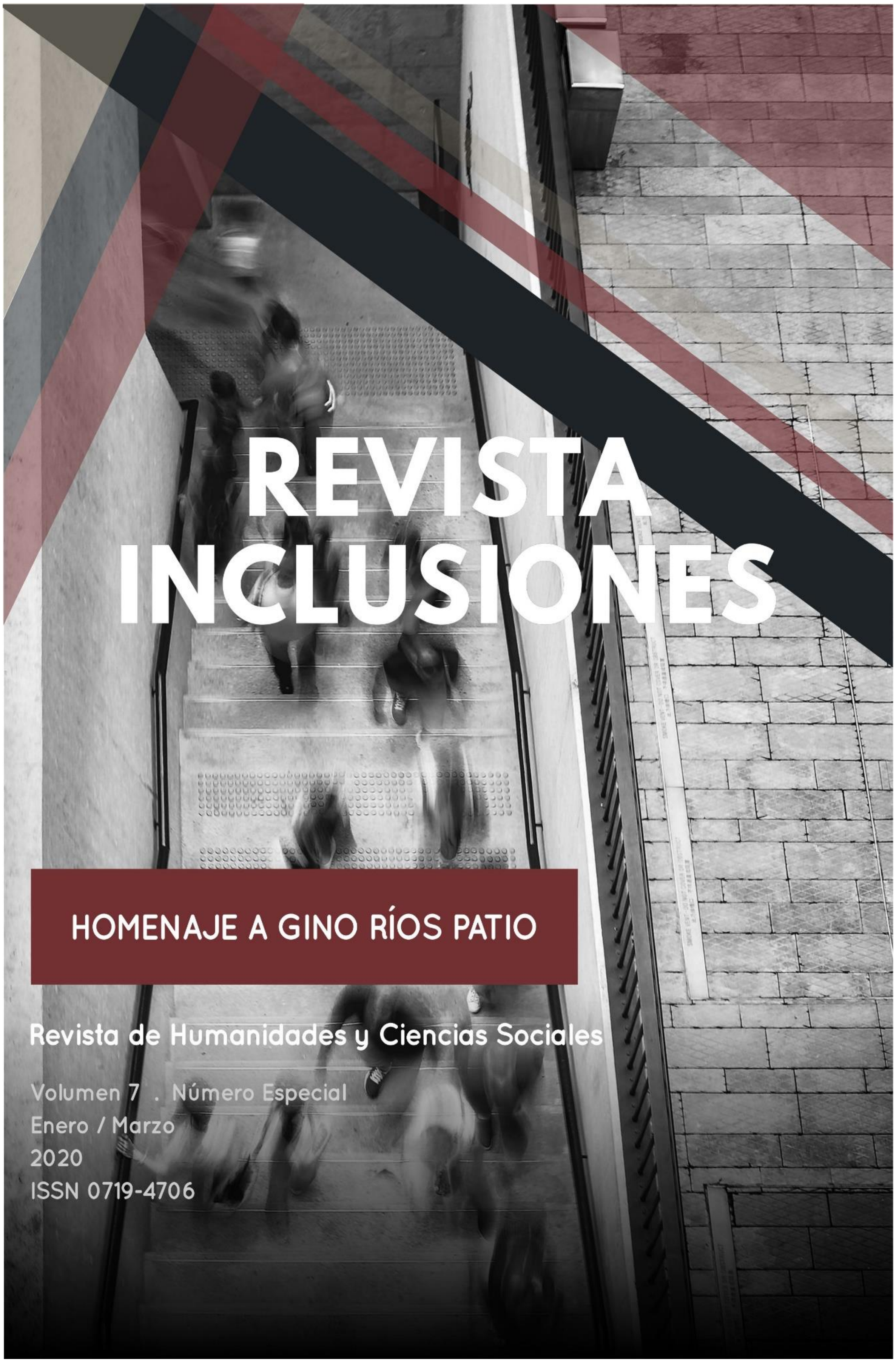
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PROBLEMS OF PROFESSIONAL EDUCATION IN RUSSIA: QUALITY MONITORING OF EDUCATIONAL PROGRAMS

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Abstract

The introduction of complex management systems in educational organizations is very expensive, often without taking into account the specifics of the organization and causing the need to install and adapt additional software and hardware. Such utilities, as a rule, are cheaper and consider the possibility of step-by-step input of separate subsystems and their modification, providing means for considering the available experience of creation and operation of separate subsystems. All this is aimed at supporting the educational process but does not take into account the assessment of the preparation quality for the implementation of the educational process itself. The main element of such preparation is the formation of educational programs.

