

Mathematical and problem-solving skills of Alternative Learning System (ALS) learners in Aritao 1: Basis for instructional intervention

Eugenio, Judith R. ✉

Nueva Vizcaya State University, Philippines (djmeugenio@gmail.com)

Tallungan, Jenifer Raymond R.

Nueva Vizcaya State University, Philippines

Agustin, Arnel A.

Nueva Vizcaya State University, Philippines



ISSN: 2243-7703
Online ISSN: 2243-7711

OPEN ACCESS

Received: 14 April 2026
Available Online: 5 May 2026

Revised: 1 May 2026
DOI: 10.5861/ijrse.2026.26147

Accepted: 4 May 2026

Abstract

The study measured the mathematical and problem-solving skills performance of the Alternative Learning System (ALS) learners in Aritao, Nueva Vizcaya for the School Year 2025–2026. The study used a quantitative design and a descriptive-comparative approach. The respondents of the study comprised 45 ALS learners with an age range of 16 to 35 years old, who came from the eight learning communities using a purposive sampling procedure. Cluster 1 included Bone North Community Learning Center, Bone South Community Learning Center, and Ocao Community Learning Center. Cluster 2 included Nagcuartelan, Balite, and Calitlitan Community Learning Centers, while Cluster 3 included Aritao Central School and Kirang Community Learning Center. The results showed that the ALS learners in the Aritao I District generally had nearly proficient skills in mathematics and problem-solving across all three clusters. The majority of subject areas, including geometry, measurement, patterns, algebra, statistics, and probability, fell into the nearly proficient category, whereas components such as number and number sense and basic trigonometry also demonstrated nearly proficient levels. The findings indicated a significant difference in the mathematical and problem-solving skills of ALS learners across clusters in Aritao I District. A contextualized learning and development plan was designed in order to improve the level of mathematical and problem-solving skills of the Alternative Learning System learners in Aritao I District.

Keywords: Alternative Learning System learners, mathematical skills, problem-solving skills

Mathematical and problem-solving skills of Alternative Learning System (ALS) learners in Aritao 1: Basis for instructional intervention

1. Introduction

Educating learners through the Alternative Learning System (ALS) is part of the educational system in the Philippines. The ALS in the Philippines targets out-of-school children and adults, emphasizing flexible education that integrates mathematical and problem-solving abilities as essential competencies within its curricular strands. Based on the LS3 results, the SDO Nueva Vizcaya ALS LS3 had a performance of 31.86 compared to Aritao I District, which had 30.88. Basically, helping students become skilled problem solvers who can use their newly acquired abilities in practical settings is one of the primary goals of mathematics education. In other words, students are expected to understand the problem at hand, identify workable solutions, and present those alternatives. Instructors need to be able to develop a plan to help students become independent learners and problem solvers. Students should be taught problem-solving skills, which are advanced cognitive abilities that necessitate identifying the nature of a problem, analyzing it, and developing a practical plan of action to address it as the complexity of the world increases (Abazov, 2016; Oliveri et al., 2017).

According to Mefoh et al. (2017), solving a problem is an intellectual process of determining how objectives are accomplished. Solving a problem enhances learners' skills in dealing with real-world challenges (Sukariasih et al., 2020) and affects the way learners generate and develop ideas (Fitriani et al., 2020). To arrive at a solution through problem-solving, students can collaborate with their peers, interact socially, exchange new ideas, engage in critical thinking, and organize their thoughts (Sutarmi & Suarjana, 2017). Furthermore, in understanding and educational exercises, when assessing students' problem-solving skills, the process is equally as important as the learning outcomes (Melawati et al., 2022). Problem-solving is the ability to understand issues and the processes involved (Mandina & Ochonogor, 2018). Making decisions regarding activities as well as subsequent stages of the process requires a solid understanding of problem-solving (Laurens et al., 2018). Learning statistics requires students to comprehend the subject matter and develop their own interpretations, much like any other subject (Wang et al., 2022). Understanding affects students' enthusiasm and academic achievement (Damopolii et al., 2018). Students must fully comprehend the problem before deciding on the best solution (Toll, 2017). To understand the issue, they draw on their prior knowledge (Simamora et al., 2017).

Meanwhile, early mathematical performance is crucial since it increases opportunities for college and employment and is a strong indicator of later academic achievement (Amanatallah & Safa, 2021). Furthermore, it is believed that solving mathematical problems is one of the most significant activities in the teaching of mathematics and forms the foundation of mathematics education. Nonetheless, students frequently perceive it as one of the most frustrating subjects, and mathematical problem-solving is considered a challenge for learners worldwide (Mikati, 2017). The challenges include understanding the mathematical problem, formulating a workable solution, applying the solution, conducting deductive reasoning, grasping and applying mathematical concepts, understanding mathematical texts, and writing mathematical explanations. The degree of these challenges varies across grade levels and depends on the level of linguistic and conceptual difficulty of the tasks (Mikati, 2017). Because of these persistent challenges, there have been calls in many countries for significant changes in the way mathematics is taught, including instructional reforms in the subject. Furthermore, students in Lebanese schools also struggle with mathematical challenges. In Lebanon, secondary school teachers lament that students still lack the capacity for logical reasoning by the time they reach Grade 12, which forces them to rely on memorization when answering problems.

In the Philippine educational system, mathematics is one of the top priorities in terms of instructional time at all levels. The Department of Education (DepEd) allotted 50 minutes per day in the previous curriculum (Revised Basic Education Curriculum), while the K-12 Curriculum mandates one hour per day for four days a week.

Students' performance in mathematics is also evaluated through national competency assessments such as the National Achievement Test and the National Career Assessment Examination. Numerous mathematics trainings are conducted nationwide for teachers and students to promote collaboration, enhance mathematical competence, and strengthen teacher–student relationships. However, many issues and challenges still arise in teaching and learning mathematics despite the emphasis of the Philippine school system on the subject. This supports the claim made by Santos et al. (2015) that students have consistently perceived mathematics as a difficult subject since its inclusion in the curriculum.

Meanwhile, the BALS Accreditation and Equivalency Program is a non-formal education (NFE) program that certifies learning for children, youth, and adults who dropped out of school early or are unable to attend formal schooling through the Alternative Learning System (ALS). The Governance of Basic Education Act (RA 9155) defines ALS as a parallel learning system that serves as an alternative to formal education. It includes knowledge and skills acquired from both informal and non-formal sources. It is the third bureau of the Department of Education (DepEd), alongside the elementary and secondary education bureaus, where the respondents of this study are affiliated (Sanchez, 2020).

