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ORIGINAL

# Inclusive assessment practices and mathematical performance among students in the Technical-Humanistic Baccalaureate

## Prácticas de evaluación inclusiva y desempeño matemático en estudiantes del Bachillerato Técnico Humanístico

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**ABSTRACT**

Introduction: For the Humanistic Technical Baccalaureate (BTH), mathematical evaluation must be relocated beyond reproducing procedures, and must also be able to prioritize the understanding, application and transfer of knowledge; knowledge that will have to be transferred to technical and socio-productive situations. Objective: To analyze inclusive evaluation practices and their link with mathematical performance indicators of students in the Educational District of La Paz 2 during the year 2026. Methods: A quantitative, non-experimental, cross-sectional, descriptive-relational study was conducted. The sample consisted of 300 teachers and 338 students selected through stratified sampling. A structured questionnaire was administered from which a Cronbach's alpha of 0.83 was obtained. Results: There was a convergence between teachers and students in the sense that if there were still memorized components in the assessment, there would be little relationship between grading and comprehension. Little incorporation of digital tools was observed and few possibilities of transferring mathematical learning to practical situations. Both actors preferred to solve real problems and to carry out projects of an applied type. Conclusions: Strengthening inclusive assessment requires expanding opportunities to demonstrate learning and explicitly linking Mathematics with the technical and socio-productive purposes of BTH.

**Keywords:** inclusive assessment; mathematics education; mathematical performance; technical education; formative assessment.

**RESUMEN**

Introducción: Para el Bachillerato Técnico Humanístico (BTH) la evaluación matemática debe ir resituada más allá de reproducir procedimientos, y también debe ser capaz de priorizar la comprensión, la aplicación y la transferencia de los saberes; saberes que habrán de transferirse a situaciones técnicas y socioproductivas. Objetivo: Analizar prácticas evaluativas de carácter inclusivo y su vinculación con indicadores de rendimiento matemático del alumnado en el Distrito Educativo de La Paz 2 durante el año 2026. Métodos: Se realizó un estudio cuantitativo, no experimental, transversal, descriptivo-relacional. La muestra estuvo constituida por 300 docentes y 338 estudiantes seleccionados mediante muestreo estratificado. Se administró un cuestionario estructurado de la que se obtuvo un alfa de Cronbach de 0,83. Resultados: Se presentó una convergencia entre docentes y estudiantes en el sentido de que de continuar existiendo componentes memorizados en la evaluación, existiría escasa relación entre la calificación y la comprensión. Se observó escasa incorporación de herramientas digitales y escasas posibilidades de transferir los aprendizajes matemáticos a situaciones de tipo práctico. Ambos actores preferían resolver problemas auténticos y la realización de proyectos de tipo aplicados. Conclusiones: Fortalecer la evaluación inclusiva requiere ampliar las oportunidades para demostrar el aprendizaje y vincular explícitamente la Matemática con los propósitos técnicos y socioproductivos del BTH.

**Palabras clave:** evaluación inclusiva; educación matemática; desempeño matemático; educación técnica; evaluación formativa.

## INTRODUCTION

Mathematics teaching in secondary education is a key element in the development of logical reasoning, problem solving, reading information presented in quantitative forms, and decision-making in academic contexts, everyday life, and the productive sphere. Its importance is especially pronounced in technical education systems; mathematical learning is not limited to the acquisition of algorithms and mathematical procedures but rather extends to developing the ability to transfer knowledge to situations related to professional specialties. In this context, assessment becomes essential, since assessment practices can either foster comprehension and application of knowledge or, conversely, reinforce rote memorization.

Contemporary research in mathematics education reveals a shift from essentially summative assessment models toward models oriented to formative assessment, understood as the use of learning evidence to adjust instruction, provide feedback, and involve students in the educational process. A recent systematic review of formative assessment in mathematics identified 45 studies conducted between 2015 and 2023 and found that formative assessment encompasses various components and is associated with cognitive, motivational, and metacognitive outcomes (1); however, its effects depend on how it is implemented and on the quality of the strategies used.