Keywords

Educational process – Educational program – Work program – Professional standard

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Introduction

Currently, the majority of educational institutions in Russia are the result of the merger of several educational institutions engaged in the training of specialists in different areas[1]. Moreover, the number of educational organizations is reduced due to the revocation of their state licenses for educational activities. Thus, the load on the remaining organizations is significantly increased due to the expansion of preparation areas, as well as an increase in the load on the teaching departments and teaching staff. The organization of activities and quality management requires the control of many different indicators: the content of academic complexes of educational disciplines, the content of scientific work, student performance indicators, the implementation of the plan of the teaching staff, etc. All this requires an integrated approach to maintain an up-to-date, competitive state, requiring not only the systematization of the information obtained but also operational management to qualitatively increase those indicators that do not meet the current standards of the educational organization and the education system as a whole[2].

All this leads to the introduction of automated systems in educational organizations, which allows integrating large arrays of versatile data and information flows between different departments, organizing information support for the educational process[3]. Currently, the majority of such systems in terms of their functionality are document management systems; only a few of them perform information and analytical functions. It is necessary to keep the educational programs of study areas up to date to ensure the activity of any educational organization, i.e. compliance with the requirements of regulatory documents. Such documents include educational, professional, industrial, etc. standards, which, over time, are modified, removed, or new ones are added.

Compliance of educational programs with such documents is determined during the accreditation procedure by specialists[4]. Such checks are not as frequent as the changes in the content of individual standards. In order to audit documents, a criterion-evaluation complex should be formed, which allows accurately determining the compliance of the control documents with modern requirements[5]. At the moment, this assessment has a binary approach: it does not matter whether or not the item being checked corresponds to the professional experience of the expert conducting the audit[6]. Thus, the solution to this problem is the creation of multifunctional automated systems for monitoring, planning and managing the content of educational programs intended for the collection, storage,

[1] G. S. Zhukova, "Razlichnye aspekty sovershenstvovaniya sistemy upravleniya obrazovaniem v tselom i obrazovatelnymi uchrezhdeniyami", Uchenye zapiski Rossiiskogo gosudarstvennogo sotsialnogo universiteta num 9 Vol: 109 (2012): 136–141.
[2] M. S. Tigina, "Matematicheskaya model otsenki urovnya sformirovannosti kompetentsii", Informatika i obrazovanie num 10 Vol: 249 (2013): 88–89.
[3] M. V. Nikitin, Stanovlenie setevogo professionalnogo obrazovaniya: monogr. (Moscow: Russcience, 2018).
[4] G. S. Zhukova, "Rossiiskoe matematicheskoe obrazovanie v vuze: sostoyanie, ozhidaniya, problem", Chelovecheskii capital 12(72) (2014): 112–119.
[5] O. A. Gorlenko; N. M. Borbats; A. Z. Simkin y T. P. Mozhaeva, Garantiya kachestva obrazovaniya v uchrezhdeniyakh vysshego obrazovaniya i srednego professionalnogo obrazovaniya. Kachestvo inzhenernogo obrazovaniya: sb. nauch. tr. (Bryansk: BGTU, 2017): 8-17.
[6] G. S. Zhukova, "Vozmozhnosti informatsionnykh tekhnologii v protsesse vuzovskoi sistemy kachestva", Vestnik Moskovskogo instituta gosudarstvennogo upravleniya i prava num 14 (2016): 48–50.

processing and use of information for self-examination, certification or comprehensive assessment[7].

Methods

To create a criterion-evaluation complex for an educational program, it is necessary to distinguish its main independent components[8]. These include work programs of each of the disciplines[9]. A work program includes different components, which should contain a description, regulated by the documents presented in Fig. 1.

