



## **The Effectiveness of the Discovery Learning Model Based on Tempoyak Ethnoscience on Acid Base Material to Improve Students' Critical Thinking Skills**

**Reni Junisa\*, Sunyono, Gamilla Nuri Utami**

Chemistry Education, Faculty of Teacher Training and Education, University of Lampung,  
Jl. Prof. Dr. Soemantri Brojonegoro No. 1 Bandar Lampung, Indonesia.

\*Corresponding e-mail: [renijunisa05@gmail.com](mailto:renijunisa05@gmail.com)

Received: June 15<sup>th</sup>, 2026 Accepted: July 1<sup>st</sup>, 2026 Online Published: August 11<sup>th</sup>, 2026

**Abstract: The Effectiveness of the Discovery Learning Model Based on Tempoyak Ethnoscience on Acid Base Material to Improve Students' Critical Thinking Skills.**

This study aimed to describe the effectiveness of the *discovery learning* model based on Tempoyak ethnoscience on acid base material to improve students' critical thinking skills. The study was conducted with 11th-grade students at SMA Muhammadiyah 2 Bandar Lampung during the 2025/2026 school year, with class XI A selected as the experimental group and class XI D as the control group. These groups were determined through a cluster random sampling. This study employed a quasi-experimental method using a pretest posttest control group design. Data analysis was performed using n-Gain, the t-test for independent samples, and the calculation of effect sizes. The results show that the mean n-Gain values for the experimental and control classes are 0.41 and 0.35, respectively. The t-test for independent samples reveals a significant difference between the two groups, while the effect size in the experimental class was 0.95 indicates a substantial effect. Thus, the discovery learning model based on Tempoyak ethnoscience regarding acids and bases proves effective to improve students' critical thinking skills.

**Keywords:** discovery learning, ethnoscience Tempoyak, acid base, critical thinking skills.

**Abstrak: Efektivitas Model Discovery Learning berbasis Etnosains Tempoyak pada Materi Asam Basa untuk Meningkatkan Keterampilan Berpikir Kritis Siswa.** Penelitian ini bertujuan untuk mendeskripsikan keefektifan model *discovery learning* berbasis etnosains Tempoyak pada materi asam basa untuk meningkatkan keterampilan berpikir kritis siswa. Penelitian ini dilakukan pada siswa kelas XI di SMA Muhammadiyah 2 Bandar Lampung tahun ajaran 2025/2026, dengan Kelas XI A sebagai kelompok eksperimen dan Kelas XI D sebagai kelompok kontrol. Kelompok-kelompok ini ditentukan melalui *cluster random sampling*. Metode penelitian yang digunakan adalah *quasi experiment* dengan desain *pretest-posttest control group design*. Analisis data dilakukan menggunakan n-Gain, uji t untuk sampel independen, dan perhitungan *effect size*. Hasil menunjukkan bahwa nilai rata-rata n-Gain untuk kelas eksperimen dan kelas kontrol masing-masing adalah 0,41 dan 0,35. Uji-t untuk sampel independen menunjukkan adanya perbedaan yang signifikan antara kedua kelompok, sedangkan *effect size* pada kelas eksperimen sebesar 0,95 mengindikasikan adanya efek yang besar. Dengan demikian, model pembelajaran *discovery learning* yang didasarkan pada etnosains Tempoyak pada

*materi asam dan basa terbukti efektif dalam meningkatkan keterampilan berpikir kritis siswa.*

**Kata kunci:** *discovery learning, etnosains Tempoyak, asam basa, keterampilan berpikir kritis.*

This is an open access article under the CC [BY-SA](#) license



## ■ INTRODUCTION

In the 21st century, education no longer focuses solely on theoretical knowledge but also emphasizes the development of skills needed to address global challenges, such as critical thinking (Selamat, 2021). Critical thinking is defined as the ability to engage in reflective thinking focused on deciding what to believe and how to act (Hutauruk et al., 2025). Critical thinking skills are essential for students because they enable them to solve problems, make rational decisions, analyze information critically, and develop independent learning abilities (Facione, 2015). Therefore, learning activities should encourage students to actively explore information, evaluate evidence, and construct their own understanding rather than merely memorizing concepts. By engaging students in meaningful learning experiences, they are expected to develop the ability to think logically and make well-reasoned decisions when solving scientific problems. Critical thinking consists of five indicators: Elementary clarification, basic support, inferences, advanced clarification, and strategies and tactics (Norris & Ennis, 1989).

However, in practice, the development of students' critical thinking skills is still not optimal, particularly in Indonesia. This condition can be seen from the results of the 2022 PISA assessment. The Programme for International Student Assessment (PISA) is an international assessment program organized by the Organisation for Economic Co-operation and Development (OECD) that measures the competencies of 15 year old students in various literacy domains (Hartono et al., 2021). In science literacy, Indonesia obtained a score of 383, which reflects students' ability to understand and apply basic scientific concepts. This score decreased by 13 points compared to the 2018 assessment, which was 396, placing Indonesia at 67th position out of 81 participating countries. A similar situation is also evident in other domains closely related to critical thinking, such as mathematics and reading literacy, where Indonesia's scores again fall far below the OECD mean (OECD, 2023).