Such transformation acquires special significance from an inclusive perspective, as classroom diversity requires assessment processes to acknowledge differences in prior knowledge, learning pace, modes of participation, and support needs for achieving learning outcomes. These aspects appear in studies on inclusive formative assessment in secondary mathematics education, which have linked such assessment to personalized diagnosis, frequent feedback, and pedagogical decisions aligned with students' characteristics (2). In this framework, attention to students with disabilities does not exhaust the scope of inclusive assessment; it also includes reducing barriers that may arise before understanding tasks, participating, and demonstrating learning.

Inclusive assessment practices can be described as practices that enable students to present evidence of learning through diverse and appropriate opportunities, including feedback aimed at improvement, and that allow knowledge to be applied to relevant tasks. This approach is particularly relevant in mathematics, where performance may be linked to conceptual understanding, perceived usefulness of feedback, self-efficacy, and the opportunities students receive to detect errors and improve procedures. Rakoczy et al. (3) found that perceived usefulness of feedback and self-efficacy mediated the effects of formative assessment on variables related to mathematical learning. Similarly, Kyaruzi et al. (4) found associations among perceptions of formative assessment, use of feedback, and mathematical performance in secondary school students.

Experimental and quasi-experimental evidence also supports reconsidering the structure of assessment practices. Kültür and Kutlu (5) identified favorable effects of formative assessment on mathematical performance and attitudes toward the subject. However, the isolated incorporation of formative activities does not guarantee better results. Pinger et al. (6) demonstrated that their effectiveness depends on the quality of implementation and on the opportunities provided to students to use the feedback received. Therefore, the quality of an assessment practice depends not only on the instrument used but also on how the information produced is transformed into new learning opportunities.

Another relevant component is technological integration. Digital tools can expand assessment possibilities by facilitating progress monitoring, immediate feedback, and varied forms of interaction with mathematical content. Faber et al. (7) found positive effects of a digital formative assessment tool on mathematical performance and student motivation. Chen et al. (8) similarly identified favorable outcomes associated with technology-mediated formative assessment activities. In a review of mathematics instruction, Balbi et al. (9) highlighted the potential of digital technologies to support formative assessment while noting that their effectiveness depends on pedagogical integration and institutional conditions.

In the Latin American context, formative assessment has also been related to the development of mathematical competencies. Farfán Pimentel and Delgado Arenas (10) highlight the need to conceptualize assessment as a continuous process that allows for recognizing progress, difficulties, and learning needs. This perspective is especially pertinent in contexts where mathematical proficiency must be expressed through interpretation, problem solving, and knowledge transfer and not only through the reproduction of procedures.

These demands take on a specific dimension in technical and vocational education. Mathematics constitutes a transversal competence for understanding and solving situations linked to productive, technological, financial, and professional processes. However, the persistence of traditional methodologies, passive student participation, and limited incorporation of real situations

in mathematics teaching have been identified in technical training institutions (11). Similarly, limited exposure to tasks that allow representing and applying concepts in different ways can hinder conceptual understanding and transfer to contextualized problems (12).

In Bolivia, this problem acquires particular characteristics in the Technical Humanistic Baccalaureate, whose formative orientation seeks to articulate scientific and humanistic knowledge with technical and socio-productive competencies. Mathematics should therefore play a transversal role that allows interpreting information, performing calculations, solving problems, and constructing quantitative models related to the different specialties. A tension arises when these formative purposes coexist with teaching and evaluation practices focused mainly on abstract procedures, conventional tests, and traditional resources.

This tension acquires particular importance in the Educational District La Paz 2. Background information gathered during the research revealed perceived difficulties in mathematical learning, the persistence of memoristic components in evaluation, limited use of technological tools, and student difficulties in transferring knowledge to practical situations. At the same time, teachers and students expressed interest in strategies based on real problems and projects related to technical training.