To meet educational needs, ALS provides opportunities for out-of-school youth and adults (OSYA) to develop foundational and lifelong learning skills through aligned and flexible educational pathways. This approach offers comparable instruction within the Philippine context. It was designed to provide a second chance to learners who discontinued their education or were unable to attend formal schooling due to various circumstances. Through this opportunity, learners are able to improve their quality of life. The DepEd program has transformed lives by helping out-of-school youth and adults achieve their goals. As part of its development, the ALS program underwent significant reforms beginning in 2016. The five-year ALS 2.0 Strategic Roadmap, the ALS 2.0 program, and the alignment of the ALS curriculum with the K–12 Basic Education Curriculum were outcomes of continuous evaluation and collaboration among government, non-government, and international organizations. The ALS K–12 curriculum is designed to align with the formal K–12 curriculum, although it is not an exact replication. It reflects comparable competencies adapted to real-life learning contexts. The goal is to replicate real-world learning environments through interconnected learning strands that respond to the needs of learners (Calabit, 2022).

Various initiatives have been implemented by the Department of Education (DepEd) to improve teaching strategies. One of its key platforms in addressing the educational needs of out-of-school Filipinos is the ALS. Beginning with the 2019 ALS K–12 curriculum, an enhanced curriculum was implemented (Department of Budget and Management, 2020). In 2013, approximately four million Filipino children and youth were not attending school (DepEd Order No. 021, 2019). The Department of Education has promoted the implementation of ALS to support vulnerable and at-risk populations. The principles underlying ALS are aligned with the philosophies of education that support inclusive and lifelong learning. However, operational and budgetary constraints remain, as ALS receives less than 1% of the total education budget. Addressing these limitations also requires higher education institutions, both public and private, to recognize and accept ALS learners (Atilano et al., 2016).

The K–12 Basic Education Curriculum of ALS, which follows a comprehensive and intersectoral approach, is institutionalized through Republic Act No. 11510 (2020). This act aims to develop competencies, values, and life skills among ALS learners while providing pathways across different modes of learning. Internationally, similar groups of out-of-school or low-performing learners are classified below Level 1 in mathematics by the Organisation for Economic Co-operation and Development (OECD) through the Programme for International Student Assessment (PISA), which reflects challenges similar to those experienced in ALS, particularly in basic problem-solving. Global studies on remedial algebra interventions indicate that non-traditional learners continue to struggle with problem-solving, highlighting the need for adaptive strategies applicable in ALS contexts (Pascua, 2024).

In local studies, Ilumin (2021) found that ALS learners in San Carlos City exhibited weak problem-solving abilities. Their pre-test results were significantly below expectations, and their difficulties were attributed to

limited understanding of problem-solving processes and possible dyscalculia, which improved after intervention. Similarly, findings from the Functional Literacy Test revealed that ALS learners in the Philippines demonstrated low mean percentage scores (MPS) in mathematics and problem-solving skills, highlighting disparities influenced by contextual factors such as socioeconomic conditions. Moralista and Delariarte (2017) reported that ALS learners showed low levels of critical thinking and creativity, which were associated with their diverse backgrounds that hinder the development of independent problem-solving skills.

Problem-solving is defined as the process of identifying the causes of a problem and seeking appropriate solutions (Naidu, 2006, as cited in Sanchez, 2020). This concept relates to Learning Strand 3 in this study, which focuses on Mathematical and Problem-Solving Skills in ALS and corresponds to informal mathematics learning (Sanchez, 2020). According to the 2024 Functional Literacy, Education, and Mass Media Survey (FLEMMS) conducted by the Philippine Statistics Authority (PSA), about 90.0% of Filipinos aged five and above, or approximately 93.09 million out of 103.46 million, possess basic literacy skills such as reading, writing, and numeracy. The functional literacy rate among individuals aged 10–64 is 70.8%, equivalent to around 60.17 million functionally literate individuals. Regional data show that Central Luzon has the highest basic literacy rate at 92.8%, while the Cordillera Administrative Region has the highest functional literacy rate at 81.2%. Females demonstrate higher functional literacy (74.1%) compared to males (67.6%), with the highest rate (78.3%) observed among individuals aged 20–24 (Philippine Statistics Authority, 2025).

Problem-solving has become a central focus in mathematics education. Although this study emphasizes Learning Strand 3—Mathematical and Problem-Solving Skills in ALS—it aligns with the broader goal of developing mathematical competence in formal education systems. Taplin’s work on the Problem-Solving Approach highlights its effectiveness in improving mathematics learning outcomes. Additionally, professional teaching standards emphasize a shift from viewing mathematics as a collection of procedures and facts to understanding it as a dynamic and meaningful discipline. The evaluation system used in ALS follows the same framework applied in Philippine public schools, aiming to assess whether teaching practices lead to improved learning outcomes through a balanced curriculum. Consequently, evaluation systems must provide meaningful feedback to enhance teaching and learning processes (Sanchez, 2020).

This study may benefit the Bureau of Alternative Education (BAE) by improving the achievement rates of ALS learners. It may also serve as a basis for budget allocation for division-level training and the development of instructional materials. Furthermore, the district may consider institutionalizing e-learning centers to better understand how these resources influence learners’ performance not only in mathematics and problem-solving but also in other subject areas. In accordance with the department’s vision, mission, and goal outcomes, as well as regional and global developments in the field, this study supported the Department of Education’s research agenda, which aims to address urgent issues in Philippine basic education, particularly in the Alternative Learning System (ALS). Furthermore, this study on the mathematical and problem-solving abilities of ALS learners in Aritao was directly aligned with DepEd’s Basic Education Research Agenda (BERA), especially under the overarching theme of Inclusive Education, which prioritizes strategies for diverse learners—including out-of-school youth and adults in non-formal systems such as ALS. By providing underrepresented populations with equitable access to essential skills, ALS exemplifies inclusive education. This aligns with BERA’s emphasis on teaching strategies, assessment, and learner-centered environments to address skill gaps in areas such as mathematics.

Similarly, this study analyzed low MPS in ALS mathematics domains and proposed interventions to improve proficiency, which is consistent with BERA’s Inclusive Education theme that examines preparedness for diverse learning contexts, inclusive programs, and instructional strategies. It also supported DepEd’s K–12 goals and Sustainable Development Goal 4 (SDG 4) for quality education by addressing BERA concerns regarding effective support systems for non-traditional learners, such as ALS participants facing socioeconomic challenges. Recent policies, including the 5-Point Reform Agenda and Republic Act No. 11650 (Inclusive Education Act), further emphasize the use of evidence-based research to address disparities among marginalized learners (Department of Education, 2019; Ilumin, 2021; Pascua, 2022).

Additionally, this study was grounded in Sustainable Development Goal 4, which aims to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. This is particularly relevant for out-of-school youth through flexible systems such as ALS and is directly aligned with this study on the mathematical and problem-solving abilities of ALS learners in Aritao. Specifically, Target 4.1 (achievement of relevant learning outcomes by Grade 12 equivalence) and Target 4.6 (youth and adult literacy and numeracy) highlight the importance of foundational numeracy, which is reflected in the identified low mathematics proficiency.

