

Software Module Development of Pupils' Performance Statistical Analysis in Public School

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Abstract

The research endeavours to discover all the objective and subjective problems affecting the quality of public education. The aim of the article is the investigation and analysis of the learners' performance indicators, revealing some new methods of assessment, as well as the creation of the statistical data analysis algorithm. The research data will let us reveal and expose all the causes and issues of students' insufficient knowledge from different academic disciplines.

Keywords

Ra (Republic of Armenia), Assessment System, Education reform, Education Quality Monitoring, Standard Deviation, Coefficient of Variation

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1. Introduction

Due to the current changes of individual and social thinking and different perceptions about education and knowledge, it becomes necessary to transform education in line with the new conditions. The aim of the reforms in the sphere of the public education is the quality improvement and ensuring compliance with the modern requirements. In the modern approaches to solving those problems a key role goes to assessment and evaluation of students' knowledge, skills and abilities. In this context it is important to implementation and introduction of a regulated formative assessment system, for the whole educational process is accompanied by evaluation and assessment system. For this purpose, it is necessary to touch upon some general issues before introducing assessment system. It is generally possible to solve social problems via improving public education quality.

Among those problems are:

- citizens' religious, ethnic and cultural upbringing,
- children's crime reduction,

- ensuring international competitiveness of the labor market and decreasing unemployment problems,
- increasing civic awareness, understanding of democratic values and human rights issues.
- By saying quality of education we mean the level of the learner according to the requirements of the state education system and the state standards of excellence and compliance [1].

It is undeniable that public education quality underwent a crucial decline during the years of formation of our independent state.

As our educational system is considered to be a conservative one, the changes being made in this area should be thoroughly based on observations, experiments, discussions and actually solve the problem of localization.

Based on the RA and international experience it should be noted that quality education is largely due to the state of the individual, and therefore well-being society and state.

Formalistic and superficial attitude towards education harms

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both the society and the state.

Generally, the recent improvement in the quality of education in many countries is mainly related to new estimates of the substantive requirements of the general education system and their proper distribution. A serious theoretical research and experiments have been done, which were tested and implemented with a noticeable positive effect.

Education quality monitoring and evaluation system of public education is needed to increase quality control mechanism, which will ensure compliance with the current state of society and educational results.

In this respect, the statistical analysis of performance indicators for quality management in educational theory and practice is an important and modern task, which is why the given research is relevant.

The study puts forward the following main goals and objectives of education:

- a) continuous and ongoing improvement of the quality of education;
- b) requirements of life, state and public order, a person's expectations of education and international education standards compliance;
- c) implementation of a common policy in the field of education;
- d) pedagogical technologies, methods of continuous improvement;
- e) assessment criteria, principles and mechanisms of development and improvement.

2. Pupils' Knowledge Assessment as a Necessary Condition of Objective Evaluation of Education Quality

In order to improve curricula and syllabi and in general the whole educational process it is necessary to use not only assessment with marks but also teaching (with no marks) assessment [1]. Assessment is gathering information about learning level reached by the students. Assessment, measurement and evaluation terms, which relate to certain periodic data collection and analysis in their decision-making purposes.

Appreciation of the work is an output, value phenomenon of making a reasoned conclusion. The teachers appreciate their students' success, as well as they measure to what extend their students have reached their academic goals. The process

of collecting data is called measurement which may include both qualitative and quantitative data. They decide the level of this or that learning attribute. The goal of measurement is to gather systematized qualitative information, e.g. from test works, questionnaires and various projects. The data is used later during final evaluation.

The term assessment was so far used mainly for measurement by us. We haven't yet differentiated between the terms to mark and to assess. Meanwile, in educational process assessing is collecting qualitative and quantitative data, and therefore, it has wider meaning than scoring. But generally teachers need assessing to put marks to students.

Formative assessment has two main types: assessment for scoring and assessment for teaching purposes.

The assessment for scoring has a controlling role of students' educational achievement level unit. Its purpose is to assess digits, or an assessment process to measure student academic achievement, and programs that set the standard.

The second form of assessment is used for study and teaching purposes. It is called it educational assessment. The goal of this type, in fact, is aimed at improving the quality of education, especially for students who have weak abilities.

The two forms of assessment, their usage in mandatory and desirable species, their quantity and periods are represented in the learner's formative assessment concept. Both are controlled and nerely exclude subjectivity. The goals of these two forms of assessment are significantly different. The scoring assessment unit has a role of controlling the quality of education. It can be applied to any topic or subtopic during the term of an academic year to fix the level of pupils' mastering practical skills, knowledge and abilities in marks. Scoring assessment records student's mastery level of the material passed. The scoring assessment unit has a competitive nature. The results are used to evaluate the quality of education and student academic achievement submission of the report.

