Effective teacher feedback: adapting Internet technologies for criteria-based assessment

Symbat Zykrina, Rustem Gabdullin & Kairzhan Kozhabaev

Shokan Ualikhanov Kokshetau State University
Kokshetau, Kazakhstan

ABSTRACT: In this study, the authors focus on the organisation of criteria-based assessment in mathematics education and aim to evaluate the role of teachers' feedback in adopting ICT for organising that assessment. In the literature review covering psychology, pedagogy and methodology, the authors found scarce information on the use of Internet resources for criteria-based assessment of mathematics education, highlighting the need for research in this area. The study presented here involved 100 mathematics teachers and 56 students in secondary schools in Kazakhstan. In the experimental group of students, the method of organising teachers' feedback in the application of Internet resources developed by the authors was applied, whereas the control group used the traditional way of organising teachers' feedback. The results of the study show an increase in the level of students' learning achievement and their independence in learning mathematics after the criteria-based assessment. This study is in the forefront of examining the application of criteria-based assessment in mathematics distance education.

INTRODUCTION

Mathematics is one of the subjects that contribute to the development of students' logical thinking. When learning mathematics, students must learn logical analysis to provide consistent proof of their statements. Thus, mathematical sciences are essential to human life, and students who know numbers and patterns of simple and logical calculations are ready to accept complex challenges in life [1]. Distance education allows students to develop independent study skills, and the effective use of Internet technologies in teaching allows teachers and educational institutions to manage learning activities. Thus, while the teacher focuses on creating the necessary conditions and tools to improve the learning of their students, the students obtain great benefits by developing their cognitive abilities using computer resources. Although the modern educational practice is characterised by a steady increase in the number of Internet technologies and schools are equipped with computer hardware and various software, the low learning outcomes achieved by students indicate that the educational environment is not yet ready for the distance education model.

According to studies related to distance learning, there are several reasons for the low performance of students in this new modality [2]. First, the current Internet resources aim to improve the efficiency and performance of teachers and students in the context of educational paradigms that can be implemented without the involvement of these technologies. Second, the main criteria for the use of e-learning technologies depend on the didactic capabilities of their creators and do not always consider the real learning needs of the target population. Third, programmers who develop these Internet tools do not always receive information about the necessary psychological, pedagogical and didactic requirements from teachers and methodologists. Developers of Internet teaching resources mostly focus on extracurricular activities or the independent works of students. This is because although the learning objectives of using these technologies are defined, the roles of the learners and teachers in using these technologies during lessons, the characteristics of the criterial based assessment, the conditions for summarising the lesson, and other related elements are not considered when developing these technologies.

With the introduction of the distance education assessment, it is very important to develop students' independence based on the principles of criteria-based assessment. Therefore, the authors aim to assess the role of teachers' feedback in adopting ICT for organising criteria-based assessment of mathematics education.

LITERATURE REVIEW

The foundations of criteria-based assessment are the humanistic ideas of pedagogy reflected in the works of Western European and Russian scholars. The psychological and pedagogical foundations of criteria-based assessment originate from classic works of educational pedagogy [3-5]. The theories of the taxonomy of educational abilities, development of students in the zone of proximal development, and development in the process of activity and learning elaborated by

these scientists have become the main foundation in the formation of the principles of criteria-based assessment. Within the framework of criteria-based assessment, the aim is to develop students' skills in the learning process. Several scientists considered the role of games and various techniques and methods of teaching in the development of the cognitive and linguistic skills of students [6-8]. An analysis of scientific works about evaluation shows that the works of Murillo and Hidalgo assessed the quality of students' knowledge [9], whereas Filsecker and Kerres [10], and Wood et al [11] raised questions about the effectiveness of school assessment and the role of formative assessment in shaping students' problem-solving skills.