One of the science subjects that significantly contributes to improving students' critical thinking skills is chemistry. This is because chemistry learning involves problem-solving activities, interpretation of experimental data, analysis, evaluation, and inference that require students to think logically and systematically (Martanisa et al., 2025). One of the chemistry topics that has the potential to develop students' critical thinking skills is acids and bases. This topic is one of the areas that requires students to understand concepts through three levels of chemical representation, namely macroscopic (real world phenomena), microscopic (particles), and symbolic (formulas and chemical equations), which play a role in building students' critical thinking skills (Emda, 2023). However, if learning remains teacher centered through lectures without linking them to real world phenomena, students will tend to memorize without truly understanding the meaning (Gazali & Dasna, 2023).

Based on observations and interviews with chemistry teacher at SMA Muhammadiyah 2 Bandar Lampung, it was found that the current chemistry learning process is still mainly focused on delivering content through direct explanations using

textbooks and PowerPoint presentations. This approach is certainly still necessary under certain conditions, especially when students need basic explanations or concept reinforcement; however, it does not fully provide students with the opportunity to learn independently through exploratory activities. Furthermore, the use of worksheets and the ethoscience approach has not yet been implemented at the school, and laboratory activities remain suboptimal due to existing limitations. Therefore, it is necessary to apply a learning model that explicitly trains students' critical thinking skills, ranging from asking questions related to phenomena, collecting and analyzing data, considering alternative solutions, to drawing conclusions and reflecting on actions (Setyawan & Kristanti, 2021). The results of the interview with the chemistry teacher at SMA Muhammadiyah 2 Bandar Lampung are presented in **Figure 1**.

| LEMBAR WAWANCARA GURU                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                            |                                                                                                                                                            |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|----|----------------|---------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|-----|-----------------------------------------------------------------------------------|----------------|
| <p><b>Judul Penelitian:</b><br/>Efektivitas Model Discovery Learning terhadap Efisiensi Waktu pada Materi Asam Basa untuk Meningkatkan Keterampilan Berpikir Kritis Siswa</p> <p><b>A. Identifikasi Responden</b><br/>Nama : Dedi<br/>Jabatan : Guru Kimia</p> <p><b>B. Identifikasi Sekolah</b><br/>Nama Sekolah : SMA Muhammadiyah 2 Bandar Lampung<br/>Alamat Sekolah : Jalan Lato, Kota Bandar Lampung</p> <p><b>C. Daftar Pertanyaan Wawancara Guru</b></p> <table border="1"> <thead> <tr> <th>No</th><th>Isi Pertanyaan</th><th>Jawaban</th></tr> </thead> <tbody> <tr> <td>1.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>2.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>3.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>4.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>5.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>6.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>7.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>8.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>9.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>10.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>11.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>12.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>13.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>14.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> <tr> <td>15.</td><td>Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?</td><td>Sangat penting</td></tr> </tbody> </table> |                                                                                                                                                            |                                                                                                                                                            | No | Isi Pertanyaan | Jawaban | 1. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 2. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 3. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 4. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 5. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 6. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 7. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 8. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 9. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 10. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 11. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 12. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 13. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 14. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting | 15. | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa? | Sangat penting |
| No                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Isi Pertanyaan                                                                                                                                             | Jawaban                                                                                                                                                    |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 12.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 13.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 14.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 15.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sangat penting                                                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | tersebut pembelajaran kimia yang menggunakan praktikum?                                                                                                    | Sebagian siswa menggunakan pembelajaran, tetapi masih banyak yang hanya mengikuti prosesnya saja, dan hanya mengikuti perintah guru saja.                  |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah siswa cenderung aktif bertanya, berdiskusi, atau menyampaikan pendapat dalam pembelajaran kimia?                                                    | Ya, sebagian besar siswa hanya mengikuti perintah guru, dan hanya mengikuti perintah guru saja.                                                            |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah dalam pembelajaran kimia, siswa sering diajak untuk berpikir lebih mendalam, menganalisis, atau membuat soal yang menantang, bukan hanya menghafal? | Tidak terlalu sering, lebih banyak memberikan soal pemahaman konsep dan latihan soal yang banyak menghafal dan analisis dan ber-pikir kritis masih kurang. |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah Bapak/Ibu pernah menerapkan model pembelajaran discovery pada pembelajaran kimia? Jika ya, bagaimana hasilnya?                                      | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah Bapak/Ibu pernah mengaitkan pembelajaran kimia dengan budaya atau kearifan lokal daerah?                                                            | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah Bapak/Ibu menggunakan LKPD (Lembar Kerja Peserta Didik) dalam pembelajaran kimia?                                                                   | Tidak, hanya menggunakan buku paket dan PPT.                                                                                                               |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sebagian besar siswa masih hanya mengikuti perintah guru dan hanya mengikuti perintah guru saja.                                                           |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah Bapak/Ibu pernah menerapkan model pembelajaran discovery pada pembelajaran kimia? Jika ya, bagaimana hasilnya?                                      | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Apakah Bapak/Ibu pernah mengaitkan pembelajaran kimia dengan budaya atau kearifan lokal daerah?                                                            | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Apakah Bapak/Ibu menggunakan LKPD (Lembar Kerja Peserta Didik) dalam pembelajaran kimia?                                                                   | Tidak, hanya menggunakan buku paket dan PPT.                                                                                                               |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sebagian besar siswa masih hanya mengikuti perintah guru dan hanya mengikuti perintah guru saja.                                                           |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 12.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Apakah Bapak/Ibu pernah menerapkan model pembelajaran discovery pada pembelajaran kimia? Jika ya, bagaimana hasilnya?                                      | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 13.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Apakah Bapak/Ibu pernah mengaitkan pembelajaran kimia dengan budaya atau kearifan lokal daerah?                                                            | Ya, pernah karena waktu pembelajaran terbatas.                                                                                                             |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 14.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Apakah Bapak/Ibu menggunakan LKPD (Lembar Kerja Peserta Didik) dalam pembelajaran kimia?                                                                   | Tidak, hanya menggunakan buku paket dan PPT.                                                                                                               |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |
| 15.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Seberapa penting bagi Anda untuk meningkatkan keterampilan berpikir kritis siswa?                                                                          | Sebagian besar siswa masih hanya mengikuti perintah guru dan hanya mengikuti perintah guru saja.                                                           |    |                |         |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |    |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |     |                                                                                   |                |

