

Assess-Discuss-Assess (ADA) Technique for Pre-Service Mathematics Teachers Licensure Preparation

Shiraz Dawn A. Tanginan

Faculty, College of Education, Cebu Technological University - Main Campus

Abstract

This study examined the effectiveness of the researcher-proposed Assess–Discuss–Assess (ADA) technique as a learning enhancement strategy in College Algebra for pre-service mathematics teachers. The ADA technique is a theory-based educational approach that integrates assessment for learning, social construction of knowledge, and cognitive reinforcement into a unified process. A quasi-experimental pretest–posttest parallel group design was employed with 60 fourth-year BSEd Mathematics students, equally divided into experimental and control groups. The experimental group was taught using the ADA intervention, while the control group underwent traditional lecture-based review. A researcher-made 50-item College Algebra test served as the instrument which underwent content validation by three math instructors, pilot testing for item clarity, and reliability checking via internal consistency. With data analyzed using descriptive statistics, paired t-tests, and independent sample t-tests, findings showed significant improvements in both groups, but the experimental group achieved higher mean gains and more consistent performance. Results affirm the ADA technique’s effectiveness in strengthening mastery and enhancing LET readiness.

Keywords: Teaching Mathematics, College Algebra, Learning Enhancement Strategy, Licensure Examination for Teachers (LET), Pre-service Mathematics Teachers, Quasi-experimental

1. Introduction

Licenses are regarded by educational institutions worldwide as a minimum qualification to teach (Yauney, 2022). In European nations, not less than two years of licensed teaching experience is needed and licenses are viewed as the most reliable teaching credential (Algate, 2022). After finishing undergraduate education, a teaching license is mandatory in certain parts of Asia (Adoniou & Gallagher, 2016; Yauney, 2022). As required by the Commission on Higher Education (CHED), qualifying in the Licensure Examination for Teachers (LET) is a defining moment for education graduates in the Philippines. It is the primary prerequisite for teaching, a national criterion for teacher competency, and a factor in determining the standard of instruction in teacher education institutions (Antiojo, 2017; Guzman, 2020).

As a preparation for the LET, a state university in Cebu offers Learning Enhancement subjects for third-year and fourth-year students covering the three key components of the exam—General Education, Professional Education, and Specialization or Majorship. These subjects are designed to reinforce foundational knowledge, strengthen pedagogical skills, and enhance content mastery, aligning with the

university's efforts to equip education graduates with the competencies required to pass the LET and succeed in the teaching profession.

Notwithstanding these initiatives, the overall situation shows that LET performance face difficulties. Declining pass rates and the increasing need for qualified teachers have led to constant pressure on teacher training programs both locally and internationally to enhance their review techniques (Paz et al., 2024). Mateo (2017) found that half of the colleges and institutions that offered elementary and secondary teacher preparation programs had passing rates that were lower than the national average. Similar findings were noted by Cruz et al. (2024) in a study conducted at a university in Metro Manila, where graduates with a BEED and a BSED failed to meet the PRC's passing standard in the professional education component. As Puertos and Canay (2022) emphasized, the Licensure Examination reflects not only the readiness of individual examinees but also the quality of instruction provided by TEIs. This underscores the need for innovative, evidence-based review interventions to enhance performance outcomes.

For Mathematics majors, proficiency in content areas such as Algebra, Trigonometry, Geometry, Calculus, and Statistics is crucial for LET success. Studies highlight conceptual and procedural deficiencies, weak algebraic reasoning, and high levels of mathematics anxiety as major obstacles (Rittle-Johnson & Schneider, 2014). Since traditional teaching methods relied on memorization and repetition of concepts, students were not strengthening their critical thinking, problem-solving, or decision-making abilities (Wang, 2022).

Locally, this challenge resonates within a state university in Cebu, where anecdotal evidence and internal observations reveal that while Learning Enhancement subjects are implemented, many students still struggle with critical algebraic concepts. These difficulties are compounded by limited feedback mechanisms, shallow review strategies, and insufficient focus on metacognitive processes.