Public education quality evaluation forms and functions

The task of assessing the quality of education has not only institutional but also social significance. It is the main levers of influence on the quality of education by the society and the state. Information about the quality of education is not only necessary for the administrative structures, but also for the educational institutions, service users, learners and parents.

The objective evaluation study of the educational process provides a feedback, which points out objective forms and methods of reaching our ultimate goal. The most effective and practical way to address the problem of students' academic achievements are the control based measurements [3, 13, 14].

The quality evaluation process is the following sequence of actions [4, 8]:

- revealing and a qualitative description of the research subject-object or phenomenon,
- selected measurement methods,
- initial data receipt and processing of statistical and mathematical transformation,
- final results and their presentation matrix, in the form of tables and graphs,
- results of content analysis.

The main functions of the education quality assessment are collection, supervision, training, developing, promoting, organizational, informational, social, economic, management, etc., representing education management process and contributing to a coordinated whole.

Learning and Education Quality Assessment provides the links between components of information change. Components of the education quality assessment and management structure choice provides opportunities for development, interconnection and interaction.

Control and assessment is realized for the sake of curriculum and standards compliance implementation and for ensuring continuous development.

Issues of monitoring and evaluation are the following:

1. educational proficiency,
2. compliance standards,
3. implementation of the school curriculum,
4. learning environment and conditions.
5. state control of education content;
6. methodological activity organization,
7. internal control and assessment process.

As a result of monitoring and evaluation data analysis, conclusions, recommendations and reports are made, based on which schools were given the necessary support.

The following principles of monitoring and evaluation should be respected;

- a) legality,
- b) feasible facts,
- c) goal-orientation,
- d) depth and versatility,
- e) scientific facts,
- f) coordination,

- g) efficiency,
- h) publicity,
- i) transparency,
- j) equity,
- k) goodwill,
- l) feedback.

Monitoring and evaluation results serve as a basis for curriculum development and review of claims, which is carried out in accordance with curriculum development and improvement of the structure.

While drawing conclusions in this study we relied on the investigations conducted by the National Institute of Education (the NIE) from February to May, 2013, as well as the results of the research done by us in Artashat high school.

The study goal was to improve evaluation system of public education, as well as to arise a number of issues requiring urgent solution using the results of the study. The study is based on the issues posed and highlighted by school teachers. The study was conducted through questionnaires.

The following issues were revealed after the study.

- evaluation of the current system;
- subject units of secondary schools teachers, particularly high school guidance evaluation of the role,
- gradual introduction of teacher evaluation and implementation of appropriate types of adjustment,
- assessment of learners with special learning needs and determining appropriate forms of investment,
- further improvement of the evaluation system.

343 schools from all Yerevan region participated in the study, more than 1,200 completed questionnaires presented by us (Table 1).

Table 1. School-based Survey Results.

N	Region	Number of schools participated in the study
1.	Aragatsotn	17
2.	Ararat	34
3.	Armavir	39
4.	Gegharqunik	30
5.	Yerevan	32
6.	Lori	60
7.	Kotayk	41
8.	Shirak	19
9.	Syunik	52
10.	Vayots Dzor	16
11.	Tavush	3
All in all		343 schools

The questionnaire is presented below.

* *Underline the preferred answer in case of multiple choice.*

1. Which type of educational evaluation do you use? Specify your point of view about the effectiveness of their application by completing the table (Table 2).

Table 2. Questionnaire Sample.

Type of the educational assessment	Effectiveness of application in percents	If the type is not applied put – sign
1. Data collection test	_____ %	
2. Oral Inquiry	_____ %	
3. Homework	_____ %	

2. In the methodological guideline of the 2012-2013 academic year which type of assessment do you use, other than those 3 types mentioned above?

1. _____
2. _____
3. _____
4. _____

3. Is it appropriate to use only oral inquiry for educational assessment (assessment without scoring) in high schools?

- a. yes
- b. no
- c. difficult to answer

4. Which type of written work is appropriate for disciplines having up to 1.5 hours per week?

- a. only thematic work
- b. only per term
- c. both thematic and term

5. Which type of assessment is preferable to use with learners with special needs?

- a. assessment with scores and assessment for educational purposes
- b. only assessment for educational purposes
- c. no learners with special needs

6. In your opinion

1) is it appropriate to use another types of educational assessment for developing learners' independence, research, cooperative abilities and creative thinking in the second term of the 12th grade?