**Figure 1.** The results of the interview

A good approach for enhancing critical thinking abilities is the discovery learning approach. Using this approach, students are meant to discover scientific principles and ideas by means of exploratory exercises. Students actively engage in observing, collecting data, analyzing information, and drawing conclusions based on the results of these activities (Izzah & Sari, 2023). The stages of discovery learning, namely stimulation, problem identification, data collection, data processing, verification, and generalization are well suited to chemistry instruction, including acid base topics (Sinambela, 2013). This process enables students to construct their understanding through direct learning experiences rather than merely receiving information from the teacher. Consequently, by participating in the discovery learning process, students can gradually connect their observations with acid base concepts, resulting in a deeper, more meaningful, and well structured understanding. Furthermore, the stages of this model provide opportunities for students to develop critical, analytical, and reflective thinking skills throughout the learning process (Puspita et al., 2018).

In addition to appropriate learning models, a contextual approach is also needed to help students perceive chemistry concepts as relevant to their daily lives. One such

approach is ethnoscience, which integrates scientific concepts with local cultural knowledge and practices (Setiawan et al., 2024). The implementation of the discovery learning model integrated with ethnoscience has been shown to improve students' critical thinking skills. Ethnoscience serves as a bridge between scientific concepts and local wisdom, helping students understand that science is not separate from everyday community life but is embedded in various traditional practices with which they are familiar (Widayanti et al., 2020).

In the context of acid base chemistry, one relevant example of ethnoscience is the fermentation process of traditional foods such as tempoyak, a fermented durian product that is popular in various regions of Indonesia, including Sumatra and Lampung, where it is commonly used as a condiment or side dish. Tempoyak is produced through a spontaneous fermentation process involving lactic acid bacteria that convert sugars in durian into organic acids, resulting in a decrease in pH and the development of a sour taste (Anggadhanika et al., 2023). From a chemical perspective, this fermentation process is directly related to acid-base concepts. During fermentation, lactic acid bacteria such as *Lactobacillus* sp. metabolize carbohydrates into organic acids, particularly lactic acid, thereby increasing the concentration of hydrogen ions ( $H^+$ ) and lowering the pH of the product to approximately 4.0-4.3 (Anggraini & Mustakim, 2025).

Although numerous studies have shown the effectiveness of the discovery learning model and ethnoscience based approaches in various chemistry topics, research that specifically integrates discovery learning based on Tempoyak ethnoscience to enhance students' critical thinking skills in acid base material remains limited.

Based on the background and previous studies, this research aims to discuss how effectively the discovery learning model based on Tempoyak ethnoscience on acid base subject to improve students' critical thinking. Therefore, the hypothesis of this study is that the effectiveness of the discovery learning model based on Tempoyak ethnoscience on acid base material to improve students' critical thinking skills.

## ■ METHOD

The investigation was carried out at SMA Muhammadiyah 2 Bandar Lampung, 11th-grade students in the 2025/2026 academic year made up the study's population. Each class had 36 students, resulting in a total population of 144 students. Sampling was conducted using the cluster random sampling technique. The sampling procedure involved writing the name of each class on a piece of paper, then rolling it up and placing it in a container to be randomly drawn. The results of the study show that the experimental class was XI A, while the control class was XI D. The research method applied is a quasi-experiment with a Pretest-Posttest Control Group Design. In this design, the experimental class is given treatment in the form of learning using the discovery learning model, while the control class receives conventional learning. Each class is given a pretest before the learning and a posttest after the learning.

