DOI 10.54596/2309-6977-2022-4-42-49
UDC 372.851
IRSTI 27.01.45

POSSIBILITY OF INTEGRATION OF SUMMATIVE AND FORMATIVE ASSESSMENT IN TEACHING MATHEMATICS

Shmigirilova I.B.[1*], Rvanova A.S.[2], Tadzhigitov A.A.[3]
[1,3]M. Kozybayev North Kazakhstan University, Petropavlovsk, Republic of Kazakhstan*
[2]ITMO University, Saint Petersburg, Russian Federation
[*]E-mail: irinankzu@mail.ru

Abstract

The factor that ensures the effectiveness of educational assessment is the integration of its formative and summative assessment practices. The article presents the results of a survey of school teachers, the analysis of which confirms the need for teachers in detailed, theoretically substantiated recommendations that will improve the effectiveness of assessment activities. The purpose of this article is to present the author's point of view on the possibility of integrating the practices of summative and formative assessment of teaching mathematics to schoolchildren. Along with methodological recommendations reflecting possible ways of integrating formative and summative assessment, the article shows an example of the active participation of students in the development of descriptors. It is especially noted that the summative assessment should not be perceived by either the student or the teacher as the end of a certain stage of education, it should become the basis for formative assessment.

Key words: criteria-based assessment, formative assessment, summative assessment, school education.

МАТЕМАТИКАНЫ ОҚЫТУДА ЖИЫНТЫҚ ЖӘНЕ ҚАЛЫПТАСТЫРУШЫ БАҒАЛАУДЫ ИНТЕГРАЦИЯЛАУ МҮМКІНДІГІ

Шмигирилова И.Б.[1*], Рванова А.С.[2], Таджигитов А.А.[3]
[1,3]М. Қозыбаев атындағы Солтүстік Қазақстан университеті, Петропавл, Қазақстан Республикасы*
[2]ИНМО университеті, Санкт-Петербург, Ресей Федерациясы
[*]E-mail: irinankzu@mail.ru

Аңдатпа

Білім беруді бағалаудың тиімділігін қамтамасыз ететін фактор оның формативті және жиынтық бағалау тәжірибелерінің интеграциясы болып табылады. Мақалада мектеп мұғалімдерінің сауалнамасының нәтижелері келтірілген, олардың талдауы мұғалімдерге бағалау шараларының тиімділігін арттыруға мүмкіндік беретін егжей-тегжейлі, теориялық негізделген ұсыныстарға деген қажеттілікті растайды. Осы мақаланың мақсаты оқушыларды математикаға оқытуды жиынтық және формативті бағалау практикасын біріктіру мүмкіндігіне авторлық көзқарасты ұсыну. Формативті және жиынтық бағалауды біріктірудің мүмкін әдістерін көрсететін әдістемелік ұсыныстармен қатар мақалада дескрипторларды әзірлеу процесіне студенттердің белсенді қатысуының мысалы көрсетілген. Жиынтық бағалауды оқушы да, мұғалім де оқытудың белгілі бір кезеңінің аяқталуы ретінде қабылдамауы керек, ол қалыптастырушы бағалаудың негізі болуы керек.

Түйін сөздер: критериалды бағалау, формативті бағалау, жиынтық бағалау, мектептегі білім.

ВОЗМОЖНОСТЬ ИНТЕГРАЦИИ СУММАТИВНОГО И ФОРМАТИВНОГО ОЦЕНИВАНИЯ В ОБУЧЕНИИ МАТЕМАТИКЕ

Шмигирилова И.Б.[1*], Рванова А.С.[2], Таджигитов А.А.[3]

[1,3]Северо-Казахстанский университет имени М. Козыбаева, Петропавловск, Республика Казахстан*

[2]Университет ИТМО, Санкт-Петербург, Российская Федерация

[*]E-mail: irinankzu@mail.ru

Аннотация

Фактором, обеспечивающим эффективность образовательного оценивания, является интеграция ее формативных и суммативных оценочных практик. В статье представлены результаты анкетирования школьных учителей, анализ которых подтверждает потребность в педагогов в подробных, теоретически обоснованных рекомендациях, которые позволят повысить эффективность оценочных мероприятий. Цель данной статьи представить авторскую точку зрения на возможность интеграции практик суммативной и формативной оценки обучении школьников математике. Наряду с методическими рекомендациями, отражающими возможные способы интеграции формативной и суммативной оценки, в статье показан пример активного участия обучающихся в процессе разработки дескрипторов. Особо отмечено, что суммативная оценка не должна восприниматься ни школьником, ни учителем как окончание определенного этапа обучения, она должна стать основой для формирующего оценивания.