- a. yes
- b. no
- c. difficult to answer

If yes, point out the types.

1. _____

2. _____

3. _____

2) learners' weekly load is

- a. too much
- b. too little
- c. normal

3) point out the desirable time limit of your discipline

Minimum _____ hours

Maximum _____ hours

7. Is it preferable to revise the material passed during the first two months of the term on the 10th grade of high school?

- a. yes
- b. no
- c. other version _____

8. Suggestions About Evaluation System Application, if There Are Any

The completed questionnaires were received and downloaded in an appropriate format and output of the results analysis was performed.

Combining NIE assessment systems division and the study results conducted by us with 43 teachers and 416 high school students in Artashat, we have come to the following conclusion.

1. Present evaluation system in public schools is generally acceptable by the majority of teachers.
2. Along with the need to change the situation it is necessary to improve evaluation system.
3. Teachers and staff gradually pay much attention to statistical and analytical functions as an important means of improving the quality of education.
4. Curricula congestion impedes the full implementation of the evaluation system.
5. There have been suggestions to have educational evaluation documents, which may take less time from the teacher and is much more important to improve the quality of public education, than surfing in the site dasar.am for hours.
6. The existing evaluation system, particularly the deployment of data required in dasar.am site, does not have any statistical and analytical tools, which is another obstacle to quality assessment.

Nowadays, it is difficult to find any educational institution

which is not equipped with computers or which has no access to the Internet. It gives us a great opportunity to improve assessment system by creating online class register. Parents have access to their child's page where they can be informed about their child's overall performance and scores.

The site address is dasar.am, the mission of which is modernization of information technologies through the creation of new quality education in public schools.

The aims of the site are:

- To promote and strengthen the provision of quality education in the RA.
- To increase efficiency and transparency in the school activity management.
- To promote creation of e-governed schools in the RA.
- To promote development and consolidation of computer literacy of teachers and students.
- To promote equal development of capital and the regional schools, in particular :
- To encourage the acquisition of information technology knowledge in RA regional schools.
- To contribute to the development and strengthening of regional schools' computer literacy training through the organization of events.
- To assist the implementation of electronic management systems in regional schools.
- To form modern and efficient system of communication among pupils, parents and teachers, promoting the formation of a teacher-parent cooperation as an important pillar of civil society.

Dasaran.am gives the pupils an opportunity:

- To find all his/her classmates and other school friends in the site.
- To take part in various competitions, olympiads, school debates and discussions, and even get precious prizes.
- To play many teaching and developing games, which boost their academic performance.
- To ask and get valuable answers from different specialists, methodologists and psychologists.
- To use « Encyclopedia » and « Applicant's corner » sections, to accumulate knowledge from different disciplines and to get professional orientation.

Parents can get information about their child's

- Marks,
- Performance,

- Absentees,
- Homework,
- Timetable.

They can even learn about parental meetings held in schools, and even have online chat with their child's teacher.

Public schools use formative and summative marks, including registration procedures and documentation requirements for registration are prescribed by the authorized public administration body.

Based on those curriculum assessment purposes, principles and types the authorized government body of education establishes assessment criteria.

Based on the survey findings and conclusions made by us, it was decided to create a model of evaluation system, which in addition to estimates of net entry process will provide the statistical and analytical functions. In other words, a program that will allow to identify the main factors hindering the quality of education. We created a software code that performs the above mentioned process step by step.

3. Methods of Performance Statistical Analysis and Discription Of Software Module Results

Improving public education is a universal problem, which requires a multifaceted intervention. The appropriate level of evaluation, with ample opportunities for professional growth, competitiveness and strengthening the role of the teacher in society: these are the factors that may be the key to the whole system of education educational policy and improvement.

Although in recent years the issue of education quality is one of the most discussed issues, but until now there is no reliable and trustworthy embedded system of quality indicators. The system of public education quality is still under development, and the results obtained from joint final exams are so far insufficient to assess the real quality of education. This is due to the fact that the tests used for the same subject in different years are not adequate, as well as the joint final examinations are held in completely various procedures.

Further improvement of the education quality is a prerequisite for effective policies to improve the data acquisition mechanism, which is aimed at the introduction of quality assurance procedures, expansion and development of the education management information system.

Learners' performance indicators are the most important characteristics of the educational institution, based on the

which we can make judgements about existing problems and the results gained fo far.