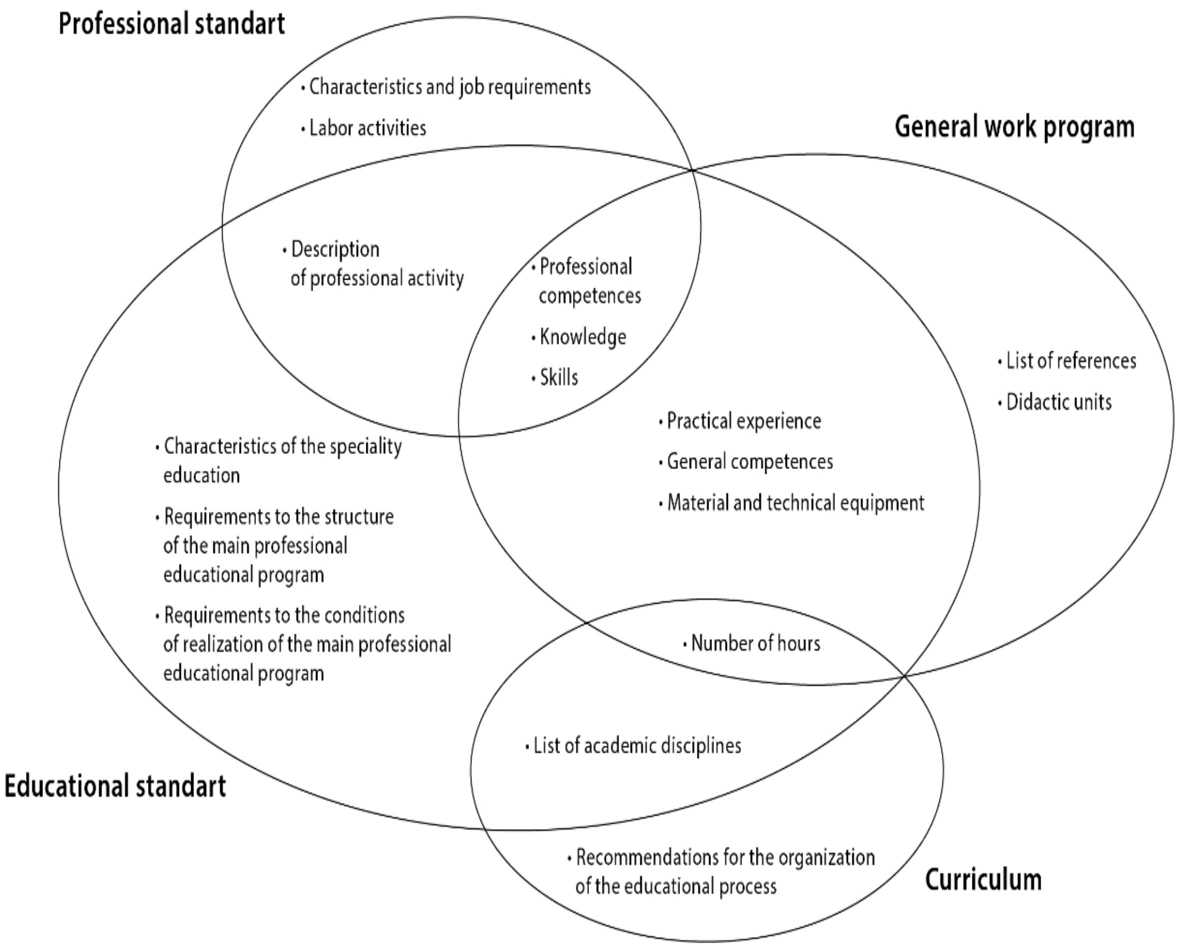

Figure 1
Structure of a discipline work program content

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7 G. S. Zhukova, “Matematicheskaya podgotovka budushchikh ekonomistov: sravnitelnyi analiz metodik i paradigm”, Chelovecheskii kapital num 7 Vol: 115 (2018): 64–74.

8 Yu. M. Abramov y O. A. Vinokurova, Problemy organizatsii informatsionnykh potokov pri razrabotke uchebno-metodicheskoi dokumentatsii. Obrazovanie i nauka v sovremennykh realiyakh: sb. materialov V Mezhdunar. nauch.-prakt. konf. (Cheboksary, June 04, 2018): 59-64.

