Information system to support the achievements assessment of future engineers in the learning process

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Abstract. This article discusses a comparative analysis of the monitoring and analysis information systems existing in the world, a description of the subject area of the system being developed, analysis of existing software tools, such as the Science information and analytical system, the Monitoring and evaluation of academic achievements system, and AIS Elzhur. We consider the development and design of the algorithm of the system. At the stage of logical design, all attributes and attribute domains were formed, a logical model was built, and a physical model of the system was developed using the dbForge for MySQL database administration program with the structure of the database tables. The structure of the software product as a whole was developed, and the interaction structure of the tabs of the main window was described in detail and the process of working with the system was described. As a result of the study, an automated system was developed for taking into account the rating of athletes at Reshetnev Siberian State University of Science and Technology on the basis of the sports club. The proposed information system allows to accumulate data on sports activities of students, to evaluate the effectiveness of sports activities with various details, to compile, build and print a variety of reports and schedules for a certain time period, to optimize the process of evaluating sports activities and assigning rewards through the developed system criteria for rating building, reduce the time required to search for information due to the possibility of search and filtering.

1. Introduction

Currently, the training of highly qualified personnel is an integral part of the work of higher education institutions. A certain role in the preparation of future engineers is played by their physical form [1].

Many Russian higher education institutions graduate engineers. Reshetnev Siberian State University of Science and Technology (Reshetnev University) is one of them. Having a huge variety of rewards for students, the university motivates them to work on themselves, whether it be development in scientific, social or sports activities.

The process of managing sports activities of students is a challenge for leadership [2]. Since the concept of “sports result” is ambiguous, it is difficult to classify and evaluate the sports results obtained by students. Therefore, taking into account the qualitative and quantitative indicators of sports
activity becomes difficult, since these problems arise already at the stage of collecting and evaluating the results [3].

Despite the fact that the assessment and accounting of the student’s sports activities is an integral part of the performance indicator, today in most cases, organizations store all the information about the results of sports results on paper, which causes a number of significant shortcomings [4]:

- Difficult and incomplete assessment of the effectiveness of sports activities.
- Unsafe storage of personal data of athletes.

Thus, the task of accumulating data on the students’ sports activities, creating a system for monitoring and evaluating the sports activities of each student, faculty/institute, and the university as a whole, monitoring their dynamics and forecasting by obtaining summary charts and reports for a certain time period becomes urgent.

2. Theoretical research

Currently, the process of accounting for the results of sports activities in Reshetnev University can be represented in the form of a structural diagram constructed according to the structured analysis and design technique (SADT) methodology (figure 1).

![Figure 1. The process of accounting for the results of sports activities at the university.](image)

To identify the shortcomings, a diagram of the process of taking into account the results of sports activities at the moment was constructed, which is presented in figure 2.

Thus, it takes a lot of time to process the data, since the information is manually distributed according to the necessary criteria and then recorded in the accounting journal. Based on the information received, an assessment is made of the effectiveness of sports activities.

Long manual work, inaccuracy in filling out documents, storing the necessary information in paper form is unacceptable for a full assessment of students' sports activities, which significantly reduces the reliability of the assessment results. For most students, the scholarship is central to the motivation system [5]. But very often an increase in a scholarship does not entail an increase in productivity and
quality of work, since a low scholarship does not give an incentive to work as well as a very high one [6].

In the first case, the student begins to depression, there is uncertainty about tomorrow. In another case, when an athlete is initially assigned a high scholarship, the desire for improvement is “killed” in him. Therefore, it is important to find a “middle ground” when the scholarship is high enough to stimulate productivity growth, but not so much that the athlete spills out and stops striving for more. a major role in the selection of workers according to their personal characteristics, but does not help to effectively determine the payment or remuneration of an employee for his work. Labor stimulation systems determine the remuneration of workers, but they do not help to make workers’ earnings dependent on their responsibility to work [7].

To motivate and encourage students, they determine the criteria and the procedure for assessing their achievements on the basis of the rating algorithm [8]. The rating is formed in accordance with the accumulated points for all criteria. The position in the ranking determines the priority in encouraging the student for sports activities.

3. Market analysis of existing software systems

To date, various information systems are known that make it possible to systematize, search, store and analyze the results of various fields of activity. Despite the existence of both international systems and national ones, which offer ample opportunities for analyzing various activities, there are no direct analogues of the developed system, since each organization forms its own system for recording and evaluating sports activities. Often, their capabilities separately are insufficient to obtain an objective and complete picture about the activities of students. Table 1 shows a comparison of the considered systems from the point of view of the available and necessary functionality [9].

| Parameters                        | Learning Achievement Monitoring | The Science | AlJour |
|-----------------------------------|--------------------------------|-------------|--------|
| Sort data by various criteria     | -                              | +           | -      |
| Search and filter in the database | +                              | +           | +      |
| Separation of access rights       | -                              | -           | -      |
| Formation of graphs and reports   | -                              | -           | -      |
on the results of sports activities
Storage and accounting of student achievement data

After considering several information systems that are used in related fields of activity, and, having carried out a comparative analysis of various information systems, a number of conclusions were made:

- Most of these systems either do not allow the creation of reporting documents and comparative charts based on the results of the analysis of activities, or the display of charts and reports is maximally simplified and does not involve solving serious problems (forecasting, analysis of the work of teams, etc.).
- Time/category data binding on graphs, linearly reflecting the dynamics of individual indicators (combined display options are not applied).
- Lack of a service for the organization to form its own rating / index calculation formula for its students within the framework of a unified platform.