During statistical analysis variable dimensions are used, which can adopt different values during testing. Particularly, a key part of our research is devoted to the quality of education at the school level within academic year, as well as performance indicators at class level within academic year, and performance indicators of each single student within academic year.

Each variable can be measured according to different levels of assessment, selection of which depends on the the reliability, veracity and objectivity of the information obtained. These scales also differ from each other with permissible quantities of mathematical operations.

Experience has shown that even very variable content, such as teaching quality indicator, may not determine the quality of education for sure.

In order to have a more thorough analysis of parameters it is necessary to apply mathematical and statistical analysis apparatus, as well as a choice of the results analysis method.

During the experiment we came across the following situation: three 12th grade high school classes the average quality index from Mathematics final test was 8 points, while each class had different mark quantity (Table 3).

Table 3. Term Summative and Formative Results Data.

Indicator title	12 ^a grade	12 ^b grade	12 ^c grade
Average score of final test	8	8	8
1-point	0	0	0
2-points	0	0	0
3-points	0	0	1
4-points	0	0	1
5-points	0	1	1
6-points	1	1	2
7-points	1	2	2
8-points	11	6	0
9-points	1	5	8
10-points	1	1	5
<i>Total number of pupils</i>	<i>15</i>	<i>16</i>	<i>20</i>

The results are presented below (figures 1-3).

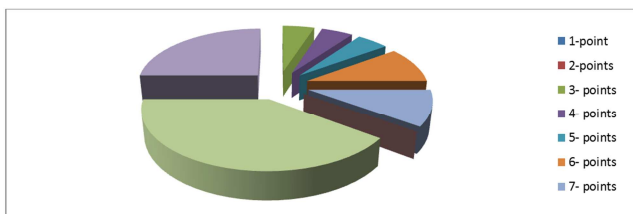


Fig. 1. Distribution of the points according to the number of pupils of the grade 12^a.

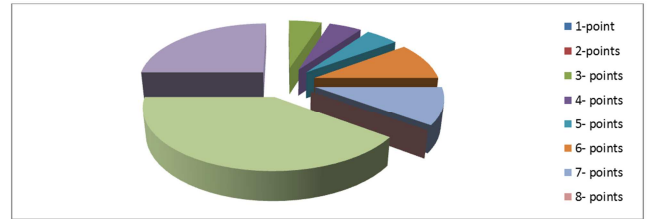


Fig. 2. Distribution of the points according to the number of pupils of the grade 12^b.

If we compare only the average points of the grades, we can see that the result is absolutely the same for all grades (8 points). Considering the distribution of the marks, a question arises: what assessment method can be chosen to assess just the very distribution and why do we have such a picture?

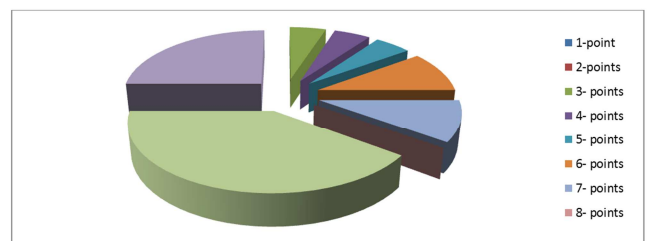


Fig. 3. Distribution of the points according to the number of pupils of the grade 12^c.

To solve this problem it is necessary to apply to the help of mathematical statistics. For the solution of this problem we made use of S. A. Ivanov's [6] methodology, the choice of the average, and a number of other statistical techniques [5, 7, 9, 10]. We have already mentioned the term "average indicator of education quality" in the article, which is the arithmetic average of the marks of the whole grade and it is determined by the following formula:

$$\bar{x} = \frac{x_1 + x_2 + x_3 + \dots + x_n}{n} = \frac{\sum x}{n}$$

where x_1, x_2, \dots, x_n -are the marks of the pupils, expressed in numbers, and n is the number of pupils.