Ключевые слова: критериальное оценивание, формативная оценка, суммативная оценка, школьное образование.

Introduction

One of the most urgent problems, both in pedagogical theory and educational practice, is the problem of monitoring and evaluating the educational achievements of schoolchildren. The governments of various countries, when shaping the policy in the field of educational assessment standards, rightly believe that the assessment of student results can serve as an indicator of national educational achievements. The effective use of assessment data is fundamental to education systems. A well-thought-out assessment system, along with a qualitative analysis of assessment results, can be a powerful tool for improving the national education system. It is no coincidence that the past twenty years of this millennium have been marked by valuation reforms around the world. At the present stage, the solution to this problem is associated with the introduction of criteria-based assessment into school practice - assessment based on the correlation of learning outcomes actually achieved by students with expected learning outcomes based on clearly developed criteria [1].

According to researchers [2, 3, 4], the criteria-based assessment of the educational results of schoolchildren is designed to provide: the ability to compare the educational achievements of each student (subject and meta-subject) with the goals of mastering the educational program; mechanism for adequate interpretation of learning outcomes in the system of marks; diagnostics of not only the end product of the educational and cognitive activity of schoolchildren in the study of a certain segment of the educational material, but also the process of promoting students in the material; objectivity, continuity, reliability and transparency of control and evaluation procedures; cognitive motivation of schoolchildren, their interest in achieving the planned results; conditions for instilling the skills of self-control and evaluative independence of students through the use of various forms of including them in control and evaluation activities.

Among the many goals in foreign practice [5, 6], three target groups are recognized as particularly significant: assessment to ensure accountability in the administrative structures of

educational systems; assessment to identify progress in the training or certification of a graduate; assessment to support learning. The first two target groups are related to summative assessment and assessment to support learning – to methods of formative assessment [7, 8, 9].

Domestic researchers, as well as many Russian authors, noting the obvious separation of the functions of summative and formative assessment, do not indicate the possibility of integrating these assessment practices. Moreover, considering the main function of formative assessment to be the provision of positive feedback on the work of students [10] or describing the tools for such an assessment and noting the importance of regular feedback for it [11], the authors do not even mention the possible interaction of these two forms of evaluation, but on the contrary, they oppose them. The purpose of this article is to present the author's point of view on the possibility of integrating the practices of summative and formative assessment in teaching mathematics to schoolchildren. The implementation of this goal required the solution of the following tasks:

– based on the analysis of the results of a survey of school teachers, to identify the difficulties associated with the integration of summative and formative assessment procedures in school practice;

– to explore and generalize the most effective approaches to the implementation of summative and formative assessment in educational practice, which most fully take into account the consistency of the subject content, the characteristics of school education and the goals of assessment;

– to propose guidelines that reflect possible approaches to the integration of formative and summative assessment in teaching mathematics to schoolchildren.

The scientific novelty of the study lies in the substantiation of the possibility of systematic use of a set of various formative assessment practices that continuously accompany the entire learning process and their integration with summative assessment.

Research methods

The study was carried out using a set of theoretical and empirical methods: comparative analysis of scientific sources and regulatory documents; primary collection of empirical data; analysis and systematization of empirical material; generalization of theoretical research, advanced pedagogical experience. Establishing the level of school teachers' ability to integrate summative and formative assessment practices, as well as difficulties in this direction, required a survey to survey school teachers. For this, a questionnaire was developed, consisting of four parts, one of which was devoted to this problem. The questionnaire was peer-reviewed and posted on the Google platform. Letters with a request to participate in the survey were sent to the e-mail addresses of Kazakhstani schools, officially posted on the websites of departments and departments of education and reference websites of cities and regions of Kazakhstan. As a result, 374 school teachers took part in the survey.

