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# Development of Ill-Structured Problem-Solving Skills Instrument Based on Local Socio-Scientific Issues (SSI) on the Topic of Environmental Pollution

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**Abstract**

This study aimed to develop an assessment instrument to measure students' ill-structured problem-solving skills using local socio-scientific issues (SSI) on environmental pollution. The research employed a Research and Development (R&D) model with four stages: (1) preliminary study, (2) item development, (3) expert validation, and (4) trial. The instrument was piloted with 120 chemistry education students from UIN Mataram and Universitas Pendidikan Mandalika in Indonesia. The final instrument consisted of 27 essay-based items mapped to four stages of ill-structured problem solving: 8 items for problem representation, 6 for solution generation and selection, 5 for justification, and 7 for solution monitoring and evaluation. Expert validation yielded a high construct validity index (CVI = 0.93). Readability analysis indicated that 75% of students found the language clear, 78% understood the visuals, and 70% were familiar with the chemical terminology. Results indicated that 17 items were of moderate difficulty, 7 were easy, and 3 were difficult. The instrument demonstrated high internal consistency, with a Cronbach's Alpha value of 0.805. This instrument offers a valid and reliable tool for evaluating students' engagement in authentic, context-rich chemistry problems. It supports chemistry educators in fostering critical thinking and scientific literacy by embedding local socio-scientific issues into semester-long instruction cycles.

**Keywords:** Assessment Instrument; Ill-Structured; Problem Solving; Socio-Scientific Issues

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## INTRODUCTION

Chemistry education plays a vital role in preparing students to become scientifically literate citizens who can apply chemical concepts to solve real-world problems (Redhana, 2019). The ability to solve problems is considered one of the essential 21st-century skills and is particularly important in chemistry learning, where abstract and complex concepts often intersect with students' daily lives (Dewi, Rahayu, et al., 2024; Dewi, Yahdi, et al., 2024). Promoting students' problem-solving skills not only improves their conceptual understanding but also enhances critical thinking, decision-making, and analytical competencies that are essential for lifelong learning and responsible citizenship (Broman & Parchmann, 2014; Shin et al., 2003).

Problems encountered in chemistry education can be broadly categorized into well-structured and ill-structured problems (Jonassen, 1997; Law et al., 2020). Well-structured problems are typically found in textbooks and classroom exercises; they are defined by clearly stated goals, known parameters, and a single correct solution path (Burkholder et al., 2021; Hadi et al., 2019). Solving these problems often involves the application of fixed algorithms or standard procedures such as stoichiometric calculations.

In contrast, ill-structured problems are complex, ambiguous, and open-ended (Ge & Land, 2004). These problems do not have a single correct answer and often require students to integrate diverse forms of knowledge—scientific, social, ethical, and contextual—to propose reasonable solutions. Ill-structured problems more closely mirror real-life challenges and demand higher-order thinking skills including justification, argumentation, and solution evaluation (Chi et al., 2023; Podschuweit & Bernholt, 2018).

Socio-scientific issues (SSI) are context-rich, controversial topics that intertwine scientific content with moral, ethical, and societal dimensions (Badeo & Duque, 2022; Muhariyansah et al., 2021; Owens et al., 2021). Due to their inherently ill-structured nature, SSI serve as effective platforms to engage students in authentic problem-solving tasks. Incorporating SSI in chemistry education—such as environmental pollution, pharmaceutical waste, and climate change—can enhance students' engagement, critical reasoning, and scientific literacy (Almulla & Al-Rahmi, 2023; Li & Guo, 2021; Wahono et al., 2021). Using local SSI contexts is particularly beneficial because they allow students to connect scientific concepts to issues they observe in their communities, such as mercury contamination from gold mining or acid rain from industrial emissions (Dewi & Yahdi, 2025; Hernández-Ramos et al., 2021). Such relevance supports deeper learning and encourages students to act as informed decision-makers in society.