9 M. S. Logachev; Yu. N. Samarin y M. S. Tigina, Avtomatizirovannye sistemy upravleniya kachestvom obrazovatelnogo protsessa: monograph (Moscow: MGUP imeni Ivana Fedorova, 2016).

The content of any program consists mainly of text and tables[10]. Their content is the responsibility of the teacher, who may make various mistakes, for example, due to insufficient software proficiency, superficial knowledge of regulatory documents, professional interests or personal beliefs[11]. Thus, errors that occur in the content of working programs can be divided into the following categories[12]:

1.- Top-level content category (Category 1). Errors arising as a result of non-compliance with the requirements of normative documents of the federal or regional levels (incorrect use of different codes and their corresponding names of elements from normative documents, determination of the number of hours for the study of different didactic units).

2.- Medium-level content category (Category 2). Errors arising from non-compliance with the requirements of normative documents of the educational organization (errors in formatting the content of the document, changes in the structure of the document).

3.- Low-level content category (Category 3). Execution errors arising from non-compliance with the requirements of the layout-template of the document.

4.- Category of technical errors (Category 4). Combines the classes of errors made when typing due to inattention or low level of software proficiency in the typesetter.

Each error category is described by the following classes[13]:

- Class 1. Errors related to skipping space or adding an extra one;
- Class 2. Empty line alignment error;
- Class 3. Errors in setting the line break character;
- Class 4. Errors in the use (including their absence) of codes of disciplines, competencies, specialties and other digital or letter classifiers established by regulatory documents[14];
- Class 5. Errors in the names of various categories (wording of competencies, headings of sections of the work program and other names defined in regulatory documents, including their absence), including interchange or omission of letters, syllables, words or sentences, punctuation errors;

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[10] M. S. Logachev; Yu. N. Samarin y M. S. Tigina, Avtomatizirovannye sistemy upravleniya kachestvom obrazovatelnogo protsessa: monograph (Moscow: MGUP imeni Ivana Fedorova, 2016).
[11] G. S. Zhukova, "Matematicheskaya podgotovka budushchikh ekonomistov: sravnitelnyi analiz metodik i paradigm", Chelovecheskii kapital num 7(115) (2018): 64–74.
[12] M. S. Logachev, Struktura, metodika i algoritmy funktsionirovaniya sistemy monitoringa upravleniya kachestvom obrazovatelnykh programm: avtoref. … kand. tekhn. nauk (Ryazan State Radio Engineering University, 2017).
[13] M. S. Logachev, "Otsenki soderzhaniya obrazovatelnykh dokumentov: statisticheskii aspect", Statistika i ekonomika num 5 (2016): 14–17.
[14] M. S. Logachev, Struktura, metodika i algoritmy funktsionirovaniya sistemy monitoringa upravleniya kachestvom obrazovatelnykh programm: avtoref. … kand. tekhn. Nauk (Ryazan State Radio Engineering University, 2017).

- Class 6. Errors in the formation of references (incorrect distribution of the main and additional literature, inconsistency of the year of publication, etc.);

- Class 7. Errors in writing the references (use of incorrect abbreviations, the omission of punctuation marks or using extra ones, etc.);

- Class 8. Errors in establishing the correspondence of ciphers and names of different categories (competencies, disciplines, specialties, etc.);

- Class 9. Errors in the number of tables (rows or attributes);

- Class 10. Errors in using uppercase or lowercase letters;

- Class 11. Errors in the sequence of elements (competencies, titles, attributes, etc.);