Research results

An analysis of teachers' self-assessment of their own assessment practices, shown in Figure 1, proves that non-teachers, while implementing the requirements of criteria-based assessment, do not always pay due attention to formative assessment. But it is this type of assessment that should be directly aimed at helping students improve their own learning outcomes. Let us pay attention to such an important component of assessment practices as the acquaintance of schoolchildren with assessment criteria, which is part of the task of formative assessment. Only 79.94% of teachers introduce students to the assessment criteria when

completing assignments. Explaining their answers to this item, the teachers noted that they usually get acquainted with the criteria before studying the topic. However, as practice shows, before studying the topic, students do not own the material that is yet to be studied. Cannot fully understand the criteria.

Only 22.45% of the respondents indicated that they practice not just acquaintance with the criteria and descriptors, but their joint development with schoolchildren. Only 4.28% of educators provide students with the opportunity to understand that there are alternative descriptors on the basis of which their work can be evaluated. Even fewer, namely 1.87% of teachers answered that as part of the formative assessment, they help students draw up a plan for correcting their own knowledge.

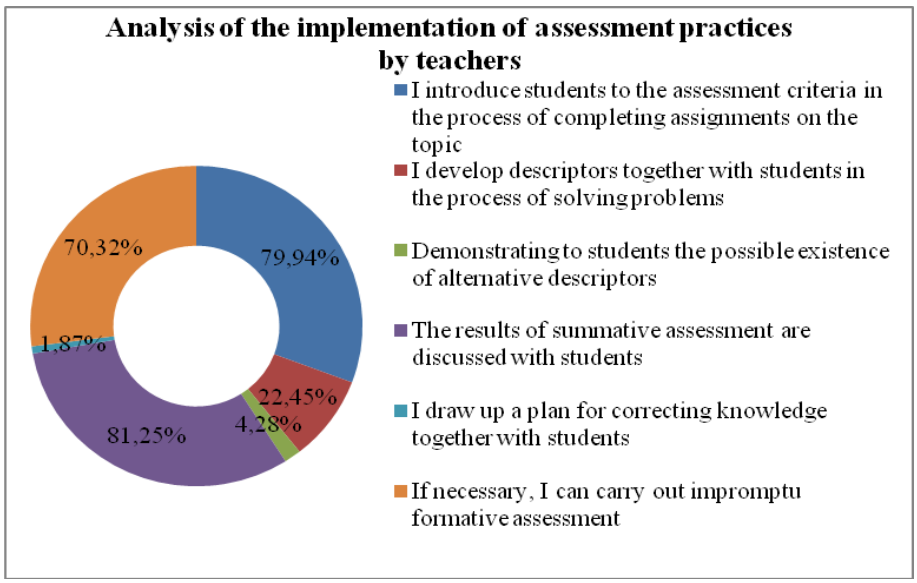


Figure 1. Analysis of the results of the survey of school teachers

Another block of the questionnaire was aimed at studying the level of evaluative competence of Kazakh teachers and areas for further improvement. Without presenting in detail the results of the answers to this block of the questionnaire, we nevertheless point out that about 10% of the teachers surveyed would like to further study certain aspects of criteria-based assessment. In addition, about 30% of teachers would like to receive advice on the practical implementation of summative and formative activities. Thus, the need for school teachers for recommendations that increase the effectiveness of assessment activities is obvious.

Discussion

The practical implementation of the principles of effective assessment in teaching mathematics, due to its subject features, has its own distinctive features. This is largely due to the fact that in teaching mathematics in Kazakhstani schools, the criteria are the ideal result of solving a particular educational task, and the descriptors are characteristics that describe specific steps (stages) of solving an objective task, which is a specific example of the educational task under consideration. At the same time, when conducting a summative assessment for a section, students should be familiar with these descriptors. Solving a mathematical task means finding the set of all its solutions, therefore the answer to any mathematical task is its objective characteristic and is uniquely defined. In turn, the process of solving a problem depends on many factors, including the subjective experience of the solver

and his intellectual abilities. Thus, the path to solving the task is not always the only one, and this fact should be taken into account when compiling descriptors for evaluation.