The Assess-Discuss-Assess (ADA) technique is a researcher proposed intervention and was devised to bridge this gap. In contrast to conventional reviews, it integrates established methods into a singular formative process—pre-assessment, guided discussion, and post-assessment—designed to enhance understanding of certain subtopics sequentially. Research in teacher education underscores the necessity for focused micro-interventions that not only review content but also scaffold student mental processes, facilitate peer interaction, and enhance metacognition (Neyney, 2023).

Regardless of the potential of ADA, structured formative models within the framework of LET preparation are still underexplored. Although the literature validates the components of ADA separately, no known local research has systematically evaluated this whole approach for College Algebra review. This research is intended to address the gap by offering evidence about the intervention's efficacy and practicality as a framework for enhancing math teacher education graduates' readiness for the licensure examination.

2. Literature Review

Both local and international research confirm that performance on licensing examinations is linked not just to subject understanding but also to academic preparedness, review frameworks, and psychological readiness. Recent data (Heretape & Paglinawan, 2024) substantiates that review programs combined with academic support services such as mentorship and formative feedback are associated with enhanced self-reported test readiness.

The ADA technique (Assess–Discuss–Assess) incorporates three empirically validated strategies: formative assessment, collaborative discussion, and retrieval practice. Each component corresponds with proven learning theories: formative learning, constructivist theory, and retrieval-based learning.

Formative assessment (FA) is a fundamental component of ADA's "Assess" phase for enhancing student performance using timely, actionable feedback. The efficacy of formative assessment is enhanced when integrated into organized learning cycles. According to Moyo et al. (2022), the capacity of students to solve higher-order thinking problems in mathematics was greatly improved by formative assessment interventions. Granberg et al. (2021) similarly discovered the impact of formative assessment treatments in improving learner's self-regulated learning, an essential skill for exam preparation and autonomous study. This is consistent with a research undertaken in Rwanda's Western Province's Nyamasheke District that examined the utilization of formative assessment by upper secondary educators to raise learners' performance and enthusiasm for mathematics. It was shown that students benefit from formative assessment since it fosters their collaborative and active learning. Nevertheless, the study's findings demonstrated that instructors don't give pupils the kind of feedback that can help them learn more effectively. According to the study, teachers should help students effectively and give them feedback that helps them learn mathematics better (Ukobizaba & Byukusenge, 2023).

In the local context, Ambrosio et al. (2021) examined the present status of formative assessment methodologies in higher education in the Philippines, specifically within mathematics instruction. It was noted that several instructors were shifting towards more student-centered and performance-based evaluations, while the implementation remained inconsistent. The research highlighted the necessity for organized, well-supported frameworks of formative assessment in higher education institutions.

Another local research on formative assessment was also made by Ebajan and Tamban (2024) who employed the FRAME technique (Feedback, Reframe, Assess, Model, Enhance) to raise the mathematical achievement of Grade 9 students in Laguna. Their quasi-experimental methodology demonstrated that the intervention group showed considerably greater mean improvements in comparison with the control group. The researchers determined that the integration of formative assessment with strategic feedback and modeling significantly enhances student understanding and motivation. This underpins the formative assessment framework of the ADA method, namely its initial and tertiary stages (Assess–Assess), which employ testing as a feedback tool for both learners and educators.

Peer-led conversations, a fundamental component of ADA's "Discuss" phase, revealed the impacts of collaborative instruction strategies and discovered that they significantly improved math results and were useful in reaching grade-specific learning objectives (Simpson, 2023 ; Jones et al.,2022 ; and Ismail et al.,2022). In a similar way a study conducted by Gillies (2016, 2019) found that students who consistently participated in collaborative tasks performed better in mathematics than their peers.

Math performance was consistently greater when learning was collaborative. According to Peñeda (2023), a local study conducted in Tacloban City, Leyte repeatedly demonstrated that classroom collaboration is a great teaching method to help learners enhance their grasp of the concepts and confidently answer problems in mathematics.

A local study on team learning was also conducted in Taytay, Rizal which revealed the performance and participation level of the learners prior to and following their involvement with Peer-Led Team Learning differed dramatically. There was a significant difference in all three engagement factors: involvement, enthusiasm, and cooperation. Overall, there is a substantial difference in the mean engagement levels of students prior to and following PLTL implementation (Lamina, 2020).