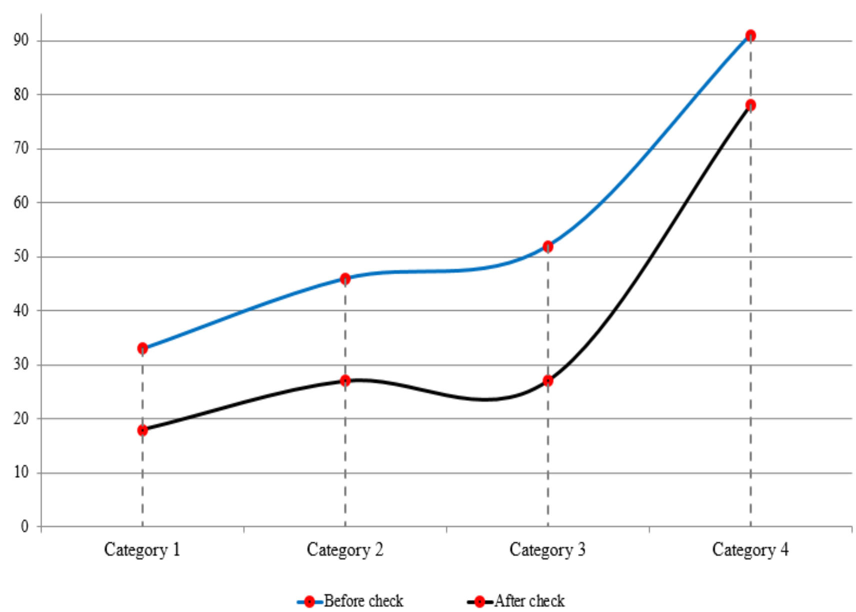
- Class 12. Errors in applying text selections (italic, bold, underlined and others);

- Class 13. Errors in the use of the educational organization template (absence of a certain number of reviewers, signatures, etc.);

- Class 14. Errors in specifying the number of hours, including their distribution;

- Class 15. Errors in table attribute names.

The results of the study of working programs for errors are presented in Fig. 2. Fig. 2*a* and 2*b* show the distribution of the number of errors by their categories and classes, respectively, before and after control of the content by specialists monitoring the content of educational documents. Fig. 2*c* shows the density distribution of the probability of error occurrence by classes (F_i, lower Fn_i and upper Fb_i of the confidence limits of probability).



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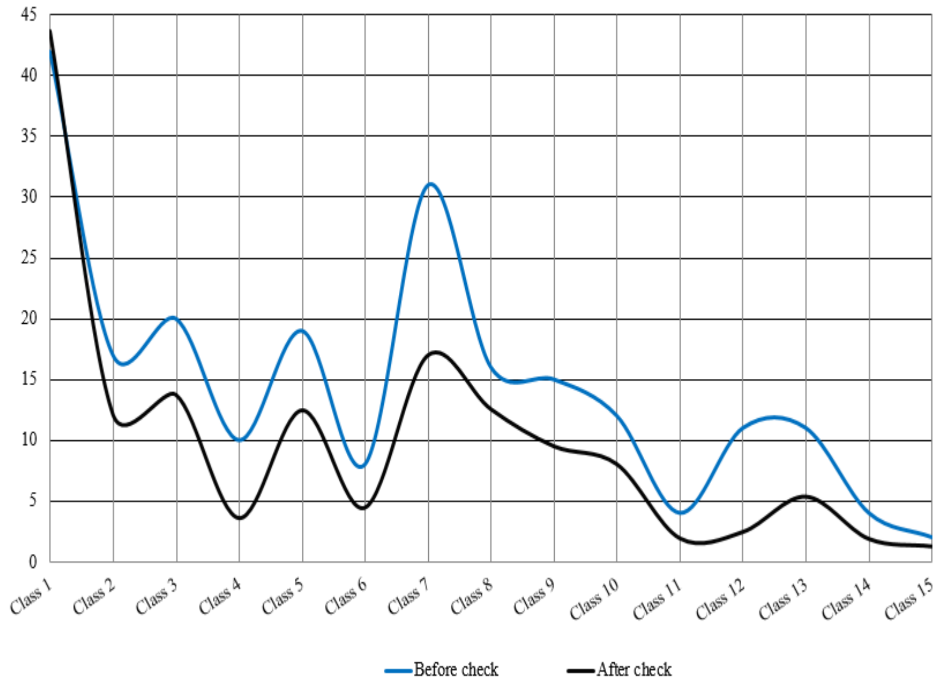