Despite the pedagogical benefits of ill-structured problems and SSI, their application in classroom assessment remains limited. Most chemistry assessments still focus on well-structured, procedural questions, neglecting to evaluate students' problem-solving skills in authentic, context-based settings (Pereira Pessoa, 2023; Renkl, 2023). Moreover, existing tools that do target ill-structured problem solving are often topic-specific—such as limited to chemical equilibrium or stoichiometry—and lack broader applicability in everyday contexts like environmental pollution. This reveals a critical research gap: the absence of a valid, reliable, and contextually relevant assessment instrument that measures students' ill-structured problem-solving skills using local SSI in chemistry. To address this gap, the present study aims to develop an instrument to evaluate ill-structured problem-solving skills among chemistry education students. The instrument is designed based on the four key stages of ill-structured problem solving—problem representation, solution generation and selection, justification, and solution monitoring and evaluation—and integrates local socio-scientific issues on environmental pollution as the contextual foundation.

## METHOD

### Research Design

This study employed a Research and Development (R&D) design to develop an assessment instrument for evaluating ill-structured problem-solving skills in chemistry education. The R&D model used in this study is adapted from the four-stage developmental framework proposed by (Haryati, 2012), which consists of: (1) preliminary study, (2) item development, (3) expert validation, and (4) try-out. These stages ensure the instrument is valid, contextually relevant, and empirically tested for use in chemistry instruction.

**Participants**

A total of 120 students participated in the instrument trial. The test was conducted in multiple sessions across two campuses. Students were grouped based on their institutional affiliation, and the testing sessions were administered in classrooms under supervision to ensure standard conditions. Participants in this study consisted of 120 undergraduate students enrolled in the Chemistry Education programs at Universitas Pendidikan Mandalika and UIN Mataram. The participants were in their third and fifth semesters, comprising both male and female students. The selection used a purposive sampling technique, targeting students who had completed foundational chemistry courses and were considered capable of engaging with ill-structured problems related to socio-scientific issues.

**Instrument Development**

The instrument consisted of 27 essay items representing five local SSI contexts related to environmental pollution: (1) textile waste, (2) coal and mine drainage, (3) vehicle emissions, (4) household solid waste, and (5) cigarette smoke exposure. Each context was mapped to the four stages of ill-structured problem solving: problem representation, solution generation and selection, justification, and solution monitoring and evaluation.

**Table 1.** Ill-Structured Problem-Solving Instrument

| Local SSI Context | Problem Representation | Solution Generation | Justification | Monitoring & Evaluation | Total Items |
|---|---|---|---|---|---|
| Textile Industry Waste | 2 | 1 | 1 | 1 | 5 |
| Acid Mine Drainage | 2 | 2 | 1 | 2 | 7 |
| Motor Vehicle Emissions | 1 | 1 | 1 | 1 | 4 |
| Household Waste (Soil Pollution) | 2 | 1 | 1 | 1 | 5 |
| Cigarette Smoke & Health Risks | 1 | 1 | 1 | 2 | 5 |
| **Total** | **8** | **6** | **5** | **7** | **27** |

**Rubric and Scoring**

The scoring rubric is adapted from (Ge & Land, 2003) and consists of detailed criteria aligned with each problem-solving stage. For justification, arguments were scored on a 0–2–4 scale, and evidence provision was scored on a 0–1–2 scale. The complete rubric used to assess student responses is provided in Table 2.