Regarding independent learning, Shen et al [12] and Ross [13] discussed the application of mutual assessment and self-assessment. They clearly showed the effectiveness of students' self-assessment in the formation of self-regulation, which is very important in organising distance education assessment [12][13]. Davis and Hersh examined the organisation of criteria-based assessment in mathematics lessons [14]. They revealed the features of organising criteria-based assessment, especially formative assessment in mathematics courses. They also highlighted ways of organising students' learning activities and gave examples of the formulation of tasks and task descriptors [14]. Moreover, Achtemeier et al [15], Clow [16], and Dominguez and Ridley [17] studied the organisation of assessment in distance education. According to the studies of Yessengabylov et al [18] and Yerimbetova et al [19], the use of Internet technologies contributes to the development of skills in the use of computer technology and technical thinking. Furthermore, the scientific works of Safri and Sheikh [20], Pusca and Northwood [21], as well as Kobylarczyk and Kuśnierz-Krupa [22] demonstrate the features of teaching and assessing students' knowledge in a distance format.

MATERIALS AND METHODS

Distance education significantly reduces teachers' control over the class and the contact between teachers and students, so it is very important to maintain the principles of criteria-based assessment in a remote lesson, and the teachers need to organise effective feedback with students. In this regard, feedback is the most powerful factor in improving academic performance, and the current resources for organising an on-line lesson offer several incentives to improve teacher-student feedback. For example, teachers can use social networks and platforms, such as Microsoft Teams or special e-learning platforms to organise feedback by introducing assessment criteria that facilitate the subsequent assessment of students' work. Thus, effective feedback should be addressed not to students' personalities but their activities in the lesson. To ensure this condition, it is important to organise mutual and self-assessment in the lesson using assessment descriptors, which will allow teachers to develop students' skills of recognising task descriptors, self-assessment skills and self-regulation skills.

There are several results from the research that helped understand the particularities of criteria-based assessment in mathematics distance education using Internet resources. First of all, an anonymous survey was conducted to determine the level of Internet resources usage by teachers, using a questionnaire system designed in surveymonkey.com. Mathematics teachers in secondary schools of the Akmola and Karaganda regions in Kazakhstan were selected to participate in the survey. They were selected because, compared with teachers of private and specialised schools, this category of teachers is representative of the use of Internet resources in mathematics courses in the country. The survey was conducted in Kazakh and Russian languages, and the respondents could choose the most convenient language through the links provided.

Links to the questionnaire were sent to the corporate chats of teachers, which made it possible to maintain the anonymity of the respondents. Moreover, the survey questions included the identification of the respondents because information about the school, gender of the respondent and personal data were not added. The survey questions were designed based on the research purpose and included questions about the experience of teachers, the courses they teach, the Internet resources they use, and the types of feedback they give. A total of 100 teachers (75 mathematics teachers who instruct with the Kazakh language and 25 mathematics teachers who instruct with the Russian language) took part in the survey. All teachers who participated in the survey indicated that they had received higher pedagogical education (55% have more than 15 years of work experience). The work experience of the interviewed teachers is depicted in Figure 1.

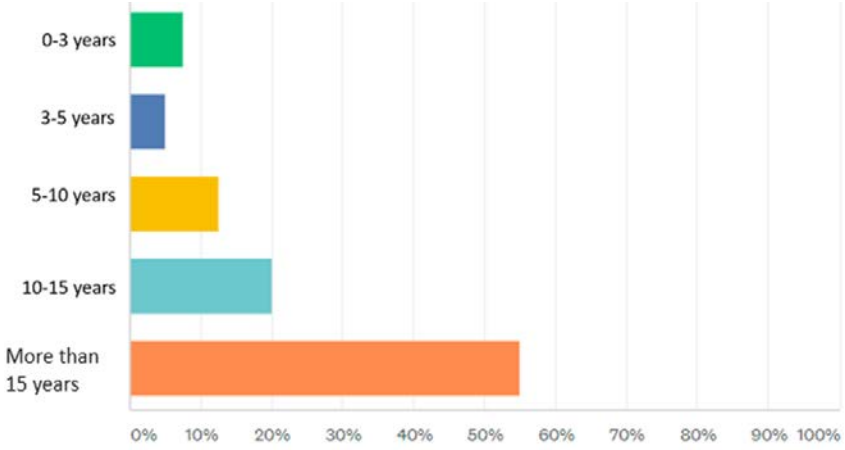

Figure 1: Work experience of the surveyed mathematics teachers.