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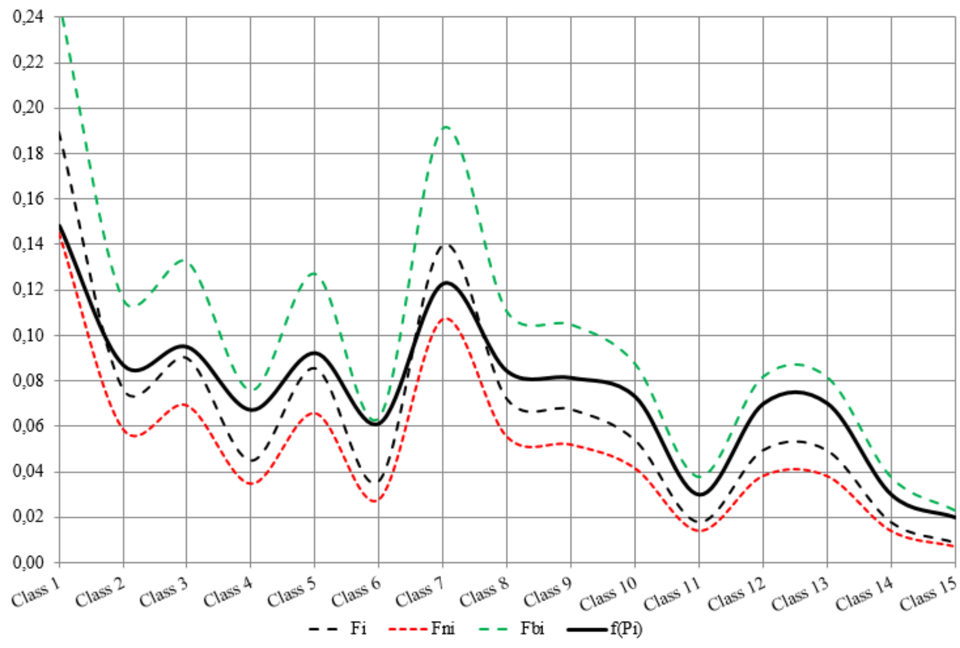

c

Figure 2
Results of the statistical study of the content of work programs[15]:
a) Distribution of the total number of errors by categories, b) Distribution of the total number of errors by classes, c) Density of errors distribution by their classes

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[15] M. S. Logachev; G. V. Tkacheva y Yu. N. Samarin, Obrazovatelnaya programma kak instrument sistemy upravleniya kachestvom professionalnogo obrazovaniya: monograph (Moscow: Infra-M, 2019).

Analyzing the process of error occurrence in all categories, it can be assumed that the regression function of the probability of errors occurring in the studied material can be described by the following law[16]:

f^* (i)=(α^2·(i+a))/i!·e^(-α·(i+

where i is the discrete number of errors of all classes;

α is the parameter of the regression function, the numerical value of which is found using the least-squares method, 0.856;

a is the parameter of the regression function, the numerical value of which is found using the least-squares method, 0.015.

Thus, the regression function of the probability of error occurrence is as follows (it is shown by graph f (P_i in Fig. 2*c*):

f^* (i)=(〖0,733〗^2·(i+0,015))/i!

Proofreading is the only means of eliminating errors in any text, including the content of educational programs. The main purpose of proofreading is to detect and eliminate errors. In connection with the peculiarities of the organization of control processes in the educational organization, the proofreading of the content of the educational program is expressed in the following actions:

1. Reading a document (from a screen or paper);

2. Search and selection of errors that do not require additional materials to identify them;

3. Access to regulatory documents to search for and highlight errors in the document being checked;

4. Proofreading and creating comments to make significant corrections.

In this case, the proofreading process is described by Erlang's law of the second-order (an increase in the index of the distribution order can be arbitrarily close to bringing the flow of corrected errors to the regular flow):

f(t)=β·t·e^(-β·t)

where β is the intensity of the proofreading;
t is the proofreading time.

In this case, the time between the occurrence of corrected errors $T = T_1 + T_2$, where T_1 and T_2 are random variables described by the exponential law[17], is as follows:

[16] M. S. Logachev, “Otsenki soderzhaniya obrazovatelnykh dokumentov: statisticheskii aspect”, Statistika i ekonomika num 5 (2016): 14–17.

$$f_1(t)=\beta\cdot e^{(-\beta\cdot t)}$$

Thus, we obtain the probability of any number of errors in the text equal to[18]:

$$P_0=1-[1+\beta t/1!+(\beta t)^2/2!+(\beta t)$$

where *m* is the number of errors.