On the other hand, Muzsnay et al. (2024) investigated the enduring impacts of retrieval practice in higher education mathematics. Their findings indicated that students who participated in systematic review via repeated testing remembered content significantly greater than those who depended exclusively on re-

reading or lectures. Consistent results were also shown in the study conducted in South Africa among second-year education students who were taking a course in mathematics. The findings indicate a significant shift in scores before and after the test within groups. Results verify that retrieval practice is most beneficial for unfamiliar content (May, 2024). This underscores ADA's implementation of re-assessment to enhance retention and strengthen mathematical fluency, especially in preparation for rigorous examinations such as the LET.

The study of Segumpan et al. (2025) affirms the need for targeted and systemic recalibration of teacher education programs to foster equitable licensure success and ensure high-quality classroom instruction in both elementary and secondary education. Heretape and Paglinawan (2024) assessed diverse academic support services and review programs aimed at enhancing LET readiness among pre-service educators. Their findings demonstrated that structured review strategies, especially those that included evaluation and active student participation, were more helpful in enhancing perceived exam preparedness and performance. These data validate the efficacy of ADA as a systematic, dynamic, and assessment-integrated review method for board examination preparation.

The integration of the study's variables, anchored on robust theoretical foundations, and empirical evidence, underscores the relevance to explore the potential of the proposed intervention: Assess–Discuss–Assess (ADA) technique in equipping education graduates for the Licensure Examination for Teachers (LET).

3. Methodology

3.1. Design

This study utilized a quasi-experimental research design to determine the degree to which the Assess–Discuss–Assess (ADA) technique enhances pre-service math teachers' performance in algebra. Lam and Wolfe (2023) define quasi-experimental research as involving comparison of groups without random assignment, often using intact groups in real-world educational contexts. Two groups were included in the design: a control group that was subjected to conventional review procedures and an experimental group that was given the ADA intervention. A pretest and a posttest were given to the two groups so that the performance improvements resulting from the intervention could be compared.

3.2 Environment

The study was carried out at a state university situated in Cebu City, Philippines. The institution is a non-profit higher education establishment officially accredited by the Commission on Higher Education of the Philippines.

3.3 Participants

The participants of this research comprised of upcoming fourth-year Bachelor of Secondary Education (BSEd) Mathematics students. Written informed consent was obtained from all participants. Due to the conduct of the intervention during the summer term, the number of available students was limited, as not all enrolled students were present during the break. Hence, a purposive sampling technique was employed, selecting only those who were both available and willing to participate in the study. To determine whether the sample size was adequate for statistical analysis, a power analysis was performed using parameters commonly applied in educational research. Assuming a medium effect size (Cohen's $d = 0.5$) based on findings from a pilot study of similar intervention design, a significance level of 0.05, and a statistical power of 0.80, the required minimum sample size for a paired t-test was calculated to be at least 21 participants. The present study involved 60 participants both in the control and experimental group who

completed the pre-test and post-test. This number exceeded the minimum requirement, ensuring sufficient statistical power to detect meaningful differences between pre and post-intervention performance. While the sample size provided sufficient statistical power for within-group comparisons, generalizability may still be limited due to the relatively small cohort size. Given that the same set of participants took the pre-test and post-test, the paired t-test was employed to analyze the data. This design allowed the researcher to directly measure individual learning gains attributable to the intervention while minimizing variability due to differences in participant characteristics. Because the study utilized all eligible and available participants during the summer term, the findings represent the complete cohort of qualified and willing students for that period. However, generalization to other populations, institutions, or academic terms should still be made with caution, as the sample reflects a specific group under particular conditions.

3.4 Instrument

This study utilized a researcher-made 50-item Mathematics Achievement Test in College Algebra as its primary instrument for measuring the mathematical proficiency of pre-service teachers. The instrument underwent content validation by three math instructors, pilot testing for item clarity, and reliability checking via internal consistency.