In the given example average rating for all grades was equal to 8 points, but additional statistical techniques are needed for mark distribution analysis. In particular, average linear deviation, dispersion, mean square deviation, coefficient of variation, etc., are to be calculated. In order to give the generalized characteristics of the distribution deviation, it is necessary to calculate the average linear deviation (d), which reflects the existing differences between the single points of whole study. Average linear deviation is defined as the arithmetic average of absolute values of deviations.

$$d = \frac{\sum |x - \bar{x}|}{n} = \frac{|x_1 - \bar{x}| + |x_2 - \bar{x}| + \dots + |x_n - \bar{x}|}{n}$$

The average square deviation and dispersion are the main

summarizing indicators of statistical variations.

$$S^2 = \frac{\sum(x_i - \bar{x})^2}{n};$$

The square root of dispersion value is called average square deviation and it is assigned with the letter S.

$$S = \sqrt{\frac{\sum(x_i - \bar{x})^2}{n}};$$

The smaller is average square deviation value, the more stable is the performance. In other words, average square deviation small value suggests that almost everyone in class has an equal performance, and there are no vivid polarizations of bad and excellent marks. On the other hand, if the average square deviation value tends to 0, it means that learners' achievements do not differ, which in its turn is a clear signal that the assessment made by the teacher is not objective.

Great value of average square deviation also needs thorough analysis. Such a result indicates that the sharp polarization of "good" and "bad" learners, which can be either a result of subjective assessment, or insufficient level of teacher's professional competence.

To determine the situation extremes we used used the operator of "coefficient of variation".

$$V = \frac{S}{\bar{x}} \times 100\%;$$

The coefficient of variation value represents a flow rate, which implies a very large fluctuation of marks in case of 40% above values.

Table 4. Statistical Operators and Their Values.

Statistical operator	Statistical operator values		
	grade 12 ^a	grade 12 ^b	grade 12 ^c
Arithmetic average (\bar{x})	8	8	8
Average linear deviation (d)	0.4	0.75	1.85
Dispersion (S^2)	0.66	1.5	7.55
Average square deviation (S)	0.81	1.22	2.73
Variation coefficient (V)	10%	15.25%	34.12%

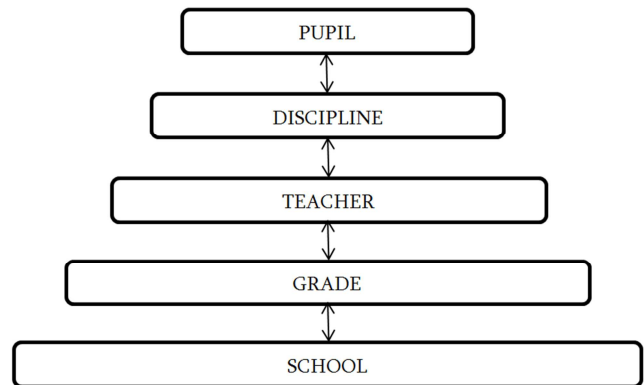
Statistical data analysis obtained via operators indicates the fact that in spite of the equal average assessment, the difference between the values of value of statistical operators is great.

The values of statistical operators in the grade 12^a indicate that all the pupils have the same results, which is impossible even theoretically. It is evident they were assessed subjectively.

The values of statistical operators in the grade indicate the credibility of performance results.

The value of the coefficient of variation of the grade 12^c indicates that the class polarization of the high and low marks, which in its turn proves to be insufficient level of teacher's professional competence.

It is possible to conduct experiments not only within one discipline via the above mentioned method, but also expand the research premises according to the scheme mentioned below (scheme1).



Scheme 1. Hierarchic Structure of the Performance Data Analysis.

4. Conclusion

The study analyses public education quality assessment forms, methods and criteria. We created public school pupils' academic performance statistics data analysis algorithm.

In our work we have tried to identify the objective and subjective issues affecting the quality of teaching in public education.

Combining NIE assessment systems division results and the results of studies conducted in Artashat high school having 43 teachers and 416 students we have come to the following conclusions:

1. Present assessment system is in general accepted among teachers.
2. Along with change of the situation it becomes necessary to improve the assessment system, as well.
3. Teachers and staff realize the importance of statistical and analytical functions as a means of improving the quality of education.
4. The existing evaluation systems, particularly the deployment of data required by the teacher in dasaran.am website, do not have the statistical and analytical tools needed, which is another obstacle to education quality assessment.
5. The following circumstances must be taken into account during the selection of the statistical methods and techniques:

- The statistical analyses based on statistical operator can not provide reliable and objective information about the quality of education.
 - It is important to follow the continuous improvement process for selection of the most appropriate methods and techniques in education quality assessment process.
 - It is necessary to master the techniques of statistical data analysis to have a valid results of statistical data analysis. These are arithmetical average value, average linear deviation, dispersion, standard deviation, coefficient of variation, etc.
6. To present the necessary statistical data we need to master their tabular, graphical presentation skills.
 7. It is necessary to establish education and knowledge quality assessment system, which, in addition to the mechanical installation of the function data, will have an apparatus of statistical data processing and analysis.

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