The instructional materials used in this study consisted of acid base teaching modules, including two lesson plans and two student worksheets designed discovery learning model based on Tempoyak ethnoscience. Student Worksheet 1 covered the concepts of acids and bases according to the Arrhenius, Brønsted-Lowry, and Lewis theories, while Student Worksheet 2 covered the concepts of pH, pK<sub>w</sub> and pOH. The Student Worksheets 1 and 2 are presented in **Figures 2 and 3**.



Figure 2. Student Worksheet 1



Figure 3. Student Worksheet 2

The research instruments consisted of pretest and posttest questions, each comprising four essay items designed to assess students' critical thinking skills. The pretest was administered before the learning activities to assess students' initial critical thinking skills, whereas the posttest was conducted after the instructional intervention to evaluate the improvement in their critical thinking skills. Each test item was accompanied by a detailed scoring rubric that specified the assessment criteria according to the critical thinking indicators being measured. Responses were scored using a 0-4 scale, enabling a more objective, consistent, and systematic evaluation of students' performance. Prior to its implementation, the test instrument underwent the preparation of a table of specifications, validity testing, and reliability testing to ensure its suitability for use in the research.

Each test item was developed based on the critical thinking skills indicators proposed by Norris & Ennis (1989) which include elementary clarification, basic

support, inference, and advanced clarification. The elementary clarification aspect was assessed through one item focusing on analyzing questions. The basic support aspect was measured through one item requiring students to observe and evaluate an observation report. The inference aspect was assessed through one item that involved making deductions or considering deductive reasoning. Meanwhile, the advanced clarification aspect was measured through one item that required students to identify terms, definitions, and dimensions of reasoning. The specification table for the pretest and posttest is presented in **Table 1**.

**Table 1.** Test Specification for Pretest and Posttest

| Basic Competencies                                                                                                                                                                                                                                    | Main Topic                                                                        | Cognitive Indicators                                                                                  | Critical Thinking Indicators (Norris & Ennis, 1989) | Item Number | Number of Items |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------|-----------------|
| 3.10 Analyze the properties of solutions based on acid-base concepts and/or the pH of solutions.<br><br>4.10 Propose ideas regarding the appropriate use of indicators to determine the acidity of acids and bases or to perform acid-base titration. | Acid-base concepts according to the Arrhenius Brønsted-lowry, and Lewis theories  | 3.10.1 Analyze questions related to indicator color changes to determine the properties of solutions. | Analyze questions                                   | 1           | 1               |
|                                                                                                                                                                                                                                                       | Acid-base concepts according to the Arrhenius, Brønsted-Lowry, and Lewis theories | 3.10.2 Identify terms and definitions in acid-base theory to classify types of reactions.             | Identify terms and definitions                      | 2           | 1               |
|                                                                                                                                                                                                                                                       | The concepts of pH, pOH, and pK <sub>w</sub>                                      | 3.10.3 Observe and evaluate observation reports to determine sources of error in pH measurements.     | Observe and evaluate observation reports            | 3           | 1               |
|                                                                                                                                                                                                                                                       | The concepts of pH, pOH, and pK <sub>w</sub>                                      | 3.10.4 Deduce or consider deductive reasoning results to verify the calculation of                    | Make deductions or consider deductive reasoning     | 4           | 1               |

|                                    |          |
|------------------------------------|----------|
| H <sup>+</sup> concen-<br>tration. |          |
| <b>Total Number of Items</b>       | <b>4</b> |

The student critical thinking activity observation sheet was used during the learning process in the experimental class. This instrument consisted of four observed aspects: understanding, asking questions, responding to other groups' presentations, and collaborating. The implementation of the learning model in the experimental class was also evaluated using an observation sheet. The implementation was classified into three categories: low, moderate, and high. Assessment was conducted using a checklist (✓). The observation sheets for student activities and the implementation of the discovery learning model were adapted from relevant previous research (Asiyifah, 2022) and modified to suit the needs of this study. The observation sheets for student activities and the implementation of the discovery learning model were adapted from Asiyifah (2022) and revised to fit the context of this study. In the student activity observation sheet, the *observing* indicator was replaced with *understanding*. Furthermore, the observation sheet for the implementation of the discovery learning model was modified to correspond to the learning steps in the ethnoscience-based student worksheet, which differ from those employed by Asiyifah (2022) because the previous study did not incorporate an ethnoscience approach.

The normalized gain (n-Gain) analysis was conducted by converting raw scores into percentage scores, calculating individual student scores and the class mean, and subsequently determining the n-gain value. The n-gain was calculated using the formula proposed by Hake (1999). He used the following criteria to interpret the resulting n-gain values: high for scores exceeding 0.7, moderate for scores greater than 0.3 and up to 0.7, and low for scores equal to or less than 0.3 (Hake, 1998).