Based on the data obtained, the average time of proofreading is determined by formula 6[19]:

$$m_{tn}=(2\cdot n)/\beta$$

Results

According to the study, the average value of the number of errors in the content of the working program is n = 222 and the time of their proofreading is as follows:

$$m_{t222}=(2\cdot 222)/(1,327\cdot 10^{(-2)}\cdot 36$$

Analyzing the duration of a specialist's work with a document, the time for checking the content, most often, is 0.33 hours. During this time, it is possible to proofread 16 errors. Therefore, the vast majority of errors remain as compared to the original document after the control procedure. As practice shows, the content of the working program is checked only twice, which means that this number of checks is not enough.

An automated monitoring system should be used to automate the activities of such specialists, based on which the following methodology should be used:

1. Get a file for proofreading (includes monitoring the conformity of the processed format, determining the code and the name of the specialty and academic discipline);
2. Define and upload a reference file (for example, an educational standard file) and matching files (metadata necessary to determine the boundaries of the search in the reference file and the file being checked) based on the data obtained in paragraph 1 of this methodology;
3. Select the structure block and its criteria for determining the labels of the reference file (RF);
4. Determine the compliance of the label in paragraph 3 of this methodology in the compliance file;
5. Set the search range in the checked file (CF) based on paragraph 4 of this methodology;

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[17] B. Yu. Lemeshko; S. B. Lemeshko; S. N. Postovalov y E. V. Chimitiva, Statisticheskii analiz dannykh, modelirovanie i issledovanie veroyatnostnykh zakonomernostei. Kompyuternyi podkhod: monograph (Novosibirsk: NGTU, 2011).
[18] G. S. Zhukova, "Rossiiskoe matematicheskoe obrazovanie v vuze: sostoyanie, ozhidaniya, problem", Chelovecheskii capital num 12 Vol: 72 (2014): 112–119.
[19] O. A. Vinokurova; M. V. Efimov; Yu. N. Samarin y M. A. Sinyak, Metody i sredstva pererabotki informatsii v dopechatnykh sistemakh: monograph (Moscow: MGUP, 2003).

6. Compare the contents of the CF with the contents of the RF label. As a result of the comparison, the following cases may occur:

1) the content of the CF label is the same as the content of the corresponding RF label: increase the parameter of the criterion per unit;

2) the beginning of the CF content is exactly the same as the content of the corresponding RF label, but the rest is not the same: increase the appropriate parameter of the criterion to zero;

3) the beginning of the content or any part of it does not match the content of the RF label: increase and maintain the parameter of the criterion to zero;

4) the beginning of the content of the CF completely coincides with the contents of the corresponding RF label and after that, the text is missing: check the following line on the subject of the remaining content. The search ends when the missing content is found (go to p. 6.1) or the first five lines are without text (go to p. 6.3) or the missing part is found (go to p. 6);

5) end of search range reached: increase the appropriate parameter of the criterion to zero;

7. Generate and save recommendations and radar charts based on the structural unit evaluation results;

8. Repeat p. 3-7 until all criteria of one structural block are checked;

9. Determine the weights corresponding to the checked structural unit;

10. Transfer the primary result of the criteria check to percent according to the weight criteria in p. 9 and save the result;

11. Repeat p. 3-10 until all structural blocks have been checked;

12. Determine the weight coefficients for the formation of the program;

13. Obtain an integral indicator of the formation of the program on the basis of paragraphs 11-12 and save the result;

14. Output and save the resulting integral index in paragraph 13 and the corresponding explanations;

15. Display saved recommendations and radar charts for structural blocks from p. 7.

In general, the process can be presented in the form of a functional diagram (Fig. 3).