This study was also aligned with the research agenda of Nueva Vizcaya State University, which focuses on curriculum development and education, particularly on curriculum enhancement. Based on the Programme for International Student Assessment (PISA) results, Filipino learners demonstrated persistently low numeracy and problem-solving proficiency. In 2022, Filipino students obtained an average score of 355 points, which is below the Organisation for Economic Co-operation and Development (OECD) average of 472, with only 16% achieving the baseline Level 2 proficiency. These results highlight fundamental gaps in applying mathematical concepts to real-life situations. Disadvantaged learners were found to be six times more likely to perform poorly, further emphasizing disparities in numeracy skills (Organisation for Economic Co-operation and Development, 2023). Similarly, PISA 2018 results showed that only 19.7% of Filipino learners achieved minimum proficiency (Level 2), with public school students obtaining an average score of 353 points. These findings parallel the challenges experienced in ALS, particularly in areas such as geometry and algebra, which are influenced by socioeconomic factors and limited instructional support. Since PISA underscores numeracy deficiencies among disadvantaged groups, these findings justify the need for contextualized and remedial interventions within ALS (Organisation for Economic Co-operation and Development, 2019; Australian Council for Educational Research, 2024).

This study focused on Learning Strand 3, particularly on competencies in number and number sense, geometry, basic trigonometry, measurement, patterns and algebra, and statistics and probability. These topics were identified as the most difficult for ALS learners, as evidenced by the results of their latest mock test. The potential output of this study was the development of activity sheets aimed at improving the mathematical and problem-solving performance of ALS learners. The instructional intervention was designed to help ALS learners enhance their mathematical and problem-solving abilities. The performance of ALS learners in mathematics and problem-solving has been a concern, particularly in Aritao. The study identified the following gaps. The varied socioeconomic backgrounds of ALS learners significantly affect their attitudes toward mathematics. Many learners perceive mathematics as difficult and lack the foundational skills necessary for success. This diversity requires tailored instructional approaches to meet different learning needs. The availability of learning materials is often limited, which hinders effective modular learning. Many ALS environments are informal and lack sufficient resources, making it difficult for learners to meaningfully engage with mathematical concepts.

Studies indicate that ALS learners often lack motivation to actively participate in learning activities. This is further compounded by the perception that mathematics is difficult or uninteresting, leading to decreased engagement. Similar to formal education settings, ALS learners may drop out due to financial constraints and lack of family support. This highlights the importance of establishing support systems that address these socioeconomic challenges. Research indicates that learners' comprehension levels do not always predict their problem-solving abilities. Success in solving mathematical problems is influenced by multiple factors, including instructional strategies, learner motivation, and cognitive abilities. This suggests the need for more comprehensive assessment approaches. Differentiated instruction is necessary, as it has been shown to help bridge learning gaps among ALS learners. However, limited resources and insufficient training may hinder teachers from effectively implementing such strategies. Adapting instruction to learners' needs can improve both performance and engagement in mathematics. Addressing these gaps requires a multifaceted approach that includes enhanced teacher training, improved instructional materials, and strategies to increase learner motivation. By focusing on these areas, educational stakeholders can develop more effective instructional interventions tailored to the unique challenges faced by ALS learners in Aritao.

Additionally, the researcher, who is an ALS teacher, observed and experienced that ALS learners in Aritao exhibited low performance in mathematical and problem-solving skills, as reflected in the results of the latest mock test, which yielded a low Mean Percentage Score (MPS). The researcher also observed that some learners had difficulty performing basic operations such as division. Moreover, the researcher heard common sentiments from ALS learners such as “Nagrigat daya Mathematics,” “Makapasadut met ti agsolve ti problem solving,” and “Awan la ngata daduma nga subject ken aside ti Math,” which reflect their struggles and negative perceptions toward mathematics. For these reasons, the researcher conducted a study on the mathematical and problem-solving skills performance of ALS learners in Aritao as a basis for developing an instructional intervention.

2. Related Literature

The study was anchored on the Granular Learning Theory of Lin (2007) and the Andragogy Approach of Knowles (1980). A proposed perspective derived from recent research emphasizes that instructional delivery and assessment in ALS are case-dependent, meaning they must be tailored to the specific circumstances, conditions, and situations of the learners involved. This idea highlights the need for adaptable modalities that address the diverse needs of learners, including those who are illiterate or from underprivileged backgrounds. Examples of these modalities include in-person instruction integrated with contemporary technology and performance-based assessments. ALS aims to educate all Filipinos, regardless of age, gender, or background, who have not completed the required cycle of basic education for various reasons. Learners within the system come from diverse backgrounds, including those with learning difficulties, creating a unique learning environment. As a result, pedagogical practices vary. This research investigated the pedagogical strategies used by program implementers to facilitate learning and assess outcomes. A hypothesis was subsequently proposed along the dimensions of PDLs, IPs, and non-literate learners.

The theoretical notion that the delivery of educational services is unique and dependent on the learners’ context, condition, and circumstances supported this study. Additionally, in recognition of the diversity of learners, the assessment of their learning is conducted through multimodal approaches that consider their varied needs and learning environments. The Granular Learning Theory served as the foundation of this investigation. Its central premise is that when pedagogical practices are implemented in a granular manner, they become meaningful in delivering instruction and assessing learning, as they respond to the real-life conditions and contexts of specific groups of learners, such as those identified in this study (Labarrete & Gillo, 2023). Another theory used in this study was the Andragogy Approach. In contrast to pedagogy, which focuses on educating children, andragogy is an educational approach centered on how adults learn. Adult learners are typically self-directed, bring rich prior experiences, and are motivated by immediate life and work needs. According to this approach, developed and popularized by Malcolm S. Knowles, the instructor functions as a facilitator who helps learners identify their learning goals, connect new knowledge with prior experiences, and apply learning to real-life situations rather than merely transmitting content (Knowles, 1980; Knowles, 1990).

Learner-centeredness is a fundamental principle of andragogy, where instruction is designed based on the learner’s self-concept, readiness to learn, and problem-oriented perspective. Learning environments often employ collaborative strategies such as discussions, case studies, role-playing, and reflective activities that promote active participation and critical thinking. Research in adult education indicates that when andragogical principles are applied—such as involving learners in planning their learning and building on their experiences—engagement, retention, and the practical application of knowledge improve (Tough, 1979). Furthermore, the conceptual framework for mathematical and problem-solving skills in ALS education integrates Polya’s problem-solving model with the Department of Education’s K–12 Basic Education Curriculum structure. It emphasizes key content areas—number and number sense, measurement, geometry, patterns and algebra, and statistics and probability—while promoting processes such as understanding, estimating, visualizing, and applying mathematics in real-life contexts. This framework is grounded in constructivist and experiential learning theories, where learners actively construct knowledge through inquiry, reflection, and collaborative activities tailored for out-of-school youth and adult learners (Amalina, 2022; Gebremeskel, 2025).