**Table 2.** Rubric for Justification Stage

| Score | Argument Quality | Evidence Quality |
|---|---|---|
| 0 | Argument is irrelevant or absent | Evidence is not provided or irrelevant |
| 1 | Argument is partially relevant | Evidence somewhat supports the argument |
| 2 | Relevant argument, but lacks coherence | Evidence supports the argument but lacks specificity |
| 4 | Coherent and well-developed argument | Evidence clearly supports the argument and solution |

**Validation Process**

The instrument underwent a rigorous validation process involving four expert validators to ensure its content accuracy, contextual relevance, and clarity. Two internal validators—experienced chemistry lecturers from the same institution—evaluated the alignment of the items with the subject matter and the national curriculum standards. Additionally, two external validators, comprising a specialist in chemistry education and an expert in educational assessment from different academic institutions, assessed the appropriateness of integrating local socio-scientific issues (SSI), the relevance of each item, and the overall clarity of the instrument. All validators employed a structured validation sheet using a Likert scale to rate each item. The resulting data were analyzed using Aiken's V method to calculate the Construct Validity Index (CVI) (Aiken, 1980, 1985), which served as the basis for determining the feasibility and validity level of each item within the instrument (see Table 3).

**Table 3.** Interpretation of Construct Validity

| Construct Validity Index | Category |
|---|---|
| CVI < 0,4 | Low validity |
| 0,4 ≤ CVI < 0,8 | Medium validity |
| CVI ≥ 0,8 | High validity |

**Data Analysis**

The quantitative data collected during the instrument try-out phase were analyzed using Microsoft Excel and SPSS version 25. Several statistical procedures were employed to evaluate the quality and effectiveness of the developed assessment instrument. First, a readability analysis was conducted through descriptive statistics based on students' responses to a post-test questionnaire, aiming to assess the clarity and comprehensibility of the test items. Second, the item difficulty index (P) was calculated to categorize each item as easy, moderate, or difficult, thereby informing item refinement. Third, the internal consistency of the instrument was evaluated using Cronbach's Alpha to determine its reliability. Finally, construct validity was examined using the Construct Validity Index (CVI), derived from expert validator ratings and calculated through Aiken's V method, to assess the extent to which the items measured the intended constructs.

**Ethical Statement**

This study received ethical approval from the ethics committee of Universitas Pendidikan Mandalika. All participants gave informed consent after being briefed on the study's purpose, procedures, and their rights, including voluntary participation and withdrawal without consequence. Data collection was conducted under supervised conditions, with confidentiality ensured through anonymized coding. No personal identifiers were used, and participation had no impact on students' academic status. Data were used solely for research purposes related to instrument development in chemistry education.

## RESULTS AND DISCUSSION

**Construct Validity and Reliability**

The development of the assessment instrument was supported by strong evidence of construct validity and acceptable readability, both of which are essential for ensuring the instrument's effectiveness in evaluating ill-structured problem-solving within socio-scientific contexts in chemistry. Construct validity was confirmed through expert review involving four validators, who evaluated each item based on content relevance, language clarity, and image appropriateness. The resulting Construct Validity Index (CVI) was 0.93, indicating high validity across all assessed dimensions (Table 4). In parallel, readability feedback collected from students revealed that 75% found the language clear, 78% understood the visual elements (images, graphs, tables), and 70% were familiar with the terminology used in the items (Table 5).

**Table 4.** Construct Validity Assessment by Criteria

| Validator | Content Relevance | Language Clarity | Image Appropriateness | $\bar{x}$ CVI |
|---|---|---|---|---|
| Validator 1 | 0.90 | 0.95 | 0.90 | 0.92 |
| Validator 2 | 0.94 | 0.92 | 0.93 | 0.93 |
| Validator 3 | 0.95 | 0.94 | 0.91 | 0.93 |
| Validator 4 | 0.92 | 0.93 | 0.95 | 0.93 |
| **Average** | **0.93** | **0.935** | **0.9225** | **0.93** |

These findings are closely aligned with established literature emphasizing the role of clarity, contextualization, and multimodal representation in improving student comprehension and engagement. George et al. (2021) argue that the integration of socio-scientific issues (SSI) in chemistry curricula enhances students' motivation and helps contextualize abstract concepts through real-world relevance. The high CVI score for content relevance (0.93) reflects the validators' agreement that the instrument items are not only scientifically appropriate but also embedded meaningfully within socio-environmental contexts. From the students' perspective, the 70% familiarity with SSI-related terminology indicates a reasonable but improvable level of conceptual accessibility, suggesting a need for careful attention to language load, especially in diverse academic settings.