Thus, there may be situations, especially when it comes to teaching geometry, when the objectivity of assessment is violated: on the one hand, descriptors, defining a plan for solving a task, act as a hint, and thus "weaker" students will demonstrate results higher than those that correspond to their knowledge and skills; on the other hand, if a student has a pronounced ability in mathematics and sees a different, sometimes more rational or original, way of solving a task, then having familiarized himself with the descriptors that define one very specific way of solving and realizing that his solution will be evaluated precisely by these descriptors, the student will not write down his solution. Thus, the teacher may not even know about his special abilities for mathematics: not those that allow him to solve summative assessment tasks for the highest score, but those that determine the originality of thinking and readiness for mathematical creativity, that is, mathematical talent.

In fairness, we note that when conducting summative assessment for a quarter, students get acquainted only with general criteria, but not with descriptors for each task, however, the teacher evaluates, again, based on those descriptors that he develops for a specific solution to the task. In this case, the teacher should be ready to revise his descriptors in case of checking

the task solved by the student in a different way, of course, if the specific solution method was not indicated in the task statement.

The described task can be solved if students become familiar with the descriptors of summative assessment tasks not directly within the framework of such summative assessment, but in the process of studying the educational content of the section and in solving tasks. This organization of learning activities is interesting because it allows you to actively involve students in the formation of descriptors. In this regard, the technology of criteria-based assessment includes not only a special approach to assessing the educational achievements of students, but also opens up new opportunities in the organization of educational activities [12].

Students should be familiar with the descriptors in advance. At the same time, the teacher can offer students ready-made descriptors or organize their activities to develop descriptors. Such activity contributes to the conscious understanding of all steps in solving the problem. In addition, the possibility of different ways of solving one problem makes it possible to organize an educational study on the creation of alternative descriptors [13]. Let us give an example of such work with descriptors in the process of developing the ability to apply the method of additional constructions when solving geometric tasks with a trapezoid can be carried out in the following sequence. The first idea about the use of the method is formed in the process of solving task 1.

Task 1. Find the area of a trapezoid with bases 6 and 11 and sides 3 and 4.

Task 2. The sides of the trapezoid lie on perpendicular lines and are equal to 3 and 4. The smaller base of the trapezoid is 3. Find the larger base of the trapezoid.

Task 3. Find the area of a trapezoid with bases 3 and 6 and diagonals 7 and 8.

Task 4. The bases of an isosceles trapezoid are 20 and 16, and the diagonals are mutually perpendicular. Find the area of the trapezoid.

Task 5. The diagonals of an isosceles trapezoid are perpendicular. Find the area of a trapezoid if its midline is 7.

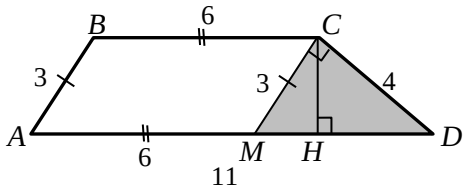
Task 6. The bases of an isosceles trapezoid are equal to a and b ($a > b$). The acute angle is 45°. Find the area of the trapezoid.

Task 7. The height of the trapezoid is 8, and the diagonals of the trapezoid are 17 and 10. Find the area of the trapezoid.

Task 8. The median line of the trapezoid is 4, the angles at one of the bases are 40^0 and 50^0. Find the bases of the trapezoid if the segment connecting the midpoints of the bases is 1.

Analyzing the steps of the solution, students, under the guidance of a teacher, form a descriptor (Table 1).

Table 1. Solution descriptors task

Solving Steps Task	Descriptors
	Builds a drawing for the task, supplements it in the course of solving.
1. Let's describ *CM*||*AB*.	Performs an additional build. Selects the resulting triangle.
2. Consider a quadrilateral *ABCM*. *AM*||*BC* (as *AD*||*BC*), *CM*||*AB* (p.1) $\Rightarrow$ *ABCM* – parallelogram (by definition) $\Rightarrow$ *CM* = *AB* = 3, *AM* = *BC* = 6 (by the property of a parallelogram). *MD* = *AD* – *AM*, *MD* = 11 – 6 = 5.	Proves that the resulting quadrilateral is a parallelogram; based on the properties of a parallelogram, proves that the elements of the resulting triangle are equal to the elements of the original trapezoid.
3. Consider ΔCMD. $CM^2 + CD^2 = MD^2 \Rightarrow \Delta CMD$ – rectangular (according to the theorem, the inverse of the Pythagorean theorem) $\Rightarrow$ $\Rightarrow S_{MCD} = \frac{1}{2} CM \cdot CD$, $S_{MCD} = \frac{1}{2} MD \cdot CH \Rightarrow$ $\Rightarrow CM \cdot CD = MD \cdot CH \Rightarrow$ $CH = \frac{CM \cdot CD}{MD}$, $CH = \frac{3 \cdot 4}{5} = \frac{12}{5}$.	Finds an element in the triangle that is necessary to solve the task.
4. $S_{ABCD} = \frac{AD + BC}{2} \cdot CH$, $S_{ABCD} = \frac{11+6}{2} \cdot \frac{12}{5} = 20{,}4$	Finds the required element or proves the required one.