To assess the research hypothesis, the mean scores of the experimental and control classes were contrasted using an independent samples t-test. Pretest and posttest data were examined for homogeneity of variance and normality using preliminary tests before hypothesis testing. Normality was assessed with the Kolmogorov-Smirnov test. If the data was thought to be normally distributed, the significance value (Sig.) surpassed 0.05. To evaluate homogeneity of variance, Levene's test was applied. The data were deemed homogeneous should the significance value exceed 0.05. At a significance level of  $\alpha = 0.05$ , the acceptance criteria for the null hypothesis ( $H_0$ ) was a significance value more than 0.05.

A comparison of the mean n-Gain scores between the experimental and control groups was conducted to evaluate the effectiveness discovery learning model based on Tempoyak ethnoscience on the acid base subject to improve students' critical thinking skills. The effectiveness of the model was determined by examining whether a statistically significant difference existed between the mean n-Gain scores of the two groups. If the data were normally distributed and the variances were homogeneous, hypothesis testing was performed using the parametric independent samples t-test. Otherwise, when the assumption of normality was not satisfied, the nonparametric Mann Whitney test was employed to compare the two groups (Sudjana, 2005).

After the t-test was performed, the next step was to calculate the effect size using the formula proposed by Jahjouh (2014) The obtained values were then interpreted as negligible when  $\mu^2$  is 0.15 or below, small when it ranges from above 0.15 to 0.40, moderate when it falls between above 0.40 and 0.75, large when it is above 0.75 up

to 1.10, and very large when it exceeds 1.10 (Dinçer, 2014).

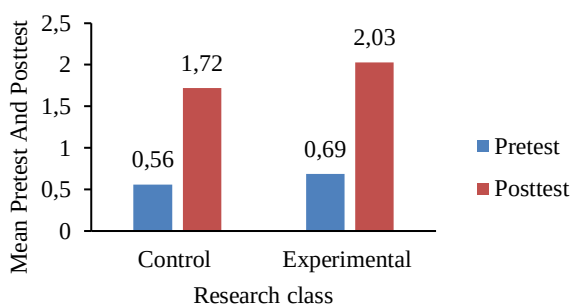
## ■ RESULT AND DISCUSSION

### Validity and Reliability Instruments

The validity test results indicate that each of the four objects  $r_{\text{count}}$  exceeds the  $r_{\text{table}}$ . So all four items are considered legitimate. After the validity study, Cronbach's Alpha was used to determine the instrument's reliability. The acquired Cronbach's Alpha coefficient was 0.782. Based on the established reliability criteria, this value indicates that the instrument was reliable and appropriate for use in the study.

### Mean Pretest and Posttest Scores

According to the survey, pretest and posttest data on critical thinking abilities are presented in **Figure 4**.

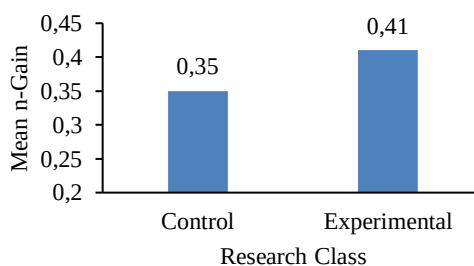


**Figure 4.** Mean Pretest and Posttest

Based on **Figure 4**, the pretest results demonstrated that the experimental and control classes mean scores were quite comparable, suggesting equivalent initial levels of critical thinking. The control class (0.56) had a slightly lower mean score than the experimental class (0.69). Moreover, the students in both classes improved their critical thinking skills according to the final test results. Between the pretest and posttest mean scores, the experimental group showed an increase of 1.34 points, whereas the control class showed an increase of 1.16 points. The experimental class had a larger improvement in critical thinking abilities than the control class, according to these findings.

### Mean n-Gain Scores

Differences in the mean n-Gain scores for students' critical thinking skills are presented in **Figure 5**.

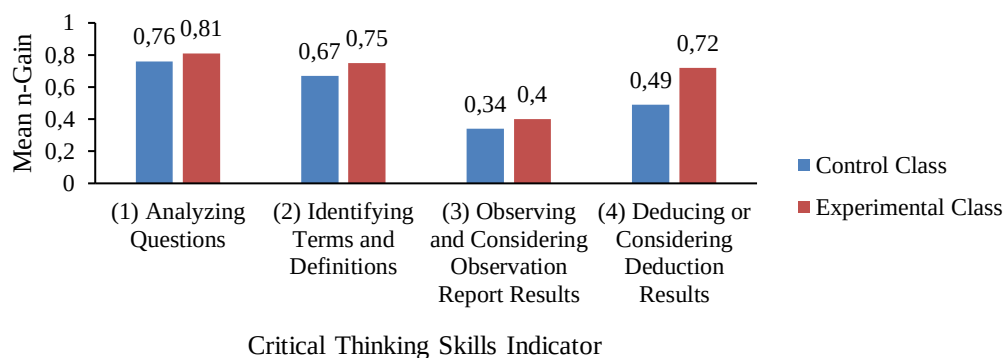


**Figure 5.** Mean n-Gain

Based on **Figure 5**, the experimental class achieved a mean n-Gain score of 0.41 for students' critical thinking skills, exceeding the score obtained by the control class (0.35). Although the n-Gain scores of both the experimental and control groups were classified as moderate according to Hake (1998), the experimental group achieved a higher mean n-Gain score than the control group. This finding indicates that the discovery learning model base on ethnoscience contributed more effectively to improving students' critical thinking skills than conventional instruction.