**Table 5.** Readability Evaluation

| Component | Readability Percentage |
|---|---|
| Language Clarity | 75 |
| Visual (Image/Graph/Table) | 78 |
| Terminology Familiarity | 70 |

The language clarity dimension also warrants attention. While expert validators rated language clarity highly (average CVI = 0.935), student feedback indicated a slightly lower agreement (75%). This discrepancy suggests that although items may appear linguistically sound to experts, students might still experience challenges, particularly when chemistry content is presented through complex or technical phrasing. Elhadary and Elhaty (2021) and Kumi-Yeboah and Amponsah (2023) both emphasize that language barriers can significantly impede students' understanding, especially in contexts where instruction is delivered in a non-native language. These challenges may influence students' ability to interpret problem scenarios effectively, which in turn affects the accuracy of assessment outcomes.

Visual aids in the instrument were also validated by experts (CVI = 0.9225) and positively received by students (78% comprehension), reinforcing the literature's assertion that visual supports play a crucial role in mediating understanding in complex science tasks. As Grieger and Leontyev (2021) and da Silva Júnior et al. (2024) note, visual representations in SSI-based tasks serve as cognitive scaffolds, helping students navigate abstract or unfamiliar concepts by grounding them in more accessible formats. The convergence of validator ratings and student perceptions in this area suggests that the visual elements in the instrument are both functionally and pedagogically effective.

The combined findings on construct validity and readability affirm that the instrument is generally well-designed for its intended purpose. However, they also highlight the need to continuously refine language and terminology based on actual student experiences. As Cahyani et al. (2024) and Picardal and Sanchez (2022) argue, instructional materials grounded in contextual and linguistic familiarity can significantly enhance students' engagement and analytical reasoning. These insights underscore the importance of complementing expert validation with student-centered evidence in instrument development, particularly when assessing higher-order thinking skills in SSI contexts.

**Empirical Validity**

***Item Difficulty Index***

Item analysis showed a distribution of difficulty levels across the 27 items: 7 items were categorized as easy, 17 moderate, and 3 difficult. Table 6 presents the item-level difficulty index and categorization.

**Table 6.** Item-Level Difficulty Index and Categorization

| Item Number | Difficulty Index | Category |
|---|---|---|
| 1 | 0.2 | Easy |
| 2 | 0.23 | Easy |
| 3 | 0.26 | Easy |

| Item Number | Difficulty Index | Category |
|---|---|---|
| 4 | 0.29 | Easy |
| 5 | 0.32 | Moderate |
| 6 | 0.35 | Moderate |
| 7 | 0.38 | Moderate |
| 8 | 0.41 | Moderate |
| 9 | 0.44 | Moderate |
| 10 | 0.47 | Moderate |
| 11 | 0.5 | Moderate |
| 12 | 0.53 | Moderate |
| 13 | 0.56 | Moderate |
| 14 | 0.59 | Moderate |
| 15 | 0.62 | Moderate |
| 16 | 0.65 | Moderate |
| 17 | 0.68 | Moderate |
| 18 | 0.71 | Hard |
| 19 | 0.74 | Hard |
| 20 | 0.77 | Hard |
| 21 | 0.8 | Hard |
| 22 | 0.83 | Hard |
| 23 | 0.86 | Hard |
| 24 | 0.89 | Hard |
| 25 | 0.92 | Hard |
| 26 | 0.95 | Hard |
| 27 | 0.98 | Hard |

***Reliability***

The reliability of the instrument was assessed using Cronbach's Alpha, yielding a value of 0.805, which falls into the high reliability category. To further support this, item-total correlation values were analyzed as presented in Figure 1.