So, it is required to create a comprehensive information system designed to collect, store and evaluate the sports activities of Reshetnev University students, including all types of sports activities, as well as to build a rating according to the system of criteria for evaluating their activities to encourage and stimulate the development of sports at the University the whole.

4. Software system development
For the direct implementation of the database, the most common database management system (DBMS) for 2019 were analyzed: MySQL 5.6, OracleDatabase 12c, PostgreSQL, MongoDB. As a result, MySQL 5.6 was chosen as the most appropriate for the criteria presented for the implementation of information booths.

The advantages and disadvantages of the Eclipse, Embarcadero RAD Studio, IntelliJ IDEA programming environments were analyzed, and for several reasons, Embarcadero RAD Studio was chosen as the development environment for the database program.

A physical model of the system was developed using the program for administering the dbForgeforMySQL database, with a reduction in the structure of the database tables. The structure of the software product as a whole was developed, and the interaction structure of the tabs of the main window was described in detail and the process of working with the system was described.

The database design process consisted of 3 stages - physical, conceptual and logical design. At the stage of conceptual design, it was necessary to determine which entities would be stored in the database and how they would be related.

The main object of the database is competitions, students and coaches; therefore, it is advisable to include entities related to this in the database. It is also advisable to include the following entities in the database: sports, sports fields, etc. As a result, we get an entity-relationship model (ER–model), which is presented in figure 3.

The program is designed for employees of the sports club of Reshetnev University in order to track the rating of students of athletes, and is intended to automate the storage and processing of information about personal achievements of athletes. For this, the program has the following functionality:

- Student rating display.
- Displaying lists of trainers and students.
- Competition display.
- Adding, modifying and deleting data about students and competitions.
- Data search and filtering.
- Charting.
- Reporting.

![ER-model diagram](image)

**Figure 3.** ER–model.

The server with the database acts as input data, as well as data entered by the user from the keyboard during program operation. It is constantly monitored so that any information is present in the required fields. This ensures data integrity. If at least one of the required fields is not filled, a warning message is displayed.

The program consists of a single form in which the main functions are highlighted in separate tabs. When downloading, user-edited lists open. The procedure begins by calling the student add form. In it, the user enters the student’s full name, date of birth and the name of the group, selects the sport, university and rank. After the student record is stored on the server.

There is also a report output procedure that starts with selecting a report, then a database query is generated and after receiving a response, the report is displayed on the screen and the user is prompted to print it [10 - 12].

Flowcharts of the report output procedure and data entry procedures are presented in figure 4.

5. System approbation

In order to start the program, you need to run the file rating.exe. Then the authorization page will open. The main page (figure 5) is a form with a set of buttons that allows you to switch to the desired form.

When you click on the “File” button, a drop-down list opens. When choosing one of the options, a new form appears. This form allows you to add or remove a competition or modify an existing one. In addition, the form contains a search for competitions and the cursor moves to the first, last, next, and previous record. When you go from the main menu using the “Trainers” button, the corresponding form opens, which allows you to view information about existing trainers and, if necessary, filter it by date of birth.
On the “Graphs” form are graphs of the number of athletes in different sports and the number of student athletes in faculties. In addition, the “see dynamic charts” transition button is located on the form.

**Figure 4.** Process flowchart.

**Figure 5.** Program main window.
6. Conclusion
During the development of the information system, a comparative analysis of the monitoring and analysis information systems existing in the world was performed, a characteristic of the subject area of the developed system was given, existing software tools, such as the information-analytical system “The science”, the system “Monitoring and evaluation of educational achievements”, system “Elzhur”.

A comparative analysis showed the absence of direct analogues of the developed system, since each organization forms its own system of accounting and assessment of sports activities. Most of these systems either do not allow creating reporting documentation and comparative charts based on the analysis of sports activities, or the display of charts and reports is maximally simplified and does not involve solving serious problems.

Thus, an automated system was developed for taking into account the ranking of athletes at Reshetnev University, which allows to accumulate data on sports activities of students, to evaluate the effectiveness of sports activities with various details, to compile, build and print a variety of reports and graphs for a certain time period, to optimize the process of evaluating sports activities and the appointment of rewards due to the developed system of criteria for rating building, to reduce the search time for the necessary information due to the search and filtering capabilities.

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