### Mean N-Gain for Each Critical Thinking Skills Indicator

The mean N-Gain for each critical thinking skills indicator are presented in **Figure 6**.



**Figure 6.** Mean n-Gain for Each Critical Thinking Skills Indicator

Based on **Figure 6**, the mean n-Gain of students' critical thinking skills indicates an improvement in both the experimental and control classes. However, the n-Gain value in the experimental class was higher than that in the control class, indicating that the improvement in students' critical thinking skills in the experimental class was greater. Meanwhile, the control class also showed an improvement, although it was not as substantial as that observed in the experimental class.

### Normality Test

The normality test conducted using the Kolmogorov-Smirnov method, produced a significance value (sig.) of 0.200 for the critical thinking skills data in both classes. As this value exceeded 0.05, the criterion for accepting  $H_0$  was satisfied. Therefore, it can be concluded that the n-Gain data from both classes were normally distributed.

### Homogeneity Test

The obtained sig. value was 0.233. Because this value exceeded 0.05, the criterion for accepting  $H_0$  was fulfilled. Therefore, the n-Gain data for students' critical thinking skills in both classes can be considered to have homogeneous variance.

### Test of the Difference Between Two Means

The comparison of the mean scores are presented in **Table 2**.

**Table 2.** Independent Samples t-test Results

| Class        | N  | Mean n-Gain | Sig. (2-tailed) | Test Criteria                 | Test Results |
|--------------|----|-------------|-----------------|-------------------------------|--------------|
| Experimental | 36 | 0.41        | 0.001           | Accept $H_1$ if $sig. < 0.05$ | Accept $H_1$ |
| Control      | 36 | 0.35        |                 |                               |              |

Based on **Table 2**, a sig. (2-tailed) value of 0.001, which was below 0.05, indicated that  $H_1$  was accepted. In addition, the experimental class obtained a higher mean n-Gain score (0.41) than the control class (0.35), demonstrating a significantly greater improvement in students' critical thinking skills.

### Effect Size Test

The findings of the effect size analysis for students' critical thinking skills are presented in **Table 3**.

**Tabel 3.** Effect Size Test Result

| Class        | N  | t       | df | $\mu$ | Criteria |
|--------------|----|---------|----|-------|----------|
| Experimental | 36 | -25.696 | 35 | 0.95  | Large    |
| Control      | 36 | -23.276 | 35 | 0.93  | Large    |

Based on **Table 3**, the effect size analysis yielded a value of 0.95 for the experimental class. In comparison, the control class achieved an effect size of 0.93. Therefore, the discovery learning model based on ethnoscience has a greater impact on students' critical thinking skills compared to conventional learning.

## ■ DISCUSSION

The results of the data analysis indicate that the implementation of the discovery learning model based ethnoscience Tempoyak effectively enhances students' critical thinking skills in understanding acid base concepts. This is evidenced by the difference in the mean n-Gain scores between the experimental class and the control class. The experimental class achieved an mean n-Gain score of 0.41, which is higher than the 0.35 achieved by the control class, although both classes fall into the moderate category. These results indicate that the improvement in critical thinking skills was greater among students who participated in the discovery learning model based ethnoscience Tempoyak among those who received conventional instruction. This finding is consistent with the study conducted by Palupi et al. (2018). which reported that the implementation of the discovery learning model based on ethnoscience enhanced students' critical thinking skills, as reflected by higher n-Gain scores in the experimental class compared with the control class.

A more detailed analysis of each critical thinking skills indicator showed that the experimental class consistently obtained higher mean n-Gain scores than the control class across all indicators. These findings indicate that the implementation of the discovery learning model based on ethnoscience contributed more substantially to the development of students' critical thinking skills, as reflected in their improved ability to analyze problems, identify key concepts and terminology, and draw appropriate conclusions. These findings are consistent with those reported by Imtihana & Utami (2024), who found

that a discovery learning model based on local potential significantly improved students' critical thinking skills.

