Training on Concept Mastery and Reasoning for the Academic Ability Test (TKA) Among Senior High School Students in Malang City

Novie Ary Priyanti[1],Novan Habiburrahman[1],M. Zainul Muttaqin[1] Agung Hariadi[1]

[1]Universitas Kristen Cipta Wacana, Malang, Indonesia

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Abstract
The Academic Ability Test (TKA) is an essential instrument used in university admission processes, measuring students' reasoning, numerical literacy, verbal comprehension, and conceptual mastery. However, many senior high school students in Malang City face significant difficulties in understanding reasoning-based question patterns, indicating the need for structured and intensive training. This community service activity aims to improve students' abilities in solving TKA questions by emphasizing concept mastery and higher- order reasoning. The training included material explanation, guided problem-solving, practice exercises, simulations, and evaluations through pre-tests and post-tests. Results showed significant improvements, with a 28% increase in conceptual understanding, a 34% increase in reasoning skills, and 82% of participants reporting that the training helped them better understand TKA question patterns.

1. Introduction

The Academic Ability Test (TKA) is designed to measure higher-order thinking skills (HOTS), including logical reasoning, numerical analysis, verbal interpretation, and conceptual understanding. In Indonesia's current university entrance selection system, TKA emphasizes analytical thinking rather than memorization, requiring students to process information, identify relationships, evaluate patterns, and draw accurate conclusions.

National and international assessments consistently indicate that Indonesian students require substantial improvement in reasoning-based competencies. Report findings from the OECD Programme for International Student Assessment (PISA) show that Indonesia ranks low in mathematical literacy, data interpretation, and logical reasoning. These results demonstrate that learning in schools has not adequately emphasized the development of critical and analytical thinking skills.

In Malang City, despite strong academic environments, similar challenges persist. Teachers report that learning in classrooms remains dominated by content delivery rather than reasoning development. Students are rarely exposed to non-routine, analytical questions similar to TKA, and structured practice is still limited. Moreover, large disparities in academic ability among students, along with test-related anxiety, further contribute to difficulties in preparing for TKA.

To address these issues, the lecturers at Universitas Kristen Cipta Wacana implemented a community service program titled "Training on Concept Mastery and Reasoning for the Academic Ability Test." This program aims to strengthen students' foundational academic skills, improve their reasoning abilities, familiarize them with modern question formats, and cultivate analytical and systematic thinking aligned with the competencies demanded in 21st-century learning.

*Corresponding author, email:
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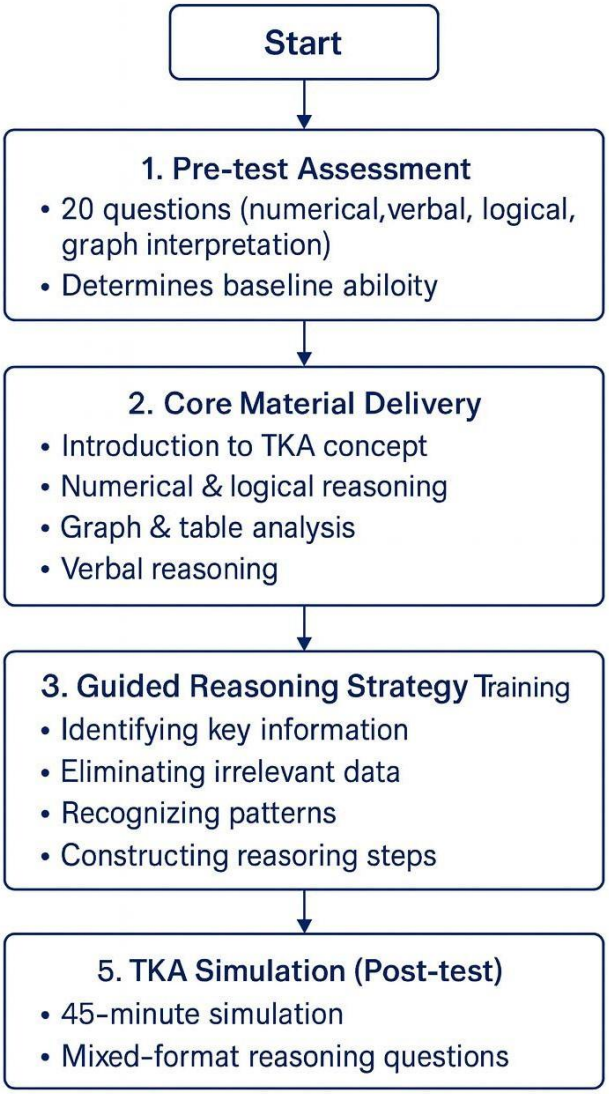
2. Method

This community service program was conducted with a total of 51 senior high school students from SMK Telkom Malang in Malang City, particularly those in grades XII. The training was designed using a structured, step-by-step approach that integrates concept strengthening, guided reasoning, active practice, and assessment.