In the survey, 97% of the teachers stated that it is important to master Internet resources in their professional development. The most popular Internet resources used in the educational process are the on-line portals, such as BilimLand, NIS Play, YaKlass and Kahoot!. The dynamics of the use of these Internet resources are presented in percentages in Figure 2.

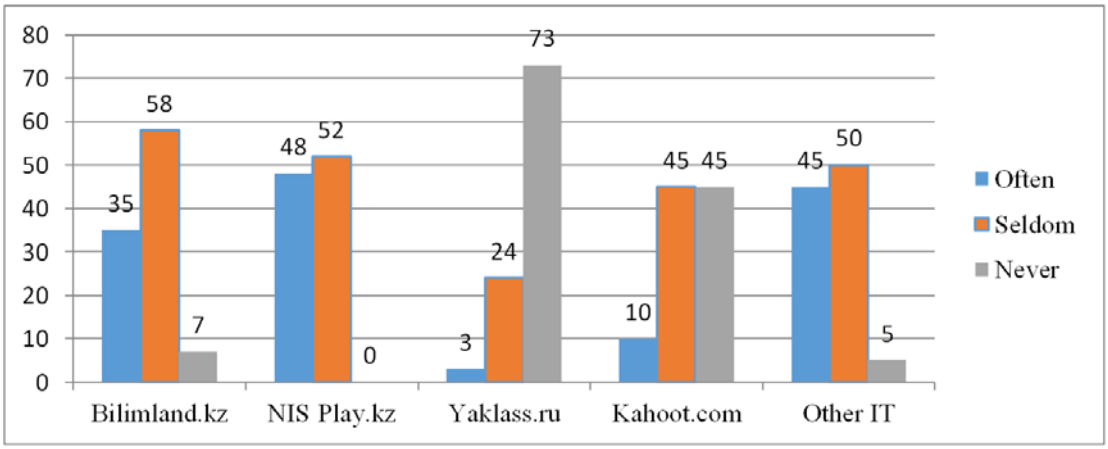

Figure 2: Dynamics of the use of Internet resources by mathematics teachers.

The most popular are BilimLand, NIS Play, and other IT. The digital educational resources of Yaklass.ru are only available to Russian-speaking teachers, as there is no Kazakh content. The game-based learning platform Kahoot.com is also rarely used in training.

The survey also revealed that teachers use more verbal feedback (67.5%) than written feedback (32.5%). These results indicate that in the context of distance learning, when personal contact between teachers and students is minimised, most teachers find it difficult to transmit feedback to students. During the investigation process, Kazakhstan's Ministry of Education and Science stated that the Internet in Kazakhstan was not technically ready for mass on-line lessons. According to the Ministry, this was verified during test lessons, and it was decided that secondary schools would use materials from on-line educational platforms. Thus, to assess the readiness of popular educational platforms for the educational process, these Internet resources were evaluated according to the following five criteria:

1) compliance of the content of Internet technologies with the curriculum adopted in general education schools and educational goals in mathematics;
2) compliance with the didactic principles of education (scientific, availability of educational material, logical sequence in the formation of knowledge and skills, visibility and simplicity of educational material and consciousness in learning);
3) the ability to create opportunities for teachers to automate the process of systematisation of students' knowledge and skills by correcting deficiencies in students' outcomes, ability to repeat educational material and tasks, and return to tasks considered;
4) open access by students to the results of a lesson;
5) transparency of student assessment tools, including the possibility of receiving feedback in connection with the introduction of criteria-based assessment.

The results of the evaluation of the readiness of Internet platforms are shown in Table 1.

Table 1: The results of the evaluation of the readiness of Internet platforms.

IT	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5
Bilimland.kz	+	+	+	+	-
Yaklass.ru	+	+	+	+	-
NIS Play.kz	-	+	+	+	-
Kahoot.com	-	-	+	+	-

Table 1 shows that the Internet platforms evaluated do not fulfil all the criteria of the assessment, which is a challenge in the implementation of Internet resources in the educational process.

