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# APPLIED RESEARCH OF THE RADIAL-RING TYPE OF LEARNING IN THE ACQUISITION OF KNOWLEDGE USING ERGONOMICS

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**Abstract:**

In this article, an attempt is made to study the quality of the learning process of the radial-ring type of the audience in the acquisition of knowledge, using ergonomic modeling.

**Keywords:** qualities, research, radial-ring, structural, ergonomic, mathematical modeling.

The purpose of this research work is to investigate the quality of the learning process in the acquisition of knowledge of the audience radial-ring view, with the help of ergonomic modelling.

To conduct research in this area, it is required to distinguish the difference between pedagogical ergonomics, where indicators are defined, influencing factors are given, properties in the learning process and influencing parameters. And applied ergonomics: it is firstly - the development and creation of a mathematical model of the learning process and secondly - on the basis of ergonomic modelling, the calculation of quality using different mathematical methods in the acquisition of knowledge.

Ergonomics is a science that is developed and created for the study of different fields of science, technology and education. It is used in: technical development-solutions, sports, engineering, medicine, pedagogy, etc.

Ergonomics is the science of research and teaching.

Analysing and synthesising the teaching process with ergonomics in mind.

Establishment of logical and informational interrelationships between the pedagogical ergonomics of the teaching process in universities.

System approach - conducting research tasks in the field of ergonomics of teaching.

The choice of econometric methods by which calculations of ergonomic models of teaching are conducted.

The emergence of pedagogical ergonomics should be considered not as an attempt to replace the functions of pedagogy, psychology and physiology, but as a natural process of emergence of a new area of the learning process in the mastering of knowledge.

In order to investigate the concept and essence of ergonomics as a science, based on the analysis of scientific works of B. F. Lomov, A. N. Leontiev, V. P. Zinchenko, V. M. Munipov, O. A. Krylov, G. M. Zarakovsky, foreign scientists K. Marrell, V. Singleton, etc. [12-15]. [12-15], it was concluded that pedagogy and ergonomics have common goals - improving the effectiveness of learning activities, health (safety), personal development (comfort, satisfaction with the content, forms, results of activity).

Under the basics of pedagogical ergonomics [4], understands a set of achievements of a complex of sciences, consisting of several elements, namely: pedagogical labour, student activity, learning environment, advanced pedagogical experience, modern teaching tools, as well as intellectual systems oriented to education, used in the learning process.

Since the classes are held in the classroom, they are: radial, circular and mixed, i.e. radial - circular type. But, the types of classrooms, depending on the conducted classes, are extraordinary, especially in the field of medicine, biology, chemistry, biotechnology, bioengineering, i.e., specialised.

In contrast to other types of learning - in radial-ring, it is non-standard and non-ordinary, but original, because it differs in the type of arrangement of learners in the classroom (e.g., circular is considered a lecture) for the acquisition of knowledge.

But, in the process of structural modelling of the arrangement of learners in the classroom, radial-ring arrangement, it, as well as other types of entirely non-standard, and 'not covering' the entire audience, to conduct research, as in the'amphitheatres' of Figure 1.

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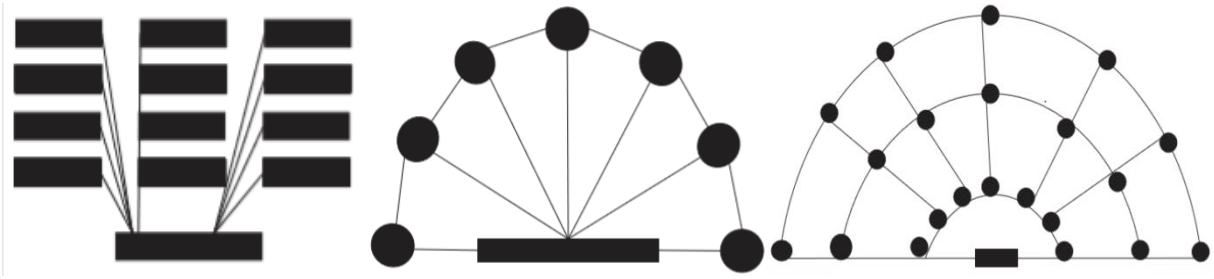

Figure 1. Types of auditoriums of the learning process.

On the basis of the structural model, an ergonomic model of the learning process is built, depending on the location of students in the classroom (Fig. 2.).