3. Methodology

Research Design. This study employed a quantitative descriptive–comparative research design to examine the mathematical and problem-solving skills performance of Alternative Learning System (ALS) learners in Aritao I District, Nueva Vizcaya, Philippines. The quantitative approach was appropriate because it enabled the systematic collection and statistical analysis of numerical data to objectively measure learner performance and compare outcomes across learning clusters. The descriptive component provided a profile of learners’ mathematical and problem-solving competencies, while the comparative component determined whether significant differences existed among learner groups from different community learning clusters. As a non-experimental design, the study examined variables in their natural setting without manipulation, thereby providing an objective assessment of ALS learners’ performance within the existing instructional context.

Research Locale and Participants. The study was conducted in Aritao I District, Nueva Vizcaya, a district composed of eight Community Learning Centers (CLCs) organized into three learning clusters. Cluster 1 included Bone North, Bone South, and Ocao Community Learning Centers; Cluster 2 consisted of Nagcuartelan, Balite, and Calitlitan Community Learning Centers; and Cluster 3 comprised Aritao Central School and Kirang Community Learning Center. These centers serve diverse ALS learners from different community settings, making the district an appropriate environment for assessing variations in mathematical and problem-solving performance. The respondents consisted of 45 active ALS learners, aged 16 to 35 years old, enrolled during School Year 2025–2026. Each cluster contributed 15 learners, ensuring equal representation across the three clusters. Including all active learners provided comprehensive coverage of the district’s ALS population and strengthened the reliability of cluster comparisons.

Sampling Procedure. The study utilized purposive sampling, a non-probability sampling technique, in selecting respondents. All registered ALS learners in Aritao I District who met the inclusion criteria—active enrollment during the study period—were included. This approach was deemed appropriate because it ensured that participants possessed the relevant educational background and learning experiences necessary to address the objectives of the study. By including the entire accessible population of ALS learners, the study maximized representativeness within the district and captured a complete picture of learner performance across clusters.

Research Instrument. Data were collected using a researcher-developed Mathematics and Problem-Solving Skills Test, designed to assess competencies aligned with Learning Strand 3 of the ALS curriculum. The instrument measured learner performance across key mathematical domains, including number sense, geometry, basic trigonometry, measurement, patterns and algebra, and statistics and probability. Test items were developed using a Table of Specifications (TOS) to ensure content validity and alignment with identified competencies. Prior to administration, the instrument underwent expert validation and pilot testing in another district to establish reliability. The pilot test yielded a Cronbach’s alpha coefficient of 0.89, indicating good internal consistency and reliability. The final test was administered in a multiple-choice format appropriate for junior high school–level competencies. Learner performance was interpreted using the following proficiency levels: Highly Proficient, Proficient, Nearly Proficient, Low Proficient, and Not Proficient, providing a standardized framework for evaluating mathematical and problem-solving ability.

Data Collection Procedure. The research instrument underwent a rigorous process of review, revision, and validation by the thesis adviser, panel members, and subject-matter experts prior to administration. After securing formal approval from the Schools Division Superintendent of Nueva Vizcaya, the researcher personally administered the instrument to the identified respondents in compliance with institutional protocols and the Data Privacy Act. Data collection was conducted directly by the researcher to ensure consistency in administration and clarity in respondent instructions. Ethical standards were strictly observed throughout the process, including informed consent, confidentiality of responses, and proper handling of participant information. All gathered data were subsequently organized, tabulated, and prepared for statistical analysis.

Statistical Treatment - Appropriate descriptive and inferential statistical tools were employed:

- **Weighted Mean** was used to determine the overall level of mathematical and problem-solving skills performance of ALS learners.
- **Analysis of Variance (ANOVA)** was utilized to determine whether significant differences existed in learners' mathematical and problem-solving performance across the three learning clusters.

All statistical analyses were conducted at the 0.05 level of significance, providing the basis for interpretation, hypothesis testing, and conclusions regarding ALS learners' mathematical competency across clusters

4. Results and Discussion

The findings of this study provide important insights into the current level of mathematical and problem-solving skills among Alternative Learning System (ALS) learners in Aritao I District and offer meaningful implications for instructional planning, curriculum enhancement, and learner support interventions. The results reveal that while ALS learners possess foundational mathematical competencies, there remain substantial areas for improvement, particularly in higher-order and analytical mathematical domains. Furthermore, the presence of significant differences across learning clusters highlights the influence of contextual and instructional factors on learner performance, thereby underscoring the necessity of localized and responsive educational interventions.

First, the study revealed that the respondents attained an overall mean score of 56.58 in mathematical and problem-solving skills, which is interpreted as Nearly Proficient. This indicates that, in general, ALS learners in Aritao I District demonstrate basic competence in mathematics, possessing an emerging understanding of core concepts and the ability to apply mathematical procedures in familiar contexts. However, their performance remains below the proficient level, suggesting that while foundational knowledge exists, learners continue to experience inconsistencies in conceptual understanding, procedural fluency, and independent problem-solving ability. This finding reflects a learning profile in which mathematical competencies are developing but still require significant instructional reinforcement to achieve mastery and sustained academic confidence.

A closer examination of the different mathematical domains reveals notable variations in learner performance. Among all competency areas, geometry obtained the highest mean score of 62.50, followed closely by number sense at 61.43, both falling within the Nearly Proficient level. These findings suggest that ALS learners possess relatively stronger competence in understanding shapes, spatial relationships, measurement concepts, numerical operations, and basic quantitative reasoning. The comparatively higher performance in these domains may be attributed to their practical application in daily life, making these concepts more familiar and accessible to learners. Number sense, in particular, forms the foundation of mathematical reasoning and is frequently reinforced through real-world activities such as budgeting, counting, estimating, and interpreting numerical information. Similarly, geometry concepts are often encountered in everyday tasks involving space, distance, size, and shape recognition, which may explain learners' relatively stronger performance in this area.

In the domain of measurement, respondents obtained a mean score of 56.65, likewise interpreted as Nearly Proficient. This indicates moderate competence in understanding units, estimation, conversion, and quantitative comparison. While learners demonstrate working knowledge of measurement principles, the findings suggest that application skills may still be inconsistent, particularly in solving contextualized measurement problems that require multiple-step reasoning or conversion across units. This competency area remains important because measurement skills are highly relevant to vocational tasks, livelihood activities, and daily decision-making, particularly among ALS learners who often engage in practical and work-oriented environments. Meanwhile, patterns and algebra, with a mean score of 51.85, and basic trigonometry, with a mean score of 51.11, also registered within the Nearly Proficient range, but at the lower end of the proficiency scale. These findings suggest that learners have only basic and developing competence in abstract reasoning, symbolic representation, pattern recognition, and mathematical generalization. Algebraic thinking and trigonometric concepts often require higher-

order cognitive processing, including analytical reasoning, conceptual abstraction, and procedural integration, which may present greater challenges for ALS learners, especially those with interrupted schooling experiences or limited exposure to sequential mathematics instruction. The relatively lower performance in these areas suggests a need for more scaffolded instruction, contextualized examples, and sustained remediation to strengthen conceptual clarity and problem-solving confidence.