RESULTS AND DISCUSSION

Because Internet technologies are only used in the course of daily classes during formative assessments, using them for criteria-based assessment is an important issue to address. An initiative in this direction was a seminar with teachers held in March 2019 at the Kokshetau State University in Kazakhstan, where the use of Internet resources for criteria-based assessment was discussed. During the discussion, some teachers noted that the transition to criteria-based

assessment had led to a decrease in students' interest in learning because, before its introduction, grading was one of the main stimulating tools. Teachers complained that the technologies they used were not adapted to criteria-based assessment and were not intended to provide feedback to students. Teachers highlighted the need for a special technique that would allow them to adapt any Internet resource to criteria-based assessment and track students' knowledge during the lesson, thereby increasing the motivation of students.

The results of the evaluation of Internet platforms show that the most suitable for adapting to criteria-based assessment are BilimLand and Yaklass. On the BilimLand Web site materials are available in three languages, so this site is the most convenient for organising criteria-based assessment.

The theoretical review shows that the process of creating task descriptors on an on-line educational platform is an important issue for determining the level of thinking skills based on Bloom's taxonomy [4]. In criteria-based assessment, the criteria are represented by three groups of levels of thinking skills: knowledge and understanding, application and high-order skills (i.e. analysis, synthesis, evaluation). To form the criteria that correspond to Bloom's taxonomy skills and the tasks of the BilimLand Web site, it is necessary to first compare them with the goal of the curriculum.

As an example, the topic *Properties of the arithmetic square root* in the 8th grade could be considered. The educational goal of this topic is *8.1.2.1 applying the properties of the arithmetic square root*. According to the level of thinking skills, tasks are offered based on the criteria for the application level. Tasks on the BilimLand Web site are presented in the form of three videos, four tasks and a test to evaluate knowledge. The first resource assignment is given to check the descriptor named …*uses properties of the square root of the product*. The second exercise is issued to check the descriptor named *uses the properties of the square root of division*. The third exercise is to test the descriptor named *uses the properties of the square root of a degree*. The fourth exercise involves checking the descriptor *knows the properties of the square root.*

After completing the tasks, the students can independently check themselves, and in the case of an incorrect answer, they can re-do the tasks, and then send the answer. After completing the tasks, one can proceed to the test execution. The first four test questions check the descriptor *finds expression value*, whereas the last two tasks are designed to check the descriptor *uses properties of the square root of degree*. Familiarisation with the descriptors is necessary for the formulation of the evaluation criteria. In this case, these descriptors generally check the following evaluation criterion: *uses the properties of the arithmetic square root when solving problems*. The exact definition of the criterion for evaluating the task will allow the students to evaluate their level of training based on the results.

To create a rubric and teacher feedback forms for formative assessment, the following levels of learning abilities in teaching mathematics are identified:

- Low level: the student learns the material after a long preparation, even if it is incomplete, he/she faces difficulties with the distribution of meaning, performs tasks only according to the model and takes a long time to fully master the material.
- Intermediate level: the student learns the material after a certain stage of preparation, is able to distinguish between basic concepts, does not immediately determine the significance, applies the acquired knowledge and methods in new situations, and takes time to reach the top.
- High level: the student is able to freely master the material, quickly shares the basics, is ready to make new conclusions, is able to freely apply the knowledge gained in new situations and quickly completes the tasks.

Based on the table for quantifying the results of criteria-based assessment, these levels were modified as shown in the rubric below (Table 2).

Table 2: A formative assessment rubric for tasks on the BilimLand platform.

The number of scored points depending on the level of training	Description
0% - 39% Low level	Has difficulties in mastering the learning objectives in accordance with the criteria. Learns the material after a long preparation, even if it is incomplete, has difficulties with the distribution of meaning, performs tasks only according to the model. It takes a long time to fully master the material.
40% - 64% Average level	Knows and understands the topic of training according to the criteria. Learns the material after a certain stage of preparation, can share the basics. Applies the acquired knowledge in new situations after a long preparation.
65% - 84% Average level	Knows and understands the topic of training according to the criteria. Does not immediately determine what is important, but applies the acquired knowledge and methods in new situations. It takes time to achieve the perfect result.
85% - 100% High level	Has a solid knowledge of the criteria for study topics. Is able to freely master the material, quickly shares the basics, is ready to draw new conclusions, is able to freely apply the knowledge gained in new situations and quickly complete tasks. Demonstrates a high level of thinking.