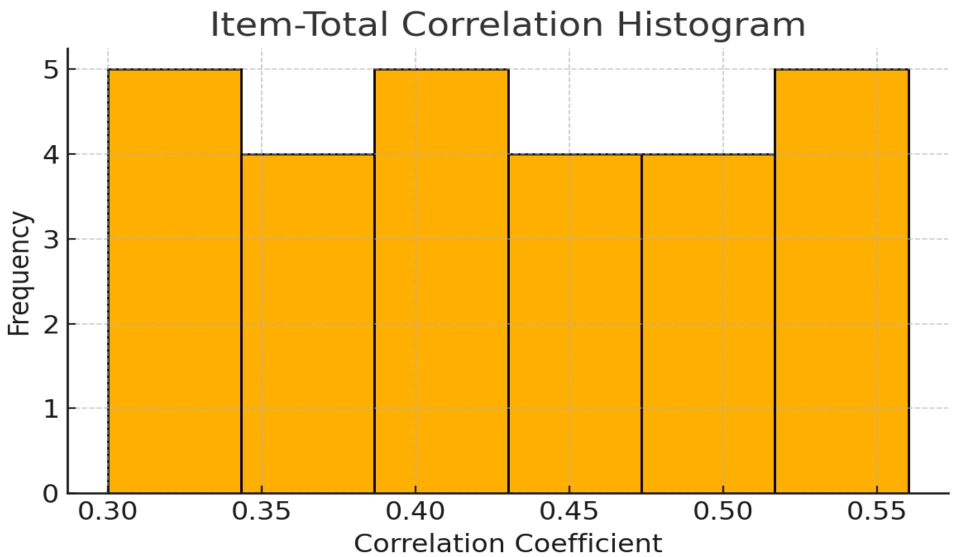
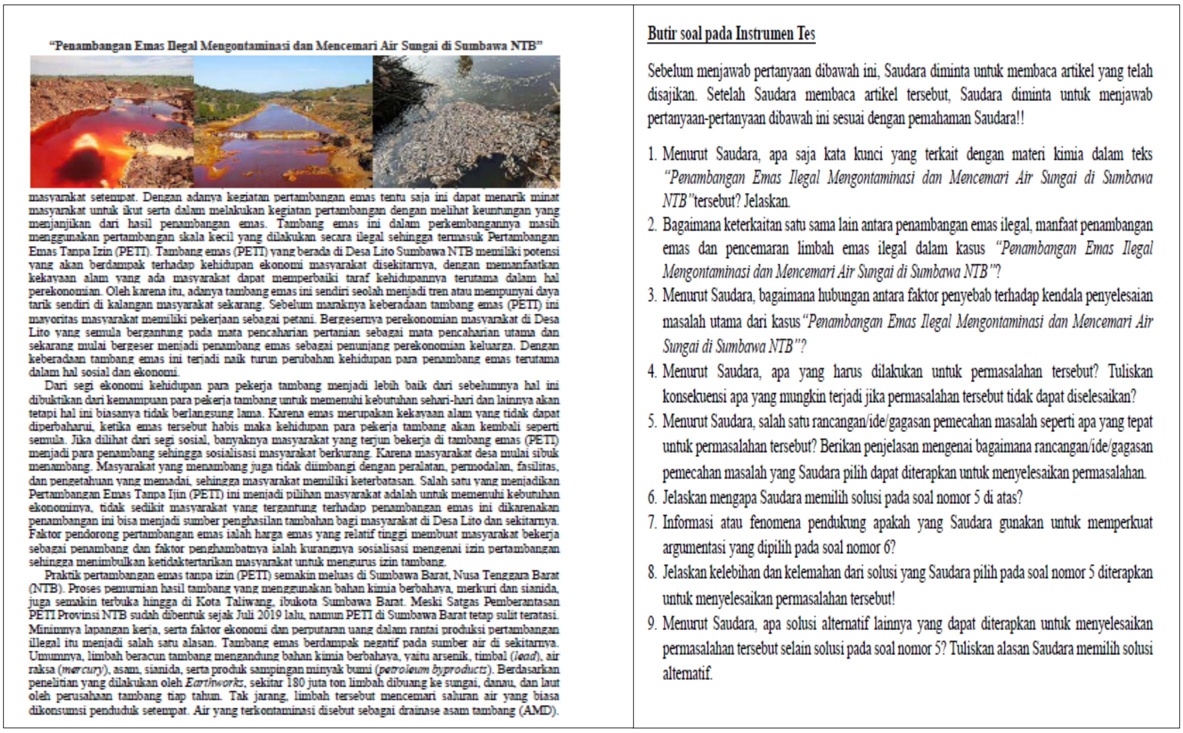