The descriptors presented in Table 1 are universal in nature, that is, they describe the steps for solving most tasks solved by the specified method, but the descriptors of each step of the solution can be refined and detailed in accordance with the characteristics of the task. For example, the descriptor corresponding to the first step of the solution can be specified as follows: through the vertex of the smaller base draws a line parallel to the lateral side, while for other task s there can be the following formulations: through the vertex of the smaller base draws a line parallel to the diagonal of the trapezoid; through a given point on a smaller base (most often the middle) draws straight lines parallel to the diagonals (lateral sides).

Detailing the descriptor corresponding to the third step of the presented solution may consist in specifying a specific solution method, namely: determines the type of triangle; expresses the area of a triangle using the area formula for a right triangle; expresses the area of a triangle as half the product of the base and the height; equating the resulting expressions, finds the height of the triangle. For this stage of the solution, it is possible to develop alternative descriptors, when the first two points in the given detail are replaced by the point: expresses the area of a triangle using Heron's formula. Further, it is useful to consider the application of the developed descriptors in the course of solving the following tasks.

The stages of solving the above tasks correspond to the developed system of descriptors, while for each specific task it is possible to refine and detail the descriptors. So, for example,

clarifying descriptors for the first solution point are determined by the nature of the additional construction: a straight line passing through the vertex of the smaller base and parallel to the side (tasks 1, 2, 6); a straight line passing through the vertex of the smaller base and parallel to the diagonal (tasks 3, 4, 5, 7); straight lines passing through the middle of the smaller base, parallel to the sides (task 8).

It is obvious that such work with the task will require additional time resources, so it is advisable not to strive to compose descriptors for each of the tasks being solved, but only for tasks of a new type, or for those that are most typical for the section under study and will form the basis of the task of summarizing assessment. The main thing is to do this not from case to case, but systematically, then the students will gradually develop an understanding of how solutions are evaluated not only for the tasks for which the descriptors were formulated, but also for other tasks of the subject area. Moreover, the need to formulate descriptors forces schoolchildren to pay more attention to understanding each stage of the decision, which will positively affect the depth of mastering the educational content.

All of the above allows us to recognize such work as one of the practices that ensure the relationship between formative assessment and summative assessment. In addition, this practice makes it possible not to provide descriptors to schoolchildren directly within the framework of the COP. At the same time, one of the significant signs of criteria-based assessment will not be violated – the students' knowledge of the criteria by which their educational work will be evaluated. After all, simply familiarizing schoolchildren with the criteria in writing or when they are voiced orally by the teacher is not an end in itself for criteria-based assessment, since it does not in itself make the assessment process much more transparent, especially for schoolchildren with a low level of learning and, on the contrary, understanding the criteria and especially descriptors in connection with the subject context, not only ensures that students are aware of the standards of assessment, and, consequently, in which direction they need to move in order to improve their educational achievements.

One more direction of integration of formative and summative assessment can be proposed. This direction allows you to implement the principle of continuous repetition. It is especially important in teaching mathematics, because, due to its subject specificity, one cannot be sure that the study of subsequent sections of the discipline will be successful if the previous section was not well understood and mastered, or was forgotten over time. This direction is determined by the fact that the summarizing assessment should not be perceived by either the student or the teacher as the end of a certain stage of education. The teacher should think over the possibility of organizing work to establish the causes of errors found in solving the tasks of summative assessment and help students draw up an individual plan for correcting knowledge and skills. Thus, becomes the basis for formative.