Table 3: Teacher's feedback table.

Final result by level of knowledge	Feedback
0% - 39%	You should re-familiarise with the video material and synopsis on the site. If you do not understand, you can consult with the teacher on the lesson materials. Repeat the tasks using the e-mail link. Good luck!
40% - 64%	You have good results in understanding this topic, but there are still errors when solving problems. After reviewing the video and synopsis on the Web site again, complete the exercises on the worksheet.
65% - 84%	You have mastered this topic well and can use it to solve problems. However, it is important to avoid mistakes in the application of knowledge and calculations. Complete the tasks on the worksheet to consolidate your knowledge and test yourself for the ready-made answers.
85% - 100%	It is clear that you have excellent knowledge of the application of this topic. You have correctly solved all the tasks (or most of the tasks). Keep it up! Complete tasks on the worksheet to consolidate your knowledge and test yourself on the ready-made answers.

This feedback from the teacher is given to the student in the form of a self-assessment sheet, which allows the teacher to summarise the lesson. The feedback does not list the student's shortcomings or use words that could demotivate them, whereas opinions and suggestions are expressed only on a specific lesson, and recommendations are given for further improvement of results. For experimental testing of the effectiveness of the method in teaching mathematics, a series of five lessons in the section *Quadratic equations* was developed for the 8th grade in the action research format. The experiment involved 8th graders who are instructed with the Kazakh language and have a similar level of student learning. The preliminary test results are shown in Table 4.

Table 4: Preliminary test results.

Group	An indicator of the quality of knowledge (%)	Number of students with a high level of learning ability	Number of students with an average level of learning ability	Number of students with a low level of learning ability
Control	71.8	7	13	8
Experimental	71.6	6	14	8

This chapter covers the topics of quadratic equations, Vieta's formulas, method for completing the square of a binomial, equations reducible to quadratic, and solving word problems using quadratic equations. For each lesson, task descriptors, assessment rubrics and teacher feedback, and differentiated homework assignments were compiled on the BilimLand Web site.

According to the study of Abylkasymova et al to develop the mathematical literacy of students by teaching applied mathematics and linking its practical orientation to everyday real life, it is necessary to expand the horizons of students, because at present the main goal of the education system is to train a specialist who is ready for competition [23]. In this regard, technical tasks were used for practical orientation in the lessons. For example: *At the technology lesson, students of the 8th grade made a box open from the top out of a metal sheet having the shape of a rectangle, the length of which is 1.5 times the width. To do this, squares with a side of 3 dm were cut out at the corners of the sheet and the resulting side faces were bent. Find the dimensions of the sheet if the volume of the resulting box turned out to be 216 cubic decimetres.* When solving this problem in a group, students compiled a mathematical model of the problem in the form of a quadratic equation and explored its roots to find the answer.

During the first lesson, the authors found that some students solved the tasks on the site faster than others and received self-assessment sheets. However, other students found it difficult to complete the tasks. Thus, it was suggested that the fast students should help the low-performing ones. However, this idea was also not successful, as some well-advanced learners simply memorised the correct answers and dictated them without explaining the solution.

Therefore, changes were made to the plan of the second lesson, and additional tasks were provided for the good students. Moreover, the slow students were allowed to ask for the teacher's advice. These changes provided differentiation in the classroom and allowed students to maintain their own pace of work. In the second lesson, the rate of homework completion increased to 93%, which is an indicator of an increase in the motivation of students.

During the third and fourth lessons, the students had already mastered the new method of testing knowledge. They were very worried when receiving the final result and did not hide their emotions.

In the fifth lesson, the impact of this method on students' academic performance and motivation was examined. The students noted that daily monitoring of results has a good effect on subsequent preparation for the lesson, thereby improving their performance in those lessons. The effectiveness of this method was also noted by parents, and since

they were interested in the success of their children, they were able to supervise their children's homework. The results of the final test are presented in Table 5.

Table 5: The results of the final test.