Although international literature provides growing evidence on formative assessment, feedback, digital technologies, and mathematical performance, a significant proportion of research has been conducted in general education contexts or in technical training systems different from the Bolivian Technical Humanistic Baccalaureate. There is, therefore, a need to generate contextualized evidence on how the inclusive characteristics of assessment practices are articulated with mathematical performance in a scenario where the transfer of knowledge to technical and socio-productive situations constitutes an explicit purpose.

Based on this problem, the aim of the study was to analyze inclusive assessment practices and their correspondence with mathematical performance indicators in students of the Technical Humanistic Baccalaureate of Educational District La Paz 2 during the 2026 school year, with special consideration of the authenticity of assessment practices, technological mediation, and the transfer of learning to technical and everyday situations.

## METHODS

This research study employed a quantitative, non-experimental, cross-sectional design with a descriptive-relational scope. It was conducted during the 2026 academic year in the La Paz 2 Educational District, Bolivia. This design enabled the analysis of assessment practices under their usual educational conditions, without deliberate manipulation of variables or assignment of participants to experimental groups.

The population consisted of 1,356 teachers belonging to the technical and humanistic areas and 2,790 students at the secondary level. The sample was determined by stratified probability sampling, considering a confidence level of 95%, margin of error of 5% and expected proportion of 50%. A sample of 300 teachers and 338 students was obtained. Students constituted the main unit of analysis of mathematical performance, while the information provided by the teachers allowed to characterize and contrast the pedagogical and evaluative practices present in the context studied.

The explanatory variable corresponded to inclusive assessment practices in Mathematics, understood as the set of assessment actions aimed at offering diversified and contextualized opportunities to demonstrate learning, reducing dependence on procedures based exclusively on memorization, and favoring the use of different resources to represent and apply knowledge. This conceptualization drew on principles of formative assessment linked to the pedagogical use of evidence, adaptation of teaching practices, and diversification of assessment opportunities (1,2,13).

The operationalization was structured into three components. The first, diversification and evaluative authenticity, included indicators related to rote assessments, correspondence between grades and understanding, real problem solving, and practical projects. The second, technological mediation, considered the use of the whiteboard and notebook, computers, spreadsheets, simulators, and other digital tools, whose incorporation can expand the possibilities for assessment and learning (14). The third component, contextualization and transfer toward BTH education, included indicators linked to the use of mathematical knowledge in economic, productive, everyday, and technical situations.

The outcome variable corresponded to mathematical performance, operationalized through indicators related to perceived difficulty, comprehension of activities and content, ability to transfer knowledge to practical situations, and mathematical application in contexts associated with

technical training. Given the characteristics of the instrument, these indicators predominantly represent an approximation of perceived and applied mathematical performance.

Information was collected using structured questionnaires administered to teachers and students. The instruments included closed-ended questions, four-category frequency scales, and classification questions. The items addressed relevance and interest in the subject, perception of difficulty and learning, assessment practices, technological and methodological gap, and methodologies linked to the Technical Humanistic Baccalaureate.

Content validity was established through expert judgment and a pilot application prior to the final data collection. The internal consistency of the instrument was evaluated using Cronbach's alpha coefficient, yielding a value of □ = 0.83, considered indicative of adequate internal consistency among the analyzed items. The quality of instruments constitutes a fundamental element for evaluative information to support pertinent pedagogical decisions (13), while previous research has evidenced relationships between formative practices, mathematical performance, and metacognitive processes in secondary school students (15).

Data collection was carried out during the 2026 academic year in the participating educational units of Educational District La Paz 2. The instruments were administered after the corresponding institutional authorizations and under informed consent. Teacher and student responses were processed independently in order to preserve the differentiation between the units of analysis.

The analysis began with frequencies and percentages for categorical indicators. The perceptions of teachers and students were compared using absolute differences expressed in percentage points. Additionally, the average of the absolute differences was calculated for those indicators that had equivalent measurements in both groups, in order to establish the degree of descriptive convergence between their perceptions.