The implementation of the discovery learning model, supported by the use of student worksheets designed according to the discovery learning syntax, contributed to the higher mean *n*-Gain score for students' critical thinking skills in the experimental class. These findings are consistent with those of Untari et al. (2024), who reported that discovery learning model supported by the use of student worksheets were effective in enhancing students' critical thinking skills. Previous research also showed that critical thinking skills improve with the use of valid learning worksheets (Mahmudah & Yonata, 2020). The connection between scientific concepts and local cultural practices also increases students' interest and motivation to learn, which may contribute to the improvement of their critical thinking skills. In this study, ethnoscience based learning using Tempoyak serves as a bridge between scientific concepts and students' everyday life experiences. Students are not directly introduced to abstract chemical concepts; instead, they are first guided to understand a familiar cultural phenomenon and then encouraged to connect it with scientific explanations. This approach makes acid base learning more concrete and easier to understand, as students can relate theoretical concepts to real practices they encounter in their local environment.

In addition, the familiarity and relevance of the cultural context increase students' engagement and curiosity in exploring the relationship between fermentation processes and acid base changes. Thus, Tempoyak does not only function as a contextual example but also as a medium that bridges students' prior experiences with scientific concepts, thereby supporting the development of critical thinking skills through observing, connecting, and logically concluding processes. The findings of the present study are consistent with Hidayati & Julianto (2025), who found that integrating ethnoscience into science learning makes learning more meaningful and increases students' motivation. Consequently, students become more actively involved in the learning process, which supports the improvement of their critical thinking skills.

Similarly, the results of the independent samples t-test showed that the discovery learning model had a significant effect on improving students' critical thinking skills, as indicated by the significant difference between the experimental and control classes ( $p < 0.05$ ). This is supported by Sitompul & Simorangkir (2014), who also found a significant difference between experimental and control classes using an independent samples t-test.

In the effect size analysis, although both classes produced substantial effects, the higher effect size observed in the experimental class suggests that the discovery learning based ethnoscience more contributes to the improvement in students' critical thinking skills than conventional instruction. These findings are consistent with those reported by Rahayuningsih et al. (2024), which showed that the discovery learning model has a high effect size in improving students' critical thinking skills.

Although this study yielded encouraging results, several limitations should be acknowledged. The research was confined to the acid-base topic, which means that the applicability of the Tempoyak ethnoscience-based discovery learning model to other chemistry topics has not yet been examined. In addition, the instructional intervention was implemented over a relatively short period, preventing the evaluation of its long-term influence on students' critical thinking skills.

## ■ CONCLUSION

The implementation of the discovery learning model based on Tempoyak ethnoscience provided meaningful and contextual learning experiences that supported students in developing critical thinking skills through problem exploration, information analysis, and concept construction. Therefore, it can be concluded that the the discovery learning model based on Tempoyak ethnoscience on acid base material is effective to improve students' critical thinking skills. For future research, it is recommended to look into using this learning model in different chemistry topics and over a longer teaching period to get a more complete understanding of its effectiveness.

## ■ REFERENCES

- Anggadhanika, L., Setiarto, R. H. B., Yusuf, D., Anshory, L., & Royyani, M. F. (2023). Exploring tempoyak, fermented durian paste, a traditional Indonesian indigenous fermented food: typical of Malay tribe. In *Journal of Ethnic Foods*, 10(1), 10-42.
- Anggraini, T., & Mustakim, A. (2025). Isolasi dan Karakterisasi Bakteri Asam Laktat pada Tempoyak sebagai Fermentasi Tradisional Khas Jambi. *Pentagon : Jurnal Matematika Dan Ilmu Pengetahuan Alam*, 3(3), 77-84.
- Asiyifah, N. (2022). Efektivitas Model Discovery Learning dalam Meningkatkan Keterampilan Berpikir Kritis Siswa pada Materi Asam Basa. Skripsi. Fakultas Keguruan Dan Ilmu Pendidikan, Universitas Lampung.
- Dinçer, S. (2014). Pengaruh pembelajaran berbantuan komputer terhadap prestasi siswa di turki dan perbandingannya dengan negara lain: studi meta-analisis. *Journal of Turkish Science Education*, 1(12), 99-118.
- Facione, P. (2015). *Critical Thinking: What It Is and Why It Counts*. Insight Assessment. Millbrae, CA. 31 pages.
- Gazali, F., & Dasna, I. W. (2023). Meningkatkan keterampilan berpikir kritis siswa dalam pembelajaran kimia. *Edukatif : Jurnal Ilmu Pendidikan*, 5(3), 1401-1410.
- Hake, R. R. (1998). Interactive-engagement versus traditional methods: A sixthou-sand student survey of mechanics test data for introductory physics courses. *American Journal of Physics*, 66(1), 64-74.
- Hartono, Fadhilah, A., & Slamet, A. (2021). Sistem Layanan Informasi PISA (Programme For International Student Assessment) Berbasis Website untuk Guru IPA SMP dan SMA. *Jurnal Pedagogi Dan Pembelajaran*, 4(3), 476-484.
- Hidayati, F., & Julianto, J. (2025). Integrasi pendekatan etnosains dalam pembelajaran sains untuk meningkatkan keterampilan berpikir kritis siswa. *DIDAKTIKA : Jurnal Pemikiran Pendidikan*, 31(1), 101-112.
- Hutauruk, J. R., Simanjuntak, Y. Y., Rachman, I. F., & Siliwangi, U. (2025). Implementasi Kurikulum Berbasis Keterampilan Abad 21 terhadap Peningkatan Critical Thinking pada Siswa SMP. *Jurnal Penelitian Pendidikan Indonesia*, 2(4), 543-552.
- Imtihana, E. R., & Utami, R. K. 2023. Pengaruh discovery learning terhadap kemampuan berpikir kritis siswa berbasis potensi lokal. *BIOSFER: Jurnal Tadris Biologi*, 14(2), 157-167.
- Izzah, R., & Sari, D. A. P. (2023). Implementasi model discovery learning untuk meningkatkan kemampuan berpikir kritis siswa SMP kelas VIII. *Jurnal Pendidikan Mipa*, 13(3), 587-595.
- Jahjough, Y. M. A. (2014). The effectiveness of blended e-learning forum in planning for science instruction. *Journal of Turkish Science Education*, 11(4), 3-16.