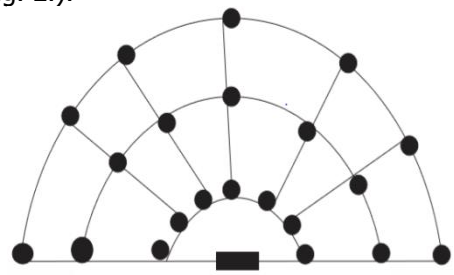

Figure 2. Structural model of the learning process of radial-ring type.

In this regard, in the learning process, the creation of an ergonomic model of a radial-ring-shaped classroom (Fig. 3) is a necessary condition for building its mathematical model to calculate the quality of the learning process.


Figure 3. Ergonomic model of the circular view of the learning process.

On the basis of the ergonomic model of Figure 3, it is possible to build a mathematical model [6-9], using the theory of matrices [1], because the arrangement of students in the classroom has a matrix form.

Theoretically, from the theory of matrices [1], the mathematical model of the learning process of radial-ring type is described by a two-dimensional matrix A(i,j), which, in general, can be represented in the following form (formula 1)

$$1.):A_{ij} = \begin{vmatrix} a_{11} & a_{21} \dots, & a_{n1} \\ a_{12} & a_{22} \dots, & a_{n2} \\ \vdots & \vdots & \vdots \\ a_{1m} & a_{2m} \dots, & a_{nm} \end{vmatrix} \qquad 1.$$

If in the radial-ring-shaped auditorium of Fig. 3, the arrangement of trainees in the auditorium is a two-dimensional matrix. 3, the arrangement of trainees as a two-dimensional matrix, then the arrangement of trainees in the classroom will be written $A_{i,j}$, as in Table 1.

Table 1

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $A_{11}$ | $A_{21}$ | $A_{31}$ | $A_{41}$ | $A_{51}$ | $A_{61}$ | $A_{71}$ | $A_{81}$ | $A_{91}$ |
| $A_{12}$ | $A_{22}$ | $A_{32}$ | $A_{42}$ | $A_{52}$ | $A_{62}$ | $A_{72}$ | $A_{82}$ | $A_{92}$ |

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| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $A_{13}$ | $A_{23}$ | $A_{33}$ | $A_{43}$ | $A_{53}$ | $A_{63}$ | $A_{73}$ | $A_{83}$ | $A_{93}$ |
| $A_{14}$ | $A_{24}$ | $A_{34}$ | $A_{44}$ | $A_{54}$ | $A_{64}$ | $A_{74}$ | $A_{84}$ | $A_{94}$ |
| $A_{15}$ | $A_{25}$ | $A_{35}$ | $A_{45}$ | $A_{55}$ | $A_{65}$ | $A_{75}$ | $A_{85}$ | $A_{95}$ |

From the arrangement of trainees in the classroom as in 'amphitheatres' Figure 3, then on the basis of the matrix - Table 1, it will be rewritten as in Table 2, taking into account the absence of trainees in the rows.

Table 2

All the elements of the matrix (tab. 2) are the numbers of the location of the trainees in the radial-ring auditorium, where, in place of the missing elements are written '1' - units, since the auditorium is 'amphitheatre-like', these positions are 'empty', i.e. there are no trainees, then, when multiplying the matrix elements by 1, the resulting result will not change.

To present the description of auditoriums with the help of ergonomics, let us give an example, where we will consider the learning of knowledge in a radial-ring auditorium [10,11], from Figure 1.

To calculate:

- the quality of the learnt knowledge of the trainees, let's denote it by the letter - A;
- and the discipline studied - Z;
- and the total acquired knowledge - K.

Then the mathematical model of the learning process, i.e. the calculation formula can be written analytically in the following form

$$K = A * Z \qquad (1).$$

Using formula 1, it is possible to calculate the learnt knowledge for one learner only. If the studied discipline consists of 36 hours, where it is necessary to conduct 18 pairs of classes, then the studied material - Z with the following topic will be repeated 18 times, which, too, will be written as a one-dimensional array - $Z_k = (Z_1, Z_2, Z_3, \ldots, Z_k)$, where k is the index of the array. Then the acquired knowledge of the learner, $K_k$, will also be equal to: k=18.

From the above formula 1, let's rewrite it in the following form

$$K_k = (((a_0 + z_1) + (a_1 + z_2)) + (a_2 + z_3)) + \ldots \qquad (3).$$

It should be said that the final result Kk , i.e. the quality of the learning process will be calculated according to formula 3, where the learner's acquired knowledge after each lesson and in general for the whole discipline is summarised, i.e.