Subsequently, the indicators were integrated into four analytical axes: evaluative authenticity, technological mediation, difficulty and mathematical understanding, and transfer of learning. The correspondence between evaluative practices and mathematical performance was examined through the convergence, direction, and magnitude of these descriptive patterns. The interpretation was carried out recognizing the cross-sectional nature of the study and avoiding attributing causal relationships to the observed associations.

The research ensured the voluntary nature of participation, the confidentiality of the information, and the exclusively academic and scientific use of the data. The information was processed in an aggregated manner, avoiding the individual identification of participating students, teachers, or institutions.

## RESULTS

The results showed a tension between the evaluative practices perceived in the studied context and the strategies that teachers and students consider most favorable for mathematical learning. The greatest agreements between both groups appeared in the characterization of current practices, while differences increased when assessing alternatives for transformation and practical utility.

Table 1 shows high convergence between teachers and students regarding the limitations of the evaluative model experienced. This convergence decreases when the desired strategies are analyzed, which shows that both actors recognize similar problems in current practices, although they have partially different expectations about the modalities that should acquire greater prominence.

The coexistence of memory-based components and a preference for contextualized situations shows that educational expectations are oriented toward assessment forms capable of better representing the understanding and use of knowledge. The relatively greater student inclination toward practical projects is especially consistent with an educational modality in which learning must be linked to technical and productive activities.

The indicators show that mathematical difficulty becomes more significant when the student must transfer what has been learned to a practical situation. The main barrier is not concentrated exclusively on recognizing or understanding content, but on mobilizing it toward scenarios different from those used during instruction.

Likewise, the agreement between teachers and students regarding technological conditions indicates that the limited diversification of resources represents a shared characteristic of the educational context.

**Table 1. Inclusive assessment practices and mathematics assessment modalities**

| Dimension | Indicator | Teachers (%) | Students (%) | Difference (pp) |
|---|---|---|---|---|
| Evaluative authenticity | Assessments associated with the recall of moments | 44,54 | 43,94 | 0,60 |
| Evaluative authenticity | The grade does not fully reflect understanding and applied competencies. | 42,55 | 42,54 | 0,01 |
| Contextualization | Preference for solving real problems | 50,10 | 34,58 | 15,52 |
| Diversification | Preference for practical projects with calculations and formulas | 22,92 | 28,64 | 5,72 |

Note. pp = percentage points. Own elaboration based on the surveys applied in the La Paz 2 Educational District.

**Table 2. Perceived mathematical performance, technological mediation and transfer to the BTH**

| Component | Indicator | Teachers (%) | Students (%) | Interpretation |
|---|---|---|---|---|
| Difficulty | Mathematics identified as the subject of greatest difficulty | 29,28 | 24,16 | Difficulty recognized by both actors |
| Comprehension | New activities and content that are difficult to understand | — | 31,08 | Barriers to new learning |
| Technological mediation | Exclusive use of blackboard and notebook | 28,88 | 30,99 | Persistence of conventional resources |
| Technological mediation | Absence of simulators, Excel, or other digital resources | 26,61 | 27,24 | Limited technological diversification |
| Transfer | Utility of Mathematics for business/ family economics | 54,52 | 41,52 | Greater utility attributed by teachers |
| Transfer | Knows the theory but does not know how to apply it. | — | 39,73 | Gap between knowledge and application |

Note. The dash indicates absence of an equivalent indicator for teachers. Own elaboration.

This situation acquires special importance in the BTH, because the use of spreadsheets, simulators, and information processing tools is part of the competencies required in different technical and productive settings.

The distance between the utility attributed by teachers and that perceived by students constitutes another central finding. Mathematical content may possess an objective utility within a technical specialty without this being necessarily recognized by the student if the activities carried out do not allow direct experience of that application.