Group	An indicator of the quality of knowledge (%)	Number of students with a high level of learning ability	Number of students with an average level of learning ability	Number of students with a low level of learning ability
Control	77.5	8	14	6
Experimental	82.3	7	16	5

Researchers indicate that a low assessment of the importance of using ICT in teaching mathematics is a hindering factor, while a high level of knowledge and skills in working with ICT increases the use of ICT for that activity [18]. Also, the regular use of Internet technologies contributes to the development of technical competencies and digital literacy of both teachers and students. Practice shows that this affects the development of creative, critical thinking, which allows to analyse and verify the accuracy of information on Web sites, as well as the ability to create media content [19]. Based on the results of the experiment, effective teacher feedback has a positive effect on the quality of students' knowledge. At the same time, this is achieved through the effective use of ICT by teachers and students. Also, the use of practice-oriented tasks made it possible to integrate mathematical knowledge with technical knowledge and connect the learning process with everyday life.

CONCLUSIONS

The introduction of a state of emergency and distance learning has opened up a new type of teaching environment for teachers. Distance learning is the safest method of organising lessons under adverse weather conditions and when there is a threat to the health of the participants in the educational process. The research results can be used to test the effectiveness of distance learning in organising one-to-one learning and working with low-performing students.

The results of the study show that there are many advantages of using Internet resources in teaching mathematics, but the institutions and state must consider the conditions and type of resources and platforms to use to guarantee effective assessment activities. Since resources required for distance courses are purchased on the Internet, each student has the opportunity to access the educational process from a personal computer. A student may have access to educational materials during a break in classes, regardless of the reason, and parents can monitor their children's progress.

Internet technologies open the possibility of using ready-made resources that save teachers' time when designing assignments for written formative assessment of students. Moreover, the teacher saves time on checking each student individually and gets the opportunity to get acquainted with the results of mastering the material during the lesson.

A relevant advantage that emerged from this study is that self-assessment sheets allow each student to receive feedback and recommendations for further improvement from the teacher. To achieve this purpose, teachers can add didactic materials and resources to the methodological database and have the opportunity to map out the route of development of students, guided by their results in each lesson. Moreover, by receiving teacher feedback, students receive differentiated homework assignments, allowing them to learn in their own learning path and style.

However, when using Internet technologies, it is necessary to consider certain limitations that significantly affect the lessons and feedback. These limitations include the intermittence and congestion on the Internet, students' lack of internal motivation and the difficulty of performing well. Moreover, the use of Internet resources requires teachers to spend a lot of time compiling and sending feedback to students. These limitations can significantly affect the teaching of the entire class; therefore, distance learning cannot replace traditional classroom teaching, where it is possible to ensure the collaborative work of students and their effective learning interaction with both teachers and peers.

When using Internet technologies, it is necessary to ensure the following requirements for the content of these resources: compliance of the content of Internet technologies with the curriculum adopted in the general education and the educational goals in mathematics; compliance with the didactic principles of education (scientific character, availability of educational material, logical sequence in the formation of knowledge and skills, clarity and simplicity of educational material, and conscientiousness in learning).

Using Internet resources for mathematics education also requires the creation of opportunities for the teacher to automate the process of systematisation of students' knowledge and skills by correcting deficiencies and making the students repeat the educational material and tasks many times and return to the tasks as required. To achieve this, the teacher and students should have open access to the designed resources.

Another important aspect to consider in the introduction of criteria-based assessment is the transparency of student assessment tools, including the possibility of obtaining feedback. This clause also proposes that assessment descriptors should be developed for tasks on Internet sites. The practical significance of the study on this point is that to ensure

the effectiveness of the educational process, a scientifically grounded methodology for organising criteria-based assessment must be developed when using Internet technologies to teach mathematics. Thus, the methodology proposed for giving feedback from a teacher to a student will facilitate the teacher's work and increase the effectiveness of criteria-based assessment when using Internet technologies in the classroom.