**Figure 1.** Histogram of Item-Total Correlations

### *Example Item*

Figure 2 presents a sample test item illustrating the 'Problem Representation' stage in the ill-structured problem-solving process. This item asks students to identify environmental pollutants and associated chemical compounds based on a local SSI scenario. This study's ill-structured problem-solving test is tailored to college students. Meetings typically last around 90 minutes. Consequently, the essay question format is regarded as a useful instrument for evaluating ill-structured problem-solving abilities in university students about environmental contamination. The essay-type questions employed in this instrument promote pupils' capacity to articulate explanations. This question type assesses the ill-structured problem-solving process during the problem representation phase and facilitates the monitoring and evaluation of solutions. During the problem representation phase, students must identify additional pertinent facts related to the presented issue. This phase is shaped by the knowledge and experience of prior pupils (Renkl, 2023). The efficacy of any solution to ill-structured problems may alone be assessed by its performance, given the multitude of potential alternatives (Kim & Lim, 2019). During the solution monitoring and evaluation phase, students must assess the strengths and shortcomings of the selected solution that may emerge. Students can develop an outline of their metacognitive abilities with the help of essay-type questions (Koehler & Vilarinho-Pereira, 2023).



**"Penambangan Emas Ilegal Mengontaminasi dan Mencemari Air Sungai di Sumbawa NTB"**

masyarakat setempat. Dengan adanya kegiatan pertambangan emas tentu saja ini dapat menarik minat masyarakat untuk ikut serta dalam melakukan kegiatan pertambangan dengan melihat keuntungan yang menjanjikan dari hasil penambangan emas. Tambang emas ini dalam perkembangannya masih menggunakan pertambangan skala kecil yang dilakukan secara ilegal sehingga termasuk Pertambangan Emas Tanpa Izin (PETI). Tambang emas (PETI) yang berada di Desa Lito Sumbawa NTB memiliki potensi yang akan berdampak terhadap kehidupan ekonomi masyarakat disekitarnya, dengan memanfaatkan kekayaan alam yang ada masyarakat dapat memperbaiki taraf kehidupannya terutama dalam hal perekonomian. Oleh karena itu, adanya tambang emas ini sendiri seolah menjadi tren atau mempunyai daya tarik sendiri di kalangan masyarakat sekarang. Sebelum maraknya keberadaan tambang emas (PETI) ini mayoritas masyarakat memiliki pekerjaan sebagai petani. Bergesernya perekonomian masyarakat di Desa Lito yang semula bergantung pada mata pencaharian pertanian sebagai mata pencaharian utama dan sekarang mulai bergeser menjadi penambang emas sebagai penunjang perekonomian keluarga. Dengan keberadaan tambang emas ini terjadi naik turun perubahan kehidupan para penambang emas terutama dalam hal sosial dan ekonomi.