**Table 3. Descriptive integration between assessment practices and mathematical performance.**

| Pattern | Integrated evidence | Interpretation |
|---|---|---|
| Traditional assessment and comprehension | Memorization and limited correspondence between grades and understanding | Immediate reproduction maintains a greater presence than functional application. |
| Difficulty and transfer | Perceived difficulty, new content, and theory without application | Barriers increase when learning must be mobilized toward new situations. |
| Low technological diversification | Predominance of blackboard/notebook and absence of software | The possibilities of exploring and demonstrating knowledge through diverse resources are reduced. |
| Applicability gap | Greater usefulness attributed by teachers than by students | The relevance of the content is not experienced in the same way from both perspectives. |
| Demand for contextualization | Preference for real problems and projects | There is a disposition toward authentic evaluative modalities. |
| Global pattern | Memorization, limited technology, and transfer difficulties | The main tension appears to be between acquired knowledge and applied knowledge |

Note. Interpretive synthesis constructed from the analyzed indicators. Own elaboration.

The comparison of the eight indicators available simultaneously for teachers and students showed an average absolute difference of 5.34 percentage points. However, when the analysis was focused exclusively on the four indicators directly related to the current assessment conditions—memorization, correspondence between grade and understanding, predominance of chalkboard and notebook, and absence of digital tools—the average absolute difference decreased to 0.84 percentage points. This proximity reveals a high descriptive convergence between teachers and

students regarding the characteristics of the assessment scenario.

The greatest discrepancies appeared in aspects related to applicability and transformation. The difference reached 15.52 percentage points in the preference for real problem solving and 13.00 percentage points in the usefulness attributed to mathematics for economic and daily activities. Thus, both groups largely agree in recognizing the limitations of current practices, but they present more pronounced differences regarding alternatives and experienced usefulness.

Among the students, a relevant descriptive gradient was also identified. The general difficulty of mathematics reached 24.16%, increased to 31.08% when new activities and content were considered, and reached 39.73% in the indicator related to difficulties in transferring theory to practical situations. Between the first and the last indicator there was a difference of 15.57 percentage points, showing that difficulties become more pronounced when knowledge must be mobilized toward application scenarios.

Overall, these patterns indicate that the main tension of mathematical performance within the BTH is not exclusively in the acquisition of procedures, but in the ability to transform them into useful tools for solving concrete situations. The high convergence with traditional practices, combined with greater transfer difficulties and a preference for contextualized assessments, constitutes the main descriptive link between assessment practices and mathematical performance.

## DISCUSSION

The findings allow us to reinterpret the main obstacle in mathematics assessment carried out in the Technical Humanistic Baccalaureate: it is not only the difficulty of the subject, but rather the distance between the ways in which what is learned is assessed and the competencies for use pursued by technical training; that is, the distance between what is taught and what the application of the training requires. The agreement between teachers and students regarding the predominance of memory-based components and the poor correspondence between grading and understanding allows us to suppose that assessment continues to be carried out in favor of the immediate reproduction of content rather than the functional use of learning. This interpretation is consistent with Maskos et al. (1), who maintain that formative assessment is strengthened whenever the evidence obtained from its results can be used to modify teaching and advance learning, and also with Töllner et al. (2), who advocate that inclusive assessment must respond to the heterogeneity of the student body and expand the possibilities for providing evidence.

The proximity between teachers' and students' perceptions is especially significant. It is not a dissatisfaction attributable exclusively to students, but rather a limitation also recognized by those who carry out the evaluation process. Rakoczy et al. (3) identified that the perceived usefulness of feedback mediates its effects on variables related to mathematical learning, while Guo et al. (16) showed that feedback characteristics are related to self-regulated learning. Consequently, replacing a conventional test with another instrument alone does not guarantee a more inclusive assessment; the change requires that the information obtained allows for recognizing errors, revising procedures, and generating effective opportunities for improvement.

The difficulty in transferring knowledge is among the most relevant outcomes within the BTH. Mathematical learning may remain circumscribed to the school setting if the proposed tasks do not require mobilizing concepts toward different contexts. In a technical modality, this gap acquires special importance because mathematics constitutes a cross-cutting tool for interpreting quantities, modeling situations, estimating resources, processing information, and solving problems related to the different specialties.