1. Training Structure

The program consisted of six major stages

1. Pre-test Assessment

A diagnostic pre-test consisting of 20 TKA-format questions was administered to measure the students initial abilities in:

- Numerical reasoning
- Verbal reasoning
- Logical reasoning
- Data and graph interpretation

The purpose of this assessment was to identify baseline competency levels and inform the subsequent training approach.

2. Core Material Delivery

Participants were provided with essential explanations regarding:

- The structure and purpose of the Academic Ability Test (TKA)
- Basic numerical concepts commonly appearing in TKA
- Logical reasoning frameworks (patterns, inference, conditional statements)
- Graph and table interpretation strategies
- Reading and analyzing short verbal passages
- Common traps and misconceptions within TKA questions
- Delivery was conducted through interactive lectures supported by slides, examples, and group demonstrations.

3. Reasoning Strategy Training

A guided problem-solving approach was used to strengthen students reasoning skills. This included:

- Identifying key information within a question
- Recognizing relevant versus irrelevant variables Applying elimination strategies to narrow down answer options
- Constructing logical sequences and evaluating relationships
- Using rapid reasoning shortcuts to optimize time
- Analyzing question structures to identify underlying patterns
- This session aimed to shift students' thinking from procedural to analytical.

4. Intensive Practice Sessions

Students worked on multiple sets of TKA-style questions with varying levels of difficulty. Activities included:

- Solving problems in small groups
- Discussing reasoning processes collectively
- Presenting solutions and defending their arguments
- Receiving direct feedback on reasoning quality and accuracy
- This stage emphasized *learning by doing* and promoted collaborative thinking.

5. TKA Simulation (Post-test)

A timed TKA simulation was administered with the following features:

- 45-minute duration
- Mixed-format questions (numerical, verbal, logical, graphical)
- Realistic test conditions to mimic actual university entrance environments
- The simulation measured students' progress and readiness after receiving the training.

6. Evaluation and Reflection

Evaluation was conducted through:

- Pre-test and post-test performance comparison
- Analysis of student worksheets
- Open-ended reflection questions
- A questionnaire on learning experience and perceived benefits
- The results of this evaluation were used to assess the overall impact of the training and identify areas for improvement.

3. Result and Discussion

The training program on Concept Mastery and Reasoning for the Academic Ability Test (TKA) produced several important findings related to students' cognitive development, reasoning improvement, readiness for university entrance tests, and changes in learning attitudes. The results were analyzed using pre-test and post-test comparisons, observation notes, worksheet analysis, and student feedback questionnaires.

1. Improvement in Students' Achievement Based on Pre-test and Post-test

The comparison between pre-test and post-test results showed significant improvement across all assessed competency areas. The percentage increase in each component is presented below:

Component	Pre-test	Post-test	Improvement
Concept Mastery	46%	74%	**+28%**
Numerical Reasoning	41%	71%	**+30%**
Verbal Reasoning	43%	70%	**+27%**
Logical Reasoning	39%	73%	**+34%**
Graph & Table Interpretation	41%	79%	**+38%**
Time Management	28%	63%	**+35%**

Table 1. Comparison between pre-test and post-test result

These results indicate that the structured training approach successfully addressed students' weaknesses and enhanced their reasoning capabilities. The increase in time management demonstrates that students not only understood the content better but also became more efficient in working under timed conditions.

2. Common Errors Identified Before the Training

Analysis of the pre-test and observation during the early practice sessions revealed several recurring patterns of errors:

a. Numerical Reasoning Errors

- Misinterpreting ratios and proportional relationships
- Difficulty analyzing variable changes in word problems
- Incorrect assumptions about linear vs non-linear trends

b. Verbal Reasoning Errors

- Inability to identify main ideas in passages
- Difficulty distinguishing facts from assumptions
- Weak inference skills

c. Logical Reasoning Errors

- Failure to connect multiple premises
- Confusion in evaluating "if–then" and "if and only if" relationships
- Incorrect construction of logical tables

d. Graph Interpretation Errors

- Misreading slopes and rates of change
- Difficulty identifying relationships between two variables
- Incorrect conclusions based solely on numerical values rather than trends

These findings confirm that students were unfamiliar with analytical thinking tasks and lacked exposure to reasoning-focused problems.