Taking into account the location of trainees in a radial-ring-shaped classroom, it can be described by a two-dimensional matrix, for example, A(i,j), where A is the name of the array, i and j are the indices of columns and rows, the dimensionality of the array on the basis of Table 2 will be equal to A (9,5).

Then in the process of training the acquired knowledge - $K_{i,j}$ with the learnt material - $Z_k$, in the trainees after each lesson, will be written in the following form

$$K_{i,j} = A_{i,j} * Z_k \qquad (4).$$

In order to process the obtained result, i.e. to calculate the quality of the learnt knowledge in points, it is necessary to convert it into 'grades', for this purpose we use the method of 'scaling' [3]. Where with the help of Brainstorming method the acquired scores are measured/determined, entered into the INSERT table [3], and on their basis the results of the survey of trainees are built.

Figure 4 shows that the trainee works in 'unison' with the teacher, where from the first calculation results obtained, it is possible to assess the learner'masteredknowledge.

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 1 | $A_{41}$ | $A_{51}$ | $A_{61}$ | 1 | 1 | 1 |
| 1 | 1 | $A_{32}$ | $A_{42}$ | $A_{52}$ | $A_{62}$ | $A_{72}$ | 1 | 1 |
| 1 | $A_{23}$ | $A_{33}$ | $A_{43}$ | $A_{53}$ | $A_{63}$ | $A_{73}$ | $A_{83}$ | 1 |
| $A_{14}$ | $A_{24}$ | $A_{34}$ | $A_{44}$ | $A_{54}$ | $A_{64}$ | $A_{74}$ | $A_{84}$ | $A_{94}$ |
| $A_{15}$ | $A_{25}$ | $A_{35}$ | $A_{45}$ | $A_{55}$ | $A_{65}$ | $A_{75}$ | $A_{85}$ | $A_{95}$ |

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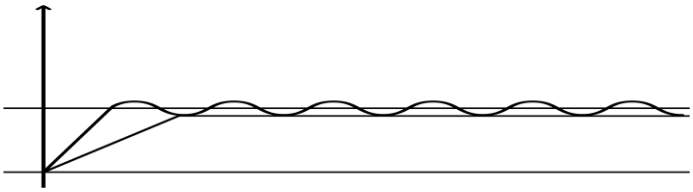

Figure 4. Result of one learner.

This indicates the adequacy of the constructed mathematical model with the ergonomic model in determining the quality of the learning process, where the dynamics of knowledge acquisition can be traced.

As a result of the conducted research of the calculation of the degree of mastering knowledge, skills and abilities, shows that they differ from the theoretical. The obtained results of the learning process, i.e. the mastery of the group, from (Fig. 5), increases in parallel with the mastery of knowledge of trainees and theoretically with the requirements of the teacher, where they are identical.

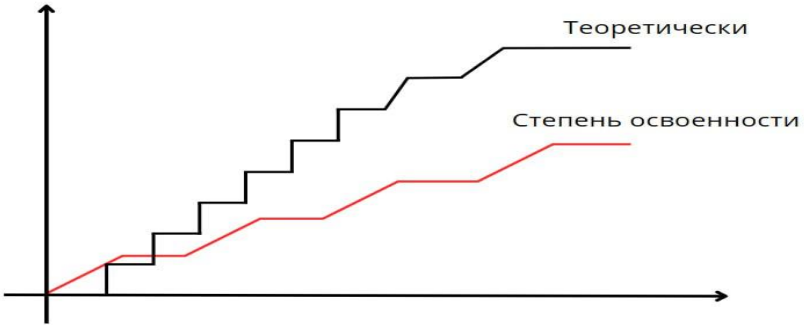


Figure 5. Degree of uptake.

**CONCLUSION**: From the above example we can conclude that: in relation to other methods of calculating the learning process, the matrix method of modelling is more accurate because:
- the construction of the ergonomic model corresponds to the structural model of the selected type of classroom for the learning process;
- the mathematical model corresponds to the learning process for a circular type of classroom;
- the chosen method of calculation describes consistently the total result and the quality of mastered knowledge.

**SUMMARY**: This research work is the first attempt at mathematical modelling and calculation of the quality of the learning process in the mastering of knowledge, for radial-ring type of learning.
There is a continuation of research work, using learning tools and intelligent systems. Then, it will be necessary to determine the quality of indicators to sensitivity - coarseness of participating: factors, parameters and properties in the acquisition of knowledge.

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