The results must therefore be interpreted from the difference between knowing a procedure and knowing when, how, and for what purpose to use it. Szeibert et al. (17) analyzed formative assessment in mathematics within a vocational context and showed the value of integrating assessment tasks into the learning process itself. Likewise, studies conducted in technical education indicate that mathematics instruction isolated from authentic situations limits the possibility of connecting concepts with experiences relevant to students (11,12). Vimbelo and Bayaga (18) highlight, from a humanizing pedagogy applied to TVET contexts, the importance of bringing mathematical learning closer to the realities and experiences of students.

This perspective allows us to understand the difference found between the utility attributed by teachers and that recognized by students. The teacher may know the possible technical applications of content, but these are not necessarily visible to the student if they are not part of the problems, activities, and assessments used during the educational process. Consequently, curricular relevance depends not only on content having potential utility, but on the student being

able to experience and use it.

The preference for solving real problems and practical projects thus acquires a meaning that goes beyond the choice of engaging activities. These strategies shift the object of assessment from the reproduction of a response toward the mobilization of concepts, procedures, decisions, and arguments. Chang et al. (19) found that a STEM approach supported by peer assessment favored interdisciplinary performance and higher-order thinking processes. Patchan et al. (20) observed contributions of peer assessment to mathematical communication and problem solving, while Smit et al. (21) identified that formative feedback can promote mathematical reasoning and that self-efficacy plays a relevant role in that process.

The BTH results can therefore be interpreted as a demand for forms of assessment capable of better representing the applied nature of technical training. However, moving toward authentic assessment does not imply eliminating all conventional activities. Boström and Palm (22) showed that the effects of training practices depend on the concrete conditions of implementation, while Pinger et al. (23) provided evidence of interactions between formative assessment and teaching quality. The assessment transformation should combine exercises, contextualized problems, explicit performance criteria, feedback, and opportunities for revision.

The limited technological integration identified broadens this issue. The agreement between teachers and students regarding the predominance of traditional resources shows that part of the mathematical processes continues to take place within a restricted instrumental repertoire. The purpose of incorporating technology is not to replace the blackboard or manual reasoning, but to expand the possibilities of representation, modeling, data processing, and experimentation. Studies by Faber et al. (7) and Chen et al. (8) show that digital resources can support assessment and mathematical learning when they generate useful information about student progress. Balbi et al. (9) add that this potential depends fundamentally on the pedagogical integration of technology.

From an inclusive perspective, technological diversification can expand the ways in which students represent, explore, and demonstrate what they have learned. However, digitalization and inclusion are not equivalent. Inclusive assessment also requires comprehensible criteria, participation, feedback, and opportunities for revision. Zulliger et al. (24) found that the effects of self-assessment and peer assessment practices on performance depend on their quality, whereas Bottge et al. (25) showed that formative strategies accompanied by specific supports can promote mathematical learning among students who face greater barriers.

The integrated pattern of the results shows a descriptive relationship among rote memorization practices, limited technological mediation, transfer difficulties, and a preference for contextualized activities. However, because this is a cross-sectional design, these relationships should not be interpreted in causal terms. The findings characterize a pedagogical scenario in which opportunities to apply learning appear to constitute a central component for understanding mathematical performance.

The contribution of the study lies precisely in contextualizing this problem within the Bolivian Technical Humanistic Baccalaureate. Mathematical assessment practices cannot be analyzed separately from the technical and socio-productive purposes of this modality. If the BTH aims to integrate scientific, humanistic, and technical training, mathematical assessment must be capable of valuing not only the precision of a procedure, but also the ability to use it in facing authentic problems.

## CONCLUSIONS

The mathematics assessment practices implemented in the Technical Humanistic Baccalaureate of the La Paz 2 Educational District reflect the coexistence of traditional practices and a demand for more contextualized practices. The high degree of agreement between teachers and students stems from the emphasis on rote memorization components and the low correspondence between grading and understanding. This low correspondence appears to be the main challenge that assessment practice must face: the shift from the verification of content to the valuation of understanding, use, and transfer of knowledge.

