los estudiantes, se determinan y se contrastan experimentalmente los requisitos de contenido, las series visuales y sonoras, el texto presentado en las diapositivas

de presentación, el diseño y la navegación. En particular, para facilitar la percepción de los estudiantes de la información educativa, se ha establecido que las diapositivas de una presentación no deben contener matrices de texto grandes; los segmentos de texto de las presentaciones deben ejecutarse utilizando una fuente determinada, con un tamaño de fuente y colores dominantes de los encabezados y el texto principal; Para facilitar la comprensión y la memorización del contenido de la enseñanza, la información teórica en ellos debe estructurarse y presentarse en forma de circuitos, tablas, diagramas, etc. Para estimular el interés en el aprendizaje, la creación de un fondo emocional positivo para la presentación de la presentación debe contener objetos de colores brillantes, fotografías, secuencias de video de lecciones de matemáticas reales. A fin de crear las condiciones para la percepción, comprensión y memorización de la información educativa, se enfatiza que el diseño de la presentación debe proporcionar un estilo único de diseño y composiciones idénticas de los componentes; Imagen del mismo tipo de información, en forma de elementos idénticos de "SmartArt".

Palabras clave: formación docente, metodología de la enseñanza de las matemáticas, clases, presentación multimedia