Most notably, statistics and probability obtained the lowest mean score of 42.22, interpreted as Low Proficient, making it the weakest mathematical domain among respondents. This finding is particularly significant because statistics and probability are essential competencies in contemporary education, supporting data interpretation, critical thinking, decision-making, and evidence-based reasoning. The low proficiency level suggests that learners experience substantial difficulty in understanding data representation, probability concepts, interpretation of statistical information, and analytical reasoning involving uncertainty or variability. This weakness may be attributed to limited instructional exposure, abstract presentation of concepts, inadequate contextualization, or insufficient opportunities for learners to engage in hands-on data analysis activities. Given the increasing importance of data literacy in modern society, this domain represents a priority area for targeted instructional intervention.

Second, the study found a statistically significant difference in the mathematical and problem-solving skills of ALS learners across the three clusters in Aritao I District, as indicated by the computed F-value of 3.21 and p-value of 0.012, which is below the 0.05 level of significance. This finding led to the rejection of the null hypothesis and confirms that learners' mathematical performance varies significantly according to cluster assignment. This result suggests that mathematical competency among ALS learners is not uniform across learning communities, but is instead influenced by contextual differences in instructional delivery, learning environment, resource availability, facilitator competence, learner support systems, and socio-economic conditions.

The significant variation across clusters may reflect differences in access to instructional materials, quality of facilitation, learner attendance patterns, exposure to enrichment activities, and the degree of community support for ALS programs. It may also indicate disparities in learners' educational backgrounds, motivation levels, and prior mathematical experiences. Since ALS learners often come from varied educational and socio-economic circumstances—including interrupted schooling, work commitments, family responsibilities, and limited academic support—their mathematical development is shaped not only by curriculum content but also by the broader learning ecology in which instruction occurs. These cluster-based differences highlight the importance of adopting differentiated, context-sensitive educational approaches rather than relying on one-size-fits-all interventions. The significance of this finding extends beyond statistical interpretation, as it underscores the need for localized assessment and cluster-responsive instructional planning. Cluster-specific challenges and strengths must be identified so that interventions can directly address the unique learning conditions of each group. This reinforces the principle that educational equity does not necessarily mean uniformity of instruction, but rather the provision of targeted support based on learners' contextual needs.

Third, in response to the significant findings of the study, particularly the identified performance gaps and cluster differences, the researcher developed a contextualized Learning and Development Program aimed at improving the mathematical and problem-solving skills of ALS learners in Aritao I District. This intervention is both timely and essential, as it addresses the specific competency weaknesses revealed by the study while recognizing the diverse learning contexts of ALS participants. The proposed program emphasizes contextualized, learner-centered, and competency-based instruction, focusing on strengthening foundational numeracy, enhancing conceptual understanding, and developing practical problem-solving skills through real-life applications. Particular emphasis is placed on improving performance in statistics and probability, as well as strengthening conceptual mastery in algebra, trigonometry, and measurement. The program incorporates differentiated instruction, remediation sessions, hands-on learning tasks, collaborative problem-solving activities, and localized examples drawn from learners' everyday experiences, making mathematics more relevant, understandable, and meaningful.

Moreover, the intervention recognizes the unique profile of ALS learners by integrating flexible learning modalities, practical applications, and motivational support mechanisms that encourage persistence and learner confidence. Capacity-building for ALS facilitators is likewise an important component, ensuring that instructors are equipped with effective pedagogical strategies for teaching mathematics in alternative education settings. The findings of this study reveal that while ALS learners in Aritao I District possess developing mathematical competence, significant gaps remain—particularly in data literacy and higher-order mathematical reasoning—and meaningful differences exist across learning clusters. These realities affirm the necessity of targeted, contextualized, and responsive educational interventions to strengthen mathematical proficiency, improve learner outcomes, and empower ALS learners with the quantitative skills needed for lifelong learning, employment readiness, and productive participation in society.

5. Conclusions

The following conclusions were drawn based on the findings of the study:

- The results suggest that many learners are not yet meeting the expected learning standards; therefore, the ALS program may require stronger remediation and reteaching strategies.
- There is a significant difference in the level of mathematical and problem-solving skills of Alternative Learning System learners in Aritao I when they are grouped according to cluster.
- The study implies that ALS learners across different clusters exhibit varying levels of mathematical and problem-solving proficiency. To address these disparities and improve learner outcomes, a contextualized learning and development program was developed specifically for ALS learners in Aritao I District. This initiative aims to enhance learners' mathematical skills and problem-solving abilities to promote more equitable skill development and better prepare them for both academic and real-life challenges.

Recommendations - The following recommendations were made based on the findings and conclusions of the study:

- To improve overall mathematics competency, targeted interventions for Alternative Learning System learners in Aritao I District may focus on low-proficiency areas such as geometry, measurement, patterns and algebra, and statistics and probability, while strengthening near-proficient skills in number sense and trigonometry. These strategies may be anchored on the DepEd Alternative Learning System guidelines, which emphasize flexible delivery, modular instruction, contextualized learning, and real-world applications.
- It is recommended that ALS teachers incorporate modules from the ALS K to 12 BEC Learning Strand 3 into weekly community-based workshops, beginning with pre- and post-assessments to monitor learner progress in identified areas of weakness. Through hands-on activities such as applying geometry in local measurements, mobile teachers may facilitate small group instruction while integrating 21st-century skills such as data interpretation. ALS graduates' success stories may also be used to motivate learners and support instructional strategies. Furthermore, to strengthen differentiated instruction, ALS facilitators may enhance their competencies through DepEd training on TPACK in mathematics, with emphasis on HOTS and SOLO-based assessments. Regular quarterly MPS reviews and updates in the Learner Information System may also be conducted to monitor improvement.
- The developed contextualized activity sheets should be utilized and distributed to all ALS learners to enhance their mathematical and problem-solving skills in geometry, measurement, patterns and algebra, statistics, and probability.
- Future researchers may conduct further studies to enhance the mathematical and problem-solving