- Mahmudah, K. A., & Yonata, B. (2020). Development of student worksheet based on inquiry and internet assisted learning to practice critical thinking skills in submateries of reaction rates. *Jurnal Pendidikan Dan Pembelajaran Kimia*, 9(3), 55-66.
- Martanisa, M., Hastuti, B., Widiastuti, A. E. S., & Kamari, A. (2025). Effectiveness of discovery learning assisted by chemical monopoly on critical thinking and learning outcomes. *Jurnal Inovasi Pendidikan IPA*, 11(2), 454-468.
- Norris, S. P., & Ennis, R. (1989). *Evaluating Critical Thinking*. In R. J. Swartz dan D. N. Perkins (Eds.), *The Practitioner's Guide to Teaching Thinking Series*. Midwest Publications, Pacific Grove. 288 pages.
- Norris, S. P., & Ennis, R. (1989b). *Evaluating Critical Thinking*. In R. J. Swartz dan D. N. Perkins (Eds.), *The Practitioner's Guide to Teaching Thinking Series*. . Midwest Publications.
- OECD. (2023). *PISA 2022 Results Factsheets Indonesia PUBE*. OECD Publishing. 10 pages.
- Palupi, M. D., Sudarmin, & Wardani, S. (2018). Chemistry in education. *CiE*, 7(1), 77-83.
- Puspita, A. D., Rudibyani, R. B., & Efkar, T. 2018. Efektivitas discovery learning untuk meningkatkan keterampilan berpikir evaluatif dan penguasaan konsep asam basa arrhenius. *Jurnal Pendidikan dan Pembelajaran Kimia*, 7(2): 1-12.
- Rahayuningsih, S. H., Asrowi, Gunarhadi, & Ramli, M. (2024). Meta-analysis effectiveness of using the discovery learning model on students' 21st-century critical thinking skills. *Jurnal Penelitian Pendidikan IPA*, 10(10), 685-692.
- Selamat, N. (2021). Keterampilan abad ke-21 pada pembelajaran sains dengan konteks socio-scientific issues di indonesia. *Jurnal Pendidikan dan Pembelajaran IPA Indonesia*, 11(2), 14-21.
- Setiawan, F., Yunus, M., & Allo, E. L. (2024). Pengaruh model pembelajaran discovery learning terhadap keterampilan berpikir kritis peserta didik kelas XI MIPA Madrasah Aliyah Syekh Yusuf (Studi pada Materi Pokok Laju Reaksi). *Jurnal Pendidikan Kimia Undiksha*, 8(2), 30-38.
- Setyawan, R. A., & Kristanti, H. S. (2021). Keterampilan berpikir kritis pada pembelajaran ipa melalui model pembelajaran discovery learning bagi siswa sekolah dasar. *Jurnal Basicedu*, 5(2), 1076-1082.
- Sinambela, P. (2013). Kurikulum 2013 dan Implementasinya dalam Pembelajaran. *Generasi Kampus*, (6), 17-29.
- Sitompul, D. E., & Simorangkir, M. (2024). Differences in learning outcomes and critical thinking skills of students taught with discovery learning model and problem based learning assisted with powerpoint media on acid-base material. *Jurnal Pendidikan dan Pembelajaran Kimia*, 13(2), 92-99.
- Sudjana, N. (2005). *Metode Statistika*. Trasiro. Bandung. 508 hlm.
- Untari, S., Setyawan, K., Segara, N., & Niswatin. (2024). Pengaruh model pembelajaran discovery learning berbantuan LKPD untuk meningkatkan kemampuan berpikir kritis. *Dialektika Pendidikan IPS*, 4(3), 1-12.
- Widayanti, E., Kunci, K., Saintifik, P., & Berpikir Kritis, K. (2020). Potensi pembelajaran saintifik bernuansa etnosains untuk memberdayakan kemampuan berpikir kritis siswa. *Wahana Didaktita: Jurnal Ilmu Kependidikan*, 18(1), 193-205.