Mathematics performance reveals a particularly relevant gap between knowing and knowing how to do. Difficulties are more evident when the student must apply content to practical situations, which shows that knowing and carrying out procedures do not ensure their functional use. This condition takes on particular significance within the BTH, where mathematics is a cross-cutting tool for solving technical, productive, commercial, and everyday problems.

The scarce incorporation of technological resources constitutes another aspect of the

previously described context, as little use is made of the blackboard and notebook, and the scarce opportunities for students to use simulators, spreadsheets, and programs in the field restrict the possibilities for mathematical representation, modeling, or experimentation. From the teacher's perspective, the use of technological resources should be considered as an added resource to diversify the way of learning and demonstrating competencies, not as a substitute for mathematical reasoning.

In summary, strengthening inclusive assessment requires a more coherent articulation among assessment practice, mathematical learning, and the technical and socio-productive aims of the Technical Humanistic Baccalaureate, based on the premise that the value of mathematical activity in this modality must be reflected in the student's ability to use knowledge in situations related to their specialization, not in the correct execution of the procedures they have learned.

## REFERENCES

1. Maskos K, Schulz A, Oeksuez SS, Rakoczy K. Formative assessment in mathematics education: a systematic review. ZDM Math Educ. 2025;57:679-693. https://doi.org/10.1007/s11858-025-01696-x
2. Töllner F, Kuhl P, Besser M. Formative assessment in inclusive mathematics education in secondary schools: a systematic review. Educ Sci. 2025;15(5):577. https://doi.org/10.3390/educsci15050577
3. Rakoczy K, Pinger P, Hochweber J, Klieme E, Schütze B, Besser M. Formative assessment in mathematics: mediated by feedback's perceived usefulness and students' self-efficacy. Learn Instr. 2019;60:154-165. https://doi.org/10.1016/j.learninstruc.2018.01.004
4. Kyaruzi F, Strijbos JW, Ufer S, Brown GTL. Students' formative assessment perceptions, feedback use and mathematics performance in secondary schools in Tanzania. Assess Educ Princ Policy Pract. 2019;26(3):278-302. https://doi.org/10.1080/0969594X.2019.1593103
5. Kültür YZ, Kutlu MO. The effect of formative assessment on high school students' mathematics achievement and attitudes. J Pedagog Res. 2021;5(4):155-171. https://doi.org/10.33902/JPR.2021474302
6. Pinger P, Rakoczy K, Besser M, Klieme E. Implementation of formative assessment: effects of quality of programme delivery on students' mathematics achievement and interest. Assess Educ Princ Policy Pract. 2018;25(2):160-182. https://doi.org/10.1080/0969594X.2016.1170665
7. Faber JM, Luyten H, Visscher AJ. The effects of a digital formative assessment tool on mathematics achievement and student motivation: results of a randomized experiment. Comput Educ. 2017;106:83-96. https://doi.org/10.1016/j.compedu.2016.12.001
8. Chen IH, Gamble JH, Lee ZH, Fu QL. Formative assessment with interactive whiteboards: a one-year longitudinal study of primary students' mathematical performance. Comput Educ. 2020;150:103833. https://doi.org/10.1016/j.compedu.2020.103833
9. Balbi A, Berrutti S, Tejera M, Gonzalez E, Bonilla M. Tecnologías digitales y evaluación formativa en clases de Matemática: una revisión de la literatura. Bolema. 2024;38:e230045. https://doi.org/10.1590/1980-4415v38a230045
10. Farfán Pimentel JF, Delgado Arenas R. Evaluación formativa en el desarrollo de competencias matemáticas en estudiantes de secundaria. Horizontes Rev Inv Cs Edu. 2025;9(36):458-466. https://doi.org/10.33996/revistahorizontes.v9i36.931