6. References

- Abazov, R. (2016). How to improve your problem-solving skills. https://www.researchgate.net/publication/305062877_How_to_Improve_Your_Problem-Solving_Skills
- Abad, L. G. (2025). The impact of teaching materials on instructional design and professional development. *Frontiers in Education*. <https://doi.org/10.3389/educ.2025.1577721>
- Agbangba, C. E., Aide, E. S., Honfo, H., & Glèlè Kakai, R. (2024). On the use of post-hoc tests in environmental and biological sciences: A critical review. *Heliyon*, 10(3), e25131. <https://doi.org/10.1016/j.heliyon.2024.e25131>
- Agcaoili, A. B. (2025). Addressing students' learning gaps in mathematics through differentiated instruction. *IIARI Journal on Education and Social Sciences*, 16(2), 1–11. https://iiari.org/journal_article/addressing-students-learning-gaps-in-mathematics-through-differentiated-instruction/
- Ajie, R. B. (2024). Analysis of students' errors in solving trigonometry problems. *American Institute of Physics Conference Proceedings*.
- Alimondo, M. S. (2019). Analysis of mathematical and problem-solving skills: Basis for policy recommendation for alternative learning system. https://animorepository.dlsu.edu.ph/etd_doctoral/1452
- Amalina, I. K. (2022). A mathematical problem-solving framework-based integrated STEM education. *International Journal of Trends in Mathematics Education Research*, 105. <https://ijtmer.saintispub.com/ijtmer/article/view/105>
- Amalina, I. K., et al. (2023). Development and differences in mathematical problem-solving skills across the student lifecycle. *Heliyon*, 9(6), e16740. <https://doi.org/10.1016/j.heliyon.2023.e16740>
- Amanatallah, L., & Safa, N. (2021). Investigating the effects of active learning strategies on problem solving: A quasi-experimental study in cycle two. *Journal of Education and Practice*, 12(17). <https://www.researchgate.net/publication/352903333>
- Atilano, E. B., Omanito, R. G., Zayra, C. D., Domingo, J. M., & Garbin, S. L. (2016). Factors influencing the dropout rate in Alternative Learning System – Accreditation and Equivalency Program.
- Australian Council for Educational Research. (2024). PISA reveals student experiences that help—and derail—maths performance. <https://www.acer.org/my/news/article/pisa-reveals-student-experiences-that-help-and-derail-maths-performance>
- Bautista, F. J., & Navarro, T. M. (2025). Developing local culture-based instructional materials of English reading comprehension infused with Besemah cultural elements. *LitPam Journal*. <https://journal-center.litpam.com/index.php/jolls/article/view/2705>
- Bayarcal, G., & Tan, D. (2023). Students' achievement and problem-solving skills in mathematics through open-ended approach. *American Journal of Educational Research*, 11(4), 183–190. <https://doi.org/10.12691/education-11-4-2>
- Borabo, J. G., & Dio, R. V. (2025). Effectiveness of strategic intervention material in improving Filipino students' performance in science and mathematics: A meta-analysis. *Journal of Basic Education Research*, 6(2), 79–89. <https://cahaya-ic.com/index.php/JBER/article/download/1420/1123/>
- Calabit, M. (2022). Alternative learning system (ALS) program graduates and level of readiness towards tertiary education. *International Journal of Education*, 10(1). <https://airccse.com/ije/papers/10122ije05.pdf>
- Candelaria, J. (2024). Effectiveness of structured tutorial programs in enhancing problem-solving skills of ALS learners. *Philippine Journal of Educational Research*.
- Callingham, R., Beswick, K., & Ferme, E. (2015). An initial exploration of teachers' numeracy in the context of professional capital. *ZDM Mathematics Education*, 47(4), 549–560.
- Castillo, C. L. T., & Dioso, E. D. (2025). Enhancing reading and numeracy skills of ALS learners: An experimental study. *IJARIE*.
- Chytrý, V., Medová, J., Řičan, J., & Škoda, J. (2020). Relation between pupils' mathematical self-efficacy and

- mathematical problem solving in the context of teachers' preferred pedagogies. *Sustainability*, 12, 10215. <https://doi.org/10.3390/su122310215>
- Damopolii, I., Nunaki, J. H., & Supriyadi, G. (2018). Effect of problem solving learning model on students achievement. *Journal of Education Research and Evaluation*, 2, 1–9. <https://doi.org/10.23887/jere.v2i1.12558>
- Dela Cruz, A. V., & Fernandez, R. T. (2025). The relationship between instructional materials availability and student engagement in science education. *RIS International Journal*. <https://rsisinternational.org/journals/ijrias/articles/the-relationship-between-instructional-materials-availability-and-student>
- Dela Cruz, J. K. B., & Lapinid, M. R. C. (2014, March). Students' difficulties in translating worded problems into mathematical symbols. *DLSU Research Congress 2014*. http://www.dlsu.edu.ph/conferences/dlsu_research_congress/2014
- Department of Education. (2017). *K to 12 basic education curriculum for the Alternative Learning System (ALS-K to 12): Learning Strand 3*. <https://www.deped.gov.ph/wp-content/uploads/2019/01/LS-3-Mathematical-and-Problem-Solving-Skills.pdf>
- Department of Education. (2019). *Learning Strand 3: Mathematical and problem-solving skills*. <https://www.deped.gov.ph/wp-content/uploads/2019/01/LS-3-Mathematical-and-Problem-Solving-Skills.pdf>
- Department of Education. (2020). About the Alternative Learning System. <https://www.deped.gov.ph/about-als/>
- Department of Education. (2025). LS3 modules with worksheets solid figures. ALS Region VIII.
- Docktor, J. L., Dornfeld, J., Frodermann, E., Heller, K., Hsu, L., Jackson, K. A., et al. (2016). Assessing student written problem solutions: A problem-solving rubric with application to introductory physics. *Physical Review Physics Education Research*, 12, 010130.
- Driver, M. K., & Powell, S. R. (2015). Symbolic and nonsymbolic equivalence tasks: The influence of symbols on students with mathematics difficulty. *Learning Disabilities Research & Practice*, 30, 127–134. <https://doi.org/10.1111/ldrp.12059>
- Edson, A. J., Phillips, E., Slanger-Grant, Y., & Stewart, J. (2018). The arc of learning framework: An ergonomic resource for design and enactment of problem-based curriculum. *International Journal of Educational Research*, 1–12. <https://doi.org/10.1016/j.ijer.2018.09.020>
- Eggen, P., & Kauchak, D. (2013). *Educational psychology: Windows on classrooms* (9th ed.). Pearson Education.
- Fajria, F., Rahmatan, H., & Halim, A. (2017). The impact of the problem solving learning model on motivation and learning outcomes. *Indonesian Journal of Science Education*, 5, 86–93. <https://doi.org/10.24815/jpsi.v5i2.9822>
- Fegsa, M. J. N. (2025). Development and validation of locally sourced math manipulatives for Grades 1 and 2 pupils. *Asian Journal of Advanced Research and Reports*, 19(4), 49–58. <https://doi.org/10.9734/jar/2025/v19i4963>
- Feletti, G. (1993). Inquiry-based and problem-based learning: How similar are these approaches to nursing and medical education? *Higher Education Research & Development*, 12(2), 143–156. <https://doi.org/10.1080/0729436930120203>
- Fitriani, A., Zubaidah, S., Susilo, H., & Al Muhdhar, M. H. I. (2020). The effects of integrated problem-based learning, predict, observe, explain on problem-solving skills and self-efficacy. *Eurasian Journal of Educational Research*, 20, 45–64. <https://doi.org/10.14689/ejer.2020.85.3>
- Garay Abad, L. (2025). The impact of teaching materials on instructional design and professional development. *Frontiers in Education*. <https://doi.org/10.3389/feduc.2025.1577721>
- Garcia, M. L., & Reyes, R. M. (2025). Teaching strategies and instructional materials in English for Indigenous learners in Zambales. *AJHSSR*. <https://www.ajhssr.com/wp-content/uploads/2025/05/S25905167178.pdf>
- Garfield, J., & Ben-Zvi, D. (2008). *Developing students' statistical reasoning: Connecting research and teaching practice*. Springer.
- Gebremeskel, A. A. (2025). Student engagement, conceptual understanding, and problem-solving ability in