REFERENCES

1. Gabdullin, R., Kozhabaev, K. and Kostangeldinova, A., Organization of educational and developmental training of school students at mathematics lessons. *Opción*. 34, **85**, 605-631 (2018).
2. Zakharova, T.B. and Zakharov, A.S., Training of teachers for the creation and development of a modern information and educational environment. *Informatics and Educ.*, 5, 85-89 (2012).
3. Glaser, R., Instructional technology and the measurement of learning outcomes: some questions. *American Psychologist*, 18, **8**, 519-521(1963).
4. Bloom, B., *Taxonomy of Educational Objectives*. New York: Longmans, 333 (1965).
5. Vygotsky, L.S., Collected works in 6 V., Problems of the development of the psyche. M. *Pedagogy*, 369 (1983).
6. Bruner, J.S., Jolly, A. and Sylva, K. (Eds), *Play Its Role in Development and Evolution*. New York: Basic Books, 1161 (1976).
7. Rogoff, B., *Apprenticeship in Thinking: Cognitive Development in Social Context*. Oxford University Press, Reprint Edition, 272 (1991).
8. Wiggins, G. and McTighe, J., *Understanding by Design*. Expanded Second Edition. Alexandria, VA: Association for Supervision and Curriculum Development. 140-142 (2005).
9. Murillo, J. and Hidalgo, N., Fair student assessment: a phenomenographic study on teachers' conceptions. *Studies in Educational Evaluation*, 65, 100860 (2020).
10. Filsecker, M. and Kerres, M., Repositioning formative assessment from an educational assessment perspective: a response to Dunn & Mulvenon (2009). *Practical Assessment, Research & Evaluation*, 17, **16**, 1-9 (2012).
11. Wood, D., Bruner, J. and Ross, G., The role of tutoring in problem solving. *J. of Child Psychiatry and Psychology*, 17, **2**, 89-100 (1976).
12. Shen, B., Bai, B. and Xue, W., The effects of peer assessment on learner autonomy: an empirical study in a Chinese college English writing class. *Studies in Educational Evaluation*, 64, 100821, 1-10 (2020).
13. Ross, J.A., The reliability, validity, and utility of self-assessment. *Practical Assessment Research & Evaluation*, 11, **10**, 1-13 (2006).
14. Davis, P. and Hersh, R., *The Mathematical Experience*. London: Penguin, 646 (1981).
15. Achtemeier, S.D., Morris, L.V. and Finnegan, C.L., Considerations for developing evaluations of online courses. *J. of Asynchronous Learning Network*, 7, **1**, 1-13 (2003).
16. Clow, K.E., Interactive distance learning: impact on student course evaluations. *J. of Marketing Educ.*, 21, **2**, 97-105 (1999).
17. Domínguez, P.S. and Ridley, D.R., Assessing distance education courses and discipline differences in their effectiveness. *J. of Instructional Psychology*, 28, **1**, 15-19 (2001).
18. Yessengabylov, I., Nurgozhayev, S., Aldabergenova, A., Smagulov, Y. and Krivankova, L., Factors in the productive use of information and communication technologies by mathematics teachers. *World Trans. on Engng. and Technol. Educ.*, 19, **4**, 392-397 (2021).
19. Yerimbetova, A., Ibraimkulov, A., Khalikova, K. and Skabayeva, G., Supporting the development of digital literacy skills for students with disabilities. *World Trans. on Engng. and Technol. Educ.*, 20, **2**, 145-150 (2022).
20. Safri, N.M. and Sheikh, U.U., Issues and challenges of technology-enhanced learning during the Covid-19 era: a case study. *World Trans. on Engng. and Technol. Educ.*, 20, **2**, 89-94 (2022).
21. Pusca, D. and Northwood, D.O., Teaching and learning engineering design: creative methods for remote education. *World Trans. on Engng. and Technol. Educ.*, 19, **3**, 306-312 (2021).
22. Kobylarczyk, J. and Kuśnierz-Krupa, D., Student assessment of remote learning as an alternative to on-campus learning at technical universities during a pandemic. *World Trans. on Engng. and Technol. Educ.*, 19, **1**, 48-51 (2021).
23. Abylkassymova, A., Mubarakov, A., Yerkisheva, Z., Turganbayeva, Z. and Baysalov, Z., Assessment of financial literacy formation methods in mathematics education: financial computation. *Inter. J. of Emerging Technologies in Learning*, 15, **16**, 49-67 (2020).