3. Effectiveness of the Guided Problem-Solving Approach

The guided problem-solving method proved highly effective. Instead of providing direct answers, facilitators guided students through reasoning pathways, including:

- Identifying relevant information
- Eliminating irrelevant data
- Recognizing hidden patterns
- Structuring problem-solving steps
- Verifying assumptions before choosing an answer

This process encouraged students to move from procedural thinking to strategic analytical thinking, enabling them to understand not only the solutions but also the reasoning behind them.

4. Development of Critical and Analytical Thinking Skills

After several sessions, students demonstrated noticeable growth in their reasoning abilities:

a. Enhanced Analytical Ability

Students became more capable of explaining the rationale behind their solutions, often supporting their responses with clear reasoning chains.

b. Increased Metacognitive Awareness

Students actively checked their work, questioned their assumptions, and corrected errors independently.

c. Improved Confidence in Tackling Challenging Questions

Many students who initially struggled with numerical reasoning showed increased willingness to attempt higher-level problems.

d. Better Collaboration in Group Discussions

Students effectively communicated ideas, challenged each other's reasoning, and reached consensus through evidence-based discussions.

5. Student Feedback and Engagement

Feedback gathered through questionnaires revealed:

- **82%** agreed that the training helped them understand TKA question patterns
- **85%** felt more confident about university entrance exams
- **78%** preferred reasoning-based discussions over memorization activities
- **91%** recommended conducting similar training regularly

Many students commented that the training was the first time they experienced structured reasoning instruction, and they felt significantly more prepared afterward.

6. Teacher Perspective and Benefits

Teachers observed that:

- Students showed increased engagement and curiosity
- Reasoning-based learning methods could be integrated into classroom instruction
- The provided sample questions and reasoning strategies would be useful for school-level assessments
- Teachers were interested in further collaboration for future training and professional development

This indicates the broader pedagogical impact of the program beyond student learning.

7. Challenges Encountered During the Training

Despite its success, the program faced several challenges:

- Variation in students' baseline abilities required differentiated instruction
- Time management remained a recurring difficulty for many students
- Anxiety about numerical problems hindered performance for some participants
- Limited exposure to analytical question formats in regular school lessons

These challenges were mitigated through step-by-step coaching, repeated practice, and confidence-building strategies.

8. Long-Term Impact and Sustainability Potential

The training offers long-term benefits, including:

- Improved readiness for national university entrance examinations (SNBT/TKA)
- Strengthening of critical thinking foundations
- Opportunities for sustained collaboration between UKCW and Telkom high schools in Malang
- Potential development of Training of Trainers (ToT) programs for teachers
- Baseline data for future educational research on academic reasoning

The success of the program demonstrates that reasoning-focused interventions are not only beneficial but essential for preparing students for higher education.

Pict.1: TKA Assesment in Telkom Senior High School Malang

4. Conclusion

The training program on Concept Mastery and Reasoning for the Academic Ability Test (TKA) in Telkom senior high school students in Malang City demonstrated significant positive impacts on students' cognitive abilities, reasoning skills, and readiness for university entrance examinations. The structured intervention consisting of concept reinforcement, guided reasoning, intensive practice, and simulated testing successfully improved students' performance across multiple domains of TKA competency.

Quantitative results showed substantial increases in conceptual mastery, numerical reasoning, logical reasoning, verbal reasoning, and graph interpretation. These improvements indicate that students not only gained a deeper understanding of the tested concepts but also developed the ability to apply analytical thinking strategies under timed conditions.

Qualitative findings further revealed enhanced confidence, improved metacognitive awareness, increased engagement during collaborative problem-solving, and stronger willingness to tackle challenging analytical questions. Teachers also benefited from the program, gaining exposure to reasoning-based instructional methods that can be integrated into everyday teaching practices.

Overall, this program proves to be an effective community service initiative that contributes meaningfully to improving students' academic competencies. It is recommended that similar training be conducted regularly across schools in Malang City and expanded to include teacher-focused capacity building sessions to sustain reasoning based learning in the long term.

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