- learning plane geometry. *Eurasia Journal of Mathematics, Science and Technology Education*.
<https://www.ejmste.com>
- Gunawan, H. A., Nisyah, M., Kusdiastuti, M., & Herayanti, L. (2020). Improving students' problem-solving skills using inquiry learning model combined with advance organizer. *International Journal of Instruction*, 13, 427–442. <https://doi.org/10.29333/iji.2020.13427a>
- Hardini, H. T., & Widayati, I. (2016). The influence of problem-based learning model toward students' activities and learning outcomes on financial management subject. *Dinamika Pendidikan*, 11, 123–129.
<https://doi.org/10.15294/dp.v11i2.8937>
- Heffernan, E. (2025). Purposive sampling | Definition & examples. *QuillBot*.
<https://quillbot.com/blog/research/purposive-sampling/>
- Hermansyah, H., Gunawan, G., Harjono, A., & Adawiyah, A. (2019). Guided inquiry model with virtual labs to improve students' understanding on heat concept. *Journal of Physics: Conference Series*, 1153, 012116.
<https://doi.org/10.1088/1742-6596/1153/1/012116>
- Hsiao, H.-S., Lin, C.-Y., Chen, J.-C., & Peng, Y.-F. (2018). The influence of a mathematics problem-solving training system on first-year middle school students. *Eurasia Journal of Mathematics, Science and Technology Education*, 14, 77–93. <https://doi.org/10.12973/ejmste/77902>
- Illumin, I. (2021). Improving the performance of the Alternative Learning System learners in basic mathematical operations through A.L.O.D.I.A. *e-Saliksik*. https://e-saliksik.deped.gov.ph/wp-content/uploads/2022/05/I_2021_Illumin_Improving-the-Performance-of-the-Alternative-Learning-S...
- Illumin, J. I. (2022). Improving the performance of Alternative Learning System learners in basic mathematical operations through alternative instructional materials. *DepEd e-Saliksik*.
- Jusmawati, S., Irman, R., Rahman, A., & Arsyad, N. (2021). The impact of creative problem-solving learning model based Android towards learning outcomes of elementary school students. *Journal of Physics: Conference Series*, 2123, 012045. <https://doi.org/10.1088/1742-6596/2123/1/012045>
- Kadence International. (2024). What is quantitative research? <https://kadence.com/en-us/what-is-quantitative-research/>
- Kim, H. Y. (2015). Statistical notes for clinical researchers: Post-hoc multiple comparisons. *Restorative Dentistry & Endodontics*, 40(2), 172–176. <https://doi.org/10.5395/rde.2015.40.2.172>
- Kingsdorf, S., & Krawec, J. (2014). Error analysis of mathematics word problem solving across students with and without learning disabilities. *Learning Disabilities Research & Practice*, 29, 66–74.
<https://doi.org/10.1111/ldrp.12029>
- Klang, N., Karlsson, N., Kilborn, W., Eriksson, P., & Karlberg, M. (2021). Mathematical problem-solving through cooperative learning—the importance of peer acceptance and friendships. *Frontiers in Education*, 6, 710296. <https://doi.org/10.3389/educ.2021.710296>
- Khoiriyah, A. J., & Husamah, H. (2018). Problem-based learning: Creative thinking skills, problem-solving skills, and learning outcomes of seventh grade students. *JPBI Jurnal Pendidikan Biologi Indonesia*, 4(2), 151–160. <https://doi.org/10.22219/jpbi.v4i2.5804>
- Knowles, M. S. (1980). *The modern practice of adult education: From pedagogy to andragogy* (Rev. ed.). Association Press.
- Knowles, M. S. (1990). *The adult learner: A neglected species* (4th ed.). Gulf Publishing.
- Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2018). How does realistic mathematics education improve students' mathematics cognitive achievement? *Eurasia Journal of Mathematics, Science and Technology Education*, 14, 569–578.
- Lindberg, S. M., Hyde, J. S., Petersen, J. L., & Linn, M. C. (2010). New trends in gender and mathematics performance: A meta-analysis. *Psychological Bulletin*, 136(6), 1123–1135.
<https://doi.org/10.1037/a0021276>
- Lin, T. (2007). Granular computing and its applications. *CAAI Transactions on Intelligent Systems*, 2(6), 8–26.
<https://doi.org/10.1515/cait-2015-0071>
- Liu, M., Bryant, D. P., Kiru, E., & Nozari, M. (2021). Geometry interventions for students with learning disabilities: A research synthesis. *Learning Disabilities Research & Practice*, 36(4), 244–257.