Conclusion

Based on the results of the work carried out in conclusion, we note:

– a problematic aspect of the practice of educational assessment remains the discrete nature of assessment activities, the lack of aggregation of summative and formative assessments of educational results of schoolchildren;

– despite some nuances in the definitions of these assessment practices, both foreign and domestic authors interpret formative assessment as a process inseparable from learning, the main purpose of which is to determine the current success of students and help them achieve educational learning goals, while in the definition of summative assessment the fact of fixing

(stating) the results of the student based on the results of mastering a specific content or for a certain time period is emphasized;

– integrating formative and summative assessments will help ensure that their benefits are maintained while offsetting those aspects of them that are considered problematic.

References:

1. Rukovodstvo po kriterial'nomu otsenivaniyu dlya uchiteley osnovnoy i obshchey sredney shkol: Uchebno-metod. posobiye. / Pod red. O.I. Mozhayevoy, A.S. Shilibekovoy, D.B. Ziyedenovoy. – Astana: AOO «Nazarbayev Intellektual'nyye shkoly», 2016. – 56 s.
2. Abekova Zh.A. Sovershenstvovaniye uchebnogo protsessa pri kriterial'nom otsenivanii, yego glavnyye preimushchestva i osobennosti / Abekova Zh.A., Oralbayev A.B., Yermakhanov M.N., Dzhakipova A.S. // Uspekhi sovremennogo yestestvoznaniya. 2015. № 5. S. 295–296.
3. Bezukladnikov K.A., Krasnoborodova B.A., Kruze A.A. Kriterial'noye otsenivaniye rezul'tatov obrazovaniya: monografiya. – Perm', 2011. – 127 s.
4. Izmagambetova R.K. Bastauysh synyp oқushylarynyң oқu zhetistikterin bағalaudағy kriterialdy bағalau zhүjesinің tiimdiligi // Қazaқ memlekettik қyzdar pedagogikalyқ universitetinің Habarshysy. – 2018. –№ 4 (76). – S. 131–13.
5. Newton P.E. Clarifying the purposes of educational assessment // Assessment in Education: Principles, Policy & Practice. – 2007. – Vol. 14, No 2. – P. 149–170.
6. Archer E. The Assessment Purpose Triangle: Balancing the Purposes of Educational Assessment // Frontiers Education. – 2017. – Vol. 4, Article 41. – URL: https://doi.org/10.3389/feduc.2017.0004 (дата обращения 12.10.2020).
7. Dixson D.D., Worrell F.C. Formative and Summative Assessment in the Classroom // Theory Into Practice. 2016. Vol. 55(2). P. 153–159.
8. Pinger P., Rakoczy K., Besser M., Klieme E. Implementation of formative assessment – Effects of quality of programme delivery on students' mathematics achievement and interest // Assessment in Education: Principles, Policy & Practic. – 2018. – Vol. 25(2). – P. 160–182.
9. Vilkova L.V. Realizatsiya formiruyushchego otsenivaniya uchebnykh dostizheniy obuchayushchikhsya: problemy i puti resheniya // Nauchno-pedagogicheskoye obozreniye. – 2019. – № 4 (26). – S. 7–13.
10. Berikhanova A.E. Қazaқstandағy orta bilim beru mektepterin formativti bағalau әdisterin pajdalanudyң tiimdiligi // Abaj atyndағy ҚazҰPU-nің Habarshysy, «Pedagogika ғylymdary» seriyasy. – 2016 – № 4(52). – S. 287–291.
11. Nygmetova B.D., Sarbasov N.S. Sushchnost' kriterial'nogo ocenivaniya v usloviyah obnovleniya soderzhaniya shkol'nogo obrazovaniya // Sankt-Peterburgskij obrazovatel'nyj vestnik. – 2017. – № 2 (6). – S. 28–32.
12. Hill J., West H. Improving the student learning experience through dialogic feed-forward assessment // Assessment & Evaluation in Higher Education. –2020. – Vol. 45, No 1. – P. 82–97.
13. Shmigirilova I.B., Rvanova A.S. Organizaciya uchebnyh issledovanij po matematike v usloviyah kriterial'nogo ocenivaniya // Vestnik Kazahskogo nacional'nogo zhenskogo pedagogicheskogo universiteta. – 2019. – №4 (80). – S. 93–98.