3.5 Data Gathering Procedure

The instructional intervention spanned four weeks: The experimental group underwent sessions based on the Assess–Discuss–Assess (ADA) technique, an interactive instructional model that fosters active learning and immediate feedback. The strategy was implemented over a period of four weeks, with three sessions per week, resulting in a total of 12 sessions. Each session lasted two to three hours.

The control group engaged in conventional lecture-based review sessions, which covered the same Algebra topics but followed a more traditional, teacher-centered approach without the structured assess-discuss-assess cycle.

After the intervention period, both groups took the same 50-item test as a post-test in the same manner as the pretest. This allowed for comparison of learning gains and the evaluation of the effectiveness of the ADA technique compared to the traditional method.

Below are the phases of the intervention of the study: the Assess-Discuss-Assess (ADA) Technique:

Phase 1 – Initial Assess

The session began with a 20-item quiz on a targeted topic. This initial assessment served as a diagnostic tool to gauge students' existing knowledge and identify misconceptions. It provided both the learners and the instructor with real-time feedback on performance, ensuring that the session addressed actual gaps in understanding.

Phase 2 – Discuss

Following the initial assessment, students engaged in structured peer discussions facilitated by the instructor. During this stage, they compared solutions, explained reasoning, and clarified misconceptions. The instructor guided the discussion, provided targeted mini-lectures when necessary, and ensured that students could connect correct concepts to the LET-type problems. Activities included:

- Peer critique and error analysis
- Group problem-solving
- Guided explanation of step-by-step solutions
- Linking concepts to LET application scenarios

Phase 3 – Final Assess

The session concluded with a re-assessment using another 20-item quiz of equivalent difficulty and cove-

rage.

The twelve instructional sessions were systematically designed to address fundamental topics in College Algebra. These included rational expressions and equations, linear equations and inequalities, quadratic equations and functions, exponential and logarithmic functions, systems of equations and inequalities, sequences and series, complex numbers, problem solving and other related concepts, graphs and their applications, as well as matrices and determinants. Collectively, these areas provided a comprehensive framework for reinforcing the essential competencies required in the subject.

3.5 Statistical Treatment

The gathered data underwent systematic processing procedures to ensure the validity and reliability of the results. To find out if the data satisfied the requirements for employing parametric testing, a test of normality was carried out initially. Paired t-test and independent samples t-test were used to statistically treat the data.

4. Results and Discussion

A test of comparability was conducted on the pretest scores of the control and experimental groups using an independent samples t-test. Results showed no significant difference between the two groups, $t(58) = -0.018$, $p = .986$, suggesting that they were comparable prior to the implementation of the intervention. The assumption of normality was met as indicated by the Shapiro–Wilk test, $W = 0.968$, $p = .110$.

To determine whether the control group exhibited a significant improvement in performance after traditional instruction, a paired sample t-test was conducted on their pretest and posttest scores.

Table 1

Test of Significance of Difference Between the Pretest and Posttest Scores of the Control Group

Measure	Mean	Std. Dev.	Mean Gain	T	df	p-value	Decision	Interpretation
Pretest	26.40	6.00						
Posttest	33.67	5.72	7.27	-7.77	29	< .001	Reject H0	Significant

*significant at $p < 0.05$

As shown in Table 1, there was a mean gain of 7.27 points. The results of the paired samples t-test revealed that the increase in scores from pretest to posttest was statistically significant, $t(29) = -7.77$, $p < .001$. Since the obtained p-value is less than the level of significance set at 0.05, the null hypothesis was rejected. This indicates that the difference observed was unlikely due to chance alone. Furthermore, the reduction in standard deviation from 6.00 in the pretest to 5.72 in the posttest suggests that the participants' performance became slightly more consistent after the intervention. Before performing the t-test, the Shapiro–Wilk test of normality was applied to verify that the data met the assumption of normal distribution. The result ($p = .501$) indicated no significant deviation from normality, thereby satisfying the assumption for the use of a parametric test.

Overall, the findings show that the control group exhibited a statistically significant improvement in performance from pretest to posttest. While the improvement was notable, the magnitude of the mean gain will be compared to that of the experimental group to assess whether the intervention applied to the latter group produced a greater effect. Students have been learning and growing as individuals for millennia

through the use of traditional teaching methods. Until the present, the majority of instruction in schools still takes place through conventional means like books, whiteboards, or even lectures. This approach has a number of shortcomings. Traditional learning methods' limitations include the inability to engage students leading to boredom, and their inability to visualize abstract ideas (Liono et al., 2021).