- Oliveri, M. E., Lawless, R., & Molloy, H. (2017). A literature review on collaborative problem solving for college and workforce readiness. *ETS Research Report Series, 2017*, 1–27.
<https://doi.org/10.1002/ets2.12133>
- Ontario Association for Mathematics Education. (2022). *Patterning and algebra, Grades 4–6*.
<https://oame.on.ca/eduproject/ontariomathedresources/files/Patterning%20and%20Algebra%204-6.pdf>
- Organization for Economic Co-operation and Development. (2019). *PISA 2018 results (Volume I): What students know and can do*. OECD Publishing. <https://doi.org/10.1787/5f07c754-en>
- Organization for Economic Co-operation and Development. (2023). *PISA 2022 results (Volume I): The state of learning and equity in education*. OECD Publishing. <https://doi.org/10.1787/53f23881-en>
- Pascua, R. B. (2022). Numeracy skills of ALS elementary learners. *International Multidisciplinary Journal of Research for Innovation, Sustainability, and Excellence, 1*(1), 1246–1553.
<https://risejournals.org/index.php/imjrise/article/download/1246/1549/3768>
- Pascua, R. B. (2024). Functional literacy test (FLT) of Alternative Learning System (ALS) learners. *International Journal of Research and Scientific Innovation, 8*(3S).
<https://rsisinternational.org/journals/ijriss/Digital-Library/volume-8-issue-3s/1863-1870.pdf>
- Philippine Statistics Authority. (2025). *2024 Functional Literacy, Education and Mass Media Survey (FLEMMS) final results* [Press release]. <https://www.scribd.com/document/945681347/2024-FLEMMS-Press-Release-Final-Results-signed>
- Pongsakdi, P. (2023). The association between working memory and mathematical problem-solving. *Frontiers in Psychology, 14*, 1091126. <https://doi.org/10.3389/fpsyg.2023.1091126>
- Punhagui, G. C. (2019). Using problem-solving as a method for the development of self-regulation of learning with adolescents: An experience report. In *Metacognition in learning*. IntechOpen.
- Raahanah, R., Mulyani, S., & Saputro, S. (2016). The effectiveness of problem solving learning models such as search solve create and share (SSCS) and cooperative problem solving (CPS) in terms of mathematical ability on learning achievement. *Incandescent Journal, 11*, 75–80.
<https://doi.org/10.29303/jpm.v11i2.106>
- RAND Corporation. (2025). Understanding how teachers select and adapt instructional materials.
<https://www.kiddom.co/insights/transforming-k-12-education-solutions-schools-are-adopting-for-2025-2026>
- Republic Act No. 11510. (2020). An act institutionalizing the Alternative Learning System in basic education for out-of-school children in special cases and adults and appropriating funds therefor. Official Gazette of the Philippines.
- Ross, S. M. (2014). *Introduction to probability and statistics for engineers and scientists* (5th ed.). Academic Press.
- Sanchez, M. (2020). Toward enhancing e-modules in teaching problem-solving in the Alternative Learning System. *The Summit 2015*. <https://rpo.ua.edu.ph/wp-content/uploads/2020/08/Summit-2015-5.-Melissa-Sanchez-182-217.pdf>
- Santos, M. L. K. P., Diaz, R. V., & Belecina, R. R. (2015). Mathematical modeling: Effects on problem solving performance and math anxiety of students. *International Letters of Social and Humanistic Sciences, 65*, 103–115. <https://doi.org/10.18052/www.scipress.com/ILSHS.65.103>
- Santos, J. P., & Cruz, L. A. (2025). Development and validation of instructional material for Araling Panlipunan based on learners' needs analysis. *International Journal of Advanced Research in Multidisciplinary Social Sciences*. <https://garph.co.uk/IJARMSS/Feb2025/G-3115.pdf>
- Sappaile, B. I., & Djam'an, N. (2017). The influence of problem-solving methods on students' mathematics learning outcomes. *Global Journal of Engineering Education, 19*, 267–272.
- Scribbr. (2023). Descriptive research: Definition, types, methods & examples.
<https://www.scribbr.com/methodology/descriptive-research/>
- Simamora, R. E., Sidabutar, D. R., & Surya, E. (2017). Improving learning activity and students' problem solving skill through problem based learning (PBL) in junior high school. *International Journal of Science and Basic Applied Research, 33*, 321–331.

- Sinaga, B., Sitorus, J., & Situmeang, T. (2023). The influence of students' problem-solving understanding and results of students' mathematics learning. *Frontiers in Education*.
<https://doi.org/10.3389/educ.2023.1088556>
- Sintema, E. J. (2023). High school students' beliefs about mathematical problem solving. *ERIC*.
<https://files.eric.ed.gov/fulltext/EJ1391467.pdf>
- Siregar, N. C., Rosli, R., & Maat, S. M. (2019). Development of the D-geometry module based on discovery learning. *International Journal of Academic Research in Progressive Education and Development*, 8(3), 99–109. <https://doi.org/10.6007/IJARPED/v8-i3/6290>
- Sukariasih, L., Tahang, L., Nursalam, L. O., & Fayanto, S. (2020). Description of physics problem-solving in the topic of static fluid: Case study of physics education. *Universal Journal of Educational Research*, 8, 4568–4579. <https://doi.org/10.13189/ujer.2020.081025>
- Sutarmi, K., & Suarjana, I. M. (2017). Increasing student learning outcomes using problem solving methods in learning. *Elementary School Scientific Journal*, 1, 75–82. <https://doi.org/10.23887/jisd.v1i2.10141>
- Sutarno, S., Setiawan, A., Kaniawati, I., & Suhandi, A. (2017). Pre-service physics teachers' problem solving skills in projectile motion concept. *Journal of Physics: Conference Series*, 895, 012015.
<https://doi.org/10.1088/1742-6596/895/1/012015>
- Taha, M., & Ahamad, N. (2021). Cognitive skill development among ALS learners: Critical thinking and problem solving. *International Journal of Research in Innovative Social Sciences*.
- Terry, A. (2024). Quantitative research designs, hierarchy of evidence and validity. *Nursing Open*.
<https://pmc.ncbi.nlm.nih.gov/articles/PMC12056466/>
- Toll, C. A. (2017). A problem-solving model for literacy coaching practice. *Reading & Writing Quarterly*, 70, 413–421. <https://doi.org/10.1002/trtr.1532>
- Tolar, T. D., Fuchs, L., Fletcher, J. M., Fuchs, D., & Hamlett, C. L. (2016). Cognitive profiles of mathematical problem solving learning disability. *Journal of Learning Disabilities*, 49, 240–256.
<https://doi.org/10.1177/0022219414538520>
- Toraman, Ç., Orakçı, Ş., & Aktan, O. (2020). Analysis of mathematics achievement, reflective thinking and metacognition. *International Journal of Progressive Education*, 16, 72–90.
<https://doi.org/10.29329/ijpe.2020.241.6>
- Tough, A. (1979). *The adult's learning projects: A fresh approach to theory and practice in adult learning*. Ontario Institute for Studies in Education.
- United Kingdom Research Journal of Humanities and Social Sciences. (2026). The lived experiences of ALS facilitators and learners. *UKRJAHS*, 8(1), 25–36. <https://ukrpublisher.com/wp-content/uploads/2026/01/UKRJAHS-0189-2026.pdf>
- Van De Walle, J., Karp, K. S., & Bay-Williams, J. M. (2016). *Elementary and middle school mathematics: Teaching developmentally*. Pearson.
- Velasco, G. Y., & Lomibao, L. S. (2024). Learning mathematics with Alternative Learning System: A literature review. *Journal of Innovations in Teaching and Learning*, 4(1), 61–65. <https://doi.org/10.12691/jitl-4-1-10>
- Wang, C., Li, J., Li, H., Xia, Y., Wang, X., Xie, Y., et al. (2022). Learning from errors? The impact of erroneous example elaboration. *BMC Medical Education*, 22, 469. <https://doi.org/10.1186/s12909-022-03460-1>