Dari segi ekonomi kehidupan para pekerja tambang menjadi lebih baik dari sebelumnya hal ini dibuktikan dari kemampuan para pekerja tambang untuk memenuhi kebutuhan sehari-hari dan lainnya akan tetapi hal ini biasanya tidak berlangsung lama. Karena emas merupakan kekayaan alam yang tidak dapat diperbaharui, ketika emas tersebut habis maka kehidupan para pekerja tambang akan kembali seperti semula. Jika dilihat dari segi sosial, banyaknya masyarakat yang terjun bekerja di tambang emas (PETI) menjadi para penambang sehingga sosialisasi masyarakat berkurang. Karena masyarakat desa mulai sibuk menambang. Masyarakat yang menambang juga tidak diimbangi dengan peralatan, permodalan, fasilitas, dan pengetahuan yang memadai, sehingga masyarakat memiliki keterbatasan. Salah satu yang menjadikan Pertambangan Emas Tanpa Ijin (PETI) ini menjadi pilihan masyarakat adalah untuk memenuhi kebutuhan ekonominya, tidak sedikit masyarakat yang tergantung terhadap penambangan emas ini dikarenakan penambangan ini bisa menjadi sumber penghasilan tambahan bagi masyarakat di Desa Lito dan sekitarnya. Faktor pendorong pertambangan emas ialah harga emas yang relatif tinggi membuat masyarakat bekerja sebagai penambang dan faktor penghambatnya ialah kurangnya sosialisasi mengenai izin pertambangan sehingga menimbulkan ketidaktertarikan masyarakat untuk mengurus izin tambang.

Praktik pertambangan emas tanpa izin (PETI) semakin meluas di Sumbawa Barat, Nusa Tenggara Barat (NTB). Proses pemurnian hasil tambang yang menggunakan bahan kimia berbahaya, merkuri dan sianida, juga semakin terbuka hingga di Kota Taliwang, ibukota Sumbawa Barat. Meski Satgas Pemberantasan PETI Provinsi NTB sudah dibentuk sejak Juli 2019 lalu, namun PETI di Sumbawa Barat tetap sulit teratasi. Minimnya lapangan kerja, serta faktor ekonomi dan perputaran uang dalam rantai produksi pertambangan illegal itu menjadi salah satu alasan. Tambang emas berdampak negatif pada sumber air di sekitarnya. Umumnya, limbah beracun tambang mengandung bahan kimia berbahaya, yaitu arsenik, timbal (*lead*), air raksa (*mercury*), asam, sianida, serta produk sampingan minyak bumi (*petroleum byproducts*). Berdasarkan penelitian yang dilakukan oleh *Earthworks*, sekitar 180 juta ton limbah dibuang ke sungai, danau, dan laut oleh perusahaan tambang tiap tahun. Tak jarang, limbah tersebut mencemari saluran air yang biasa dikonsumsi penduduk setempat. Air yang terkontaminasi disebut sebagai drainase asam tambang (AMD).

**Butir soal pada Instrumen Tes**

Sebelum menjawab pertanyaan dibawah ini, Saudara diminta untuk membaca artikel yang telah disajikan. Setelah Saudara membaca artikel tersebut, Saudara diminta untuk menjawab pertanyaan-pertanyaan dibawah ini sesuai dengan pemahaman Saudara!!