To determine whether the experimental group's performance improvements were statistically significant, a paired sample t-test was applied to their pretest and posttest results.

Table 2
Test of Significance of Difference Between the Pretest and Posttest Scores of the Experimental Group

Measure	Mean	Std. Dev.	Mean Gain	t	df	p-value	Decision	Interpretation
Pretest	26.43	8.22						
Posttest	39.1	6.99	12.67	-10.22	29	< .001	Reject H0	Significant

*significant at $p < 0.05$

As shown in Table 2, the group's performance improved from the pretest to the posttest by a mean gain of 12.67 points, with posttest scores consistently higher than pretest scores. This improvement was found to be statistically significant, $t(29) = -10.22$, $p < .001$. The null hypothesis that there is no difference between the two sets of scores is rejected because the calculated p-value is less than the significance level of 0.05. The large t-value and very small p-value provide strong evidence that the observed increase in performance was not due to chance.

Compared with the control group, which registered a smaller improvement, the experimental group's higher mean gain reflects the effectiveness of the instructional strategy in promoting a deeper understanding of the subject matter and enhancing learning outcomes.

Prior to the t-test, the assumption of normality was assessed using the Shapiro–Wilk test. This test is recommended for small to moderate sample sizes and has greater power than alternative tests such as Kolmogorov–Smirnov. The Shapiro-Wilk test was deemed appropriate to confirm the normality assumption necessary for the use of t-tests in this investigation, with 30 respondents per group. The data satisfied the criteria for using a parametric test, since the findings showed no discernible deviation from normality ($p = .414$).

In summary, the experimental group exhibited a statistically significant and educationally meaningful improvement in performance from pretest to posttest. The size of the gain, combined with the reduction in score variability, points to the success of the applied instructional approach that focused on the combination of formative assessment, constructivist guided learning and retrieval practice in fostering learning. Several research demonstrated that constructivist teaching methods, retrieval-based learning, and formative assessment techniques all had a statistically significant impact on students' mathematical proficiency and is advised that teachers implement such approaches to support student-centered classrooms in mathematics instruction (Kultur and Kutlu, 2021; Sezuo, 2022; Buchin & Mulligan, 2022).

To further evaluate the effectiveness of the ADA technique, an independent samples t-test was performed to compare the mean gain scores of the control and experimental groups.

Table 3

Test of Significance of Mean Gain Difference in the Pre-Test and Post-Test Performance Level between the Control and Experimental Group

Group	n	Mean Gain	SD	t	df	p-value	Decision	Interpretation
Control	30	7.27	5.13	-3.48	58	< .001	Reject H0	Significant
Experimental	30	12.67	6.79					

*significant at $p < 0.05$

As shown in Table 3, results indicated a statistically significant difference between the two groups, $t(58) = -3.48$, $p < .001$, with a Cohen’s d of -0.898 , representing a large effect size. This finding means that the improvement in scores from pretest to posttest was significantly greater in the experimental group compared to the control group.

In practical terms, the experimental group appeared to acquire more from the applied instructional technique than the control group, which was given traditional training, based on the difference in mean gains. The magnitude of the difference underscores the potential of the intervention to enhance students’ mathematical performance, aligning with prior research emphasizing the value of active, strategy-based approaches to instruction. Teachers must employ innovative techniques that promote students’ learning and thinking along with active learning techniques, as the use of modern teaching methods improves thinking processes more effectively than conventional methods (Hammadi, 2022).

5. Conclusion

According to the study, both the experimental and control groups showed improvement from the pretest to the posttest, but the experimental group exposed to the Assess–Discuss–Assess (ADA) technique showed significantly greater gains in College Algebra performance. This confirms that the ADA technique is more effective than traditional instruction, producing higher achievement and more consistent results among learners. These findings highlight the value of ADA-based instruction in strengthening pre-service teachers’ readiness for the Licensure Examination for Teachers.

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