11. Vimbelo S, Bayaga A. Current pedagogical practices employed by a Technical Vocational Education and Training college's mathematics lecturers. S Afr J High Educ. 2023;37(4):305-321. https://doi.org/10.20853/37-4-5292
12. Sehole L, Sekao D, Mokotjo L. Mathematics conceptual errors in the learning of a linear function: a case of a Technical and Vocational Education and Training college in South Africa. Indep J Teach Learn. 2023;18(1):81-97. https://doi.org/10.17159/ijtl.v18i1.17173
13. Schildkamp K, van der Kleij FM, Heitink MC, Kippers WB, Veldkamp BP. Formative assessment: a systematic review of critical teacher prerequisites for classroom practice. Int J Educ Res. 2020;103:101602. https://doi.org/10.1016/j.ijer.2020.101602
14. Shute VJ, Rahimi S. Review of computer-based assessment for learning in elementary and secondary education. J Comput Assist Learn. 2017;33(1):1-19. https://doi.org/10.1111/jcal.12172
15. Wafubwa RN, Csíkos C. Impact of formative assessment instructional approach on students' mathematics achievement and their metacognitive awareness. Int J Instr. 2022;15(2):119-138. https://doi.org/10.29333/iji.2022.1527a
16. Guo W, Lau KL, Wei J. Teacher feedback and students' self-regulated learning in mathematics: a comparison between a high-achieving and a low-achieving secondary school. Stud Educ Eval. 2019;63:48-58. https://doi.org/10.1016/j.stueduc.2019.07.001
17. Szeibert J, Muzsnay A, Szabó C, Bereczky-Zámbó CG. A case study of using test-enhanced learning as a formative assessment in high school mathematics. Int J Sci Math Educ. 2023;21(2):623-643. https://doi.org/10.1007/s10763-022-10264-8
18. Vimbelo S, Bayaga A. Humanising pedagogy in mathematics education at South African Technical and Vocational Education and Training colleges: influence on TVET teaching and learning. Int J Learn Teach Educ Res. 2023;22(9):633-655. https://doi.org/10.26803/ijlter.22.9.34
19. Chang D, Hwang GJ, Chang SC, Wang SY. Promoting students' cross-disciplinary performance and higher order thinking: a peer assessment-facilitated STEM approach in a mathematics course. Educ Technol Res Dev. 2021;69(6):3281-3306. https://doi.org/10.1007/s11423-021-10062-z
20. Patchan MM, Rambo-Hernandez KE, Deitz BN, McNeill J. Using peer assessment to improve middle school mathematical communication. J Educ Res. 2022;115(2):146-160. https://doi.org/10.1080/00220671.2022.2074948
21. Smit R, Dober H, Hess K, Bachmann P, Birri T. Supporting primary students' mathematical reasoning practice: the effects of formative feedback and the mediating role of self-efficacy. Res Math Educ. 2023;25(3):277-300. https://doi.org/10.1080/14794802.2022.2062780
22. Boström E, Palm T. The effect of a formative assessment practice on student achievement in mathematics. Front Educ. 2023;8:1101192. https://doi.org/10.3389/feduc.2023.1101192
23. Pinger P, Rakoczy K, Besser M, Klieme E. Interplay of formative assessment and instructional quality: interactive effects on students' mathematics achievement. Learn Environ Res. 2018;21(1):61-79. https://doi.org/10.1007/s10984-017-9240-2
24. Zulliger S, Buholzer A, Ruelmann M. Observed quality of formative peer and self-assessment in everyday mathematics teaching and its effects on student performance. Eur J Educ Res. 2022;11(2):663-680. https://doi.org/10.12973/eu-jer.11.2.663

25. Bottge BA, Ma X, Gassaway LJ, Jones M, Gravil M. Effects of formative assessment strategies on the fractions computation skills of students with disabilities. Remedial Spec Educ. 2021;42(5):279-289. https://doi.org/10.1177/0741932520942954

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