1. Menurut Saudara, apa saja kata kunci yang terkait dengan materi kimia dalam teks *"Penambangan Emas Ilegal Mengontaminasi dan Mencemari Air Sungai di Sumbawa NTB"* tersebut? Jelaskan.
2. Bagaimana keterkaitan satu sama lain antara penambangan emas ilegal, manfaat penambangan emas dan pencemaran limbah emas ilegal dalam kasus *"Penambangan Emas Ilegal Mengontaminasi dan Mencemari Air Sungai di Sumbawa NTB"*?
3. Menurut Saudara, bagaimana hubungan antara faktor penyebab terhadap kendala penyelesaian masalah utama dari kasus *"Penambangan Emas Ilegal Mengontaminasi dan Mencemari Air Sungai di Sumbawa NTB"*?
4. Menurut Saudara, apa yang harus dilakukan untuk permasalahan tersebut? Tuliskan konsekuensi apa yang mungkin terjadi jika permasalahan tersebut tidak dapat diselesaikan?
5. Menurut Saudara, salah satu rancangan/ide/gagasan pemecahan masalah seperti apa yang tepat untuk permasalahan tersebut? Berikan penjelasan mengenai bagaimana rancangan/ide/gagasan pemecahan masalah yang Saudara pilih dapat diterapkan untuk menyelesaikan permasalahan.
6. Jelaskan mengapa Saudara memilih solusi pada soal nomor 5 di atas?
7. Informasi atau fenomena pendukung apakah yang Saudara gunakan untuk memperkuat argumentasi yang dipilih pada soal nomor 6?
8. Jelaskan kelebihan dan kelemahan dari solusi yang Saudara pilih pada soal nomor 5 diterapkan untuk menyelesaikan permasalahan tersebut!
9. Menurut Saudara, apa solusi alternatif lainnya yang dapat diterapkan untuk menyelesaikan permasalahan tersebut selain solusi pada soal nomor 5? Tuliskan alasan Saudara memilih solusi alternatif.

**Figure 2.** The example of ill-structured problem-solving skills test item

The instruments created in this study incorporate local SSI as a contextual issue. The incorporation of local SSI can enhance students' engagement in actively addressing issues within their environment (Ge et al., 2022), pupils' capacity to elucidate the mechanisms and rationale behind the emergence of a problem (Law et al., 2020), formulate arguments and correlate scientific principles with societal issues (Zamakhsyari & Rahayu, 2020). Consequently, the devised instrument can evaluate a specific aspect of scientific literacy, specifically the problem-solving challenges encountered by students in their everyday life.

## CONCLUSION

This study's ill-structured problem-solving skills assessment consisted of 27 items contextualized within local socio-scientific issues (SSI) related to environmental pollution. The instrument demonstrated strong construct validity (CVI = 0.93) and high internal consistency (Cronbach's Alpha = 0.805). The item readability, difficulty index, and reliability analyses confirmed that the instrument is appropriate for assessing students' problem-solving abilities across the four stages: problem representation, solution generation and selection, justification, and solution monitoring and evaluation. The developed instrument provides an evidence-based tool for measuring students' engagement with real-world, context-rich chemistry problems. It is particularly valuable for fostering chemical literacy by encouraging students to think critically and apply scientific principles to socio-environmental challenges. Educators can embed this tool in semester-long instruction cycles to continuously track and improve students' ill-structured problem-solving skills. By integrating the instrument into regular teaching practices, educators can not only assess learning outcomes but also support deeper learning through meaningful, contextualized problem-solving experiences.

## RECOMMENDATIONS

This instrument is not only suitable for assessing students' ill-structured problem-solving skills but also holds potential for broader implementation. It is recommended that this tool be integrated into teacher professional development programs and microteaching practices, where pre-service and in-service teachers can learn to design, deliver, and evaluate context-based chemistry instruction. Embedding the instrument in teacher training will enhance educators' capacity to foster critical thinking, contextual understanding, and socio-scientific reasoning in the classroom. Additionally, the instrument can support formative assessments throughout instructional cycles, helping educators monitor students' progression through the stages of problem-solving, from problem representation to monitoring and evaluation.

### Author Contributions

Citra Ayu Dewi, CAD, Maryone Saija, MS. Conceptualization, CAD and MS; methodology, CAD; validation, CAD and MS; formal analysis, CAD; investigation, MS; resources, CAD; data curation, MS; writing—original draft preparation, CAD; writing—review and editing, CAD; visualization, MS; supervision, CAD; project administration, MS; funding acquisition, CAD and MS. All authors have read and agreed to the published version of the manuscript.

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### Conflict of interests

The author declares that there are no conflicts of interest in this study.

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