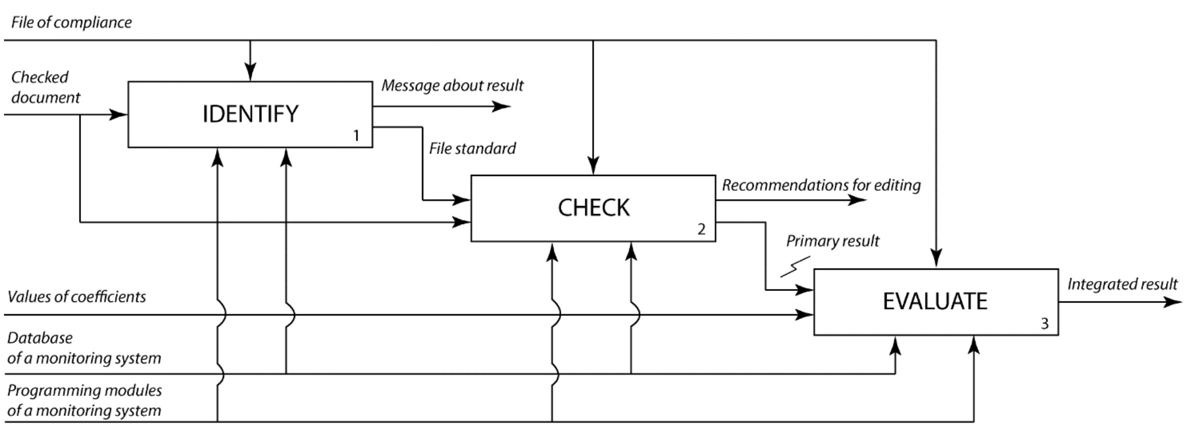

Figure 3
Functional diagram of the process of control of the contents of a work program[20]

[20] M. S. Logachev, Struktura, metodika i algoritmy funktsionirovaniya sistemy monitoringa upravleniya kachestvom obrazovatelnykh programm: avtoref. … kand. tekhn. nauk (Ryazan State Radio Engineering University, 2017).

Discussion

Based on the developed methodology, we determine the amount of time that will be spent

by a specialist and an automated system to check the contents of work programs. The results are shown in Table 1.

Evaluation element	**Characteristic**	**Work program results**		
		Program 1	**Program 2**	**Program 3**
1	2	3	4	5
Work program	Number of characters	50,480	43,756	46,032
	Number of errors	23	37	58
	Probability of error	0.00046	0.00085	0.0013
	Methodologist check intensity	0.0046	0.0085	0.013
	System check intensity	0.657	1.214	1.856
	Working hours of the methodologist, in s	10,000	8,706	8,923
	Working hours of the system, in s	70	61	62.5
	Correlation	142.9	142.7	142.8

Table 1
Work program monitoring results

The obtained results show that the use of an automated system to check one work program is effective in time and in the quality of obtaining the result. Any educational program consists of at least 30 working programs; thus, when using software tools, the time of specialists is significantly saved.

Conclusions

Based on the results obtained, the automated system for monitoring the quality of educational programs shows the exact result much faster than a human specialist. This takes into account only the time of the monitoring itself, which includes the proofreading process. For automated monitoring, the preparation process should be considered: launching the program, checking for updates, downloading a document, and, in a particular case, choosing the required curriculum and educational standard. Therefore, with an increase in the number of checks and directions of educational programs, the work time of the specialist increases and when using the software the preparatory stage is carried out only once. Accordingly, the use of an automated system for monitoring the quality of educational programs at each stage of the process saves time, though not increasing the likelihood of errors in the final document.

Preparation of documents of an educational organization affects not only the level of the workload of teachers but also the quality of graduates. Currently, education implies a certain structure of knowledge, skills and abilities formed in the student at different stages of their study in the framework of the education system[21]. Modern trends of professional education and professional activity of graduates of educational institutions, as future specialists, require a more thorough and detailed approach not only to assess the

[21] G. S. Zhukova, "Razlichnye aspekty sovershenstvovaniya sistemy upravleniya obrazovaniem v tselom i obrazovatelnymi uchrezhdeniyami", Uchenye zapiski Rossiiskogo gosudarstvennogo sotsialnogo universiteta num 9 Vol: 109 (2012): 136–141.

level of formation of their professional and general competencies, but also the constant monitoring of the quality of educational programs[22]. The developed methodology allows redistributing and reducing the burden on the specialists of educational organizations while increasing the effectiveness and quality of the monitoring of the content of documents.

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