

Science Literacy E-Assessment: Innovation of Digital Assessment Instruments in Junior High School Science

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Abstract: Students' weak scientific literacy is partly linked to the lack of assessment tools designed specifically to measure it. A review of 40 daily Biology test items for Grade VIII at SMP Adabiah Padang showed that only 37.5% addressed the indicator of explaining phenomena scientifically, while no items addressed interpreting and evaluating data. This study aimed to produce a valid and practical digital scientific literacy assessment (E-Assessment) for junior high school (SMP/MTs) science. It followed a Research and Development approach based on the Plomp model, restricted to the prototyping phase. The participants were three expert validators, three science teachers, and 15 Grade VIII students of SMP Adabiah Padang. Validity and practicality were analyzed descriptively using percentage scores. Expert validation averaged 97.7% (about 98%, very valid), while teacher and student practicality scores were 97.0% and 86.3%, both in the very practical category. These findings indicate that the developed E-Assessment is a valid and practical prototype for measuring students' scientific literacy.

Keywords: E-Assessment, Science Literacy, Junior High School Science, Plomp Model.

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I. INTRODUCTION

Science education in the 21st century asks more of students than mastering theories and recalling facts. Students need solid scientific literacy. Sari et al. (2025) note that this literacy involves thinking critically, judging issues against sound evidence, and applying scientific reasoning to everyday choices. Toharuddin et al. (2011) describe it as the capacity to understand, communicate, and use scientific knowledge to solve problems and reach well-reasoned decisions. In short, scientific literacy is a form of critical thinking in which scientific knowledge, supported by evidence and reasoning, is used to handle problems and make decisions in daily life.

The PISA 2025 framework centers scientific literacy on students' ability to decide and act on real-life problems, and it organizes the construct into four aspects: context, competence, knowledge, and scientific identity (OECD, 2023). Context covers issues from the personal and local to the national and global level, and requires learners to explain and evaluate scientific phenomena in their surroundings (Wasis et al., 2020).

Competence consists of three cognitive abilities: explaining phenomena scientifically, evaluating and

designing scientific inquiry, and interpreting data and evidence scientifically to support decisions (Deta et al., 2024). Knowledge refers to the content, procedural, and epistemic understanding needed to carry out these competencies. Scientific identity, which evolved from the earlier attitude aspect, reflects how connected learners feel to science through science capital, attitudinal constructs, and environmental constructs (OECD, 2023).

Preliminary observations at SMP Adabiah Padang in February 2026 showed that the school has tried to strengthen teaching quality and student literacy through Subject Teacher Forum (MGMP) training and the School Literacy Movement (GLS). However, the outcomes of that training and the GLS have not yet been built into daily classroom assessment.

We analyzed 40 items from the Odd Semester Daily Assessment (2025/2026) for Grade VIII Biology at the school. Only 15 items (37.5%) matched the first scientific literacy indicator, explaining phenomena scientifically. Items matching the second indicator (constructing, evaluating, and interpreting data) and the third (researching, evaluating, and using scientific information) were absent (0%). Most items instead measured theoretical recall. According to the OECD (2023), a balanced PISA-style science test should allocate 36–44% of items to the first indicator and 24–36% to each of

the second and third.

Assessment is also moving from paper to digital formats, such as computer-based tests (Ashari et al., 2023). An electronic assessment built around scientific literacy can make evaluation more efficient through fast, accurate, and flexible data processing, and can offer interactive multimedia stimuli that support deeper measurement of literacy (Asrial et al., 2022). To address the gap described above, this study develops a valid and practical scientific literacy E-Assessment for Grade VIII biology in junior high school (SMP/MTs).

II. RESEARCH AND METHODS

This Research and Development (R&D) study applied the Plomp development model (Plomp & Nieveen, 2013). The procedure stopped at the prototyping phase and did not proceed to the field test/assessment phase. The study ran from February to August 2026 at Universitas PGRI Sumatera Barat and SMP Adabiah Padang. Participants were three expert validators (content, evaluation, and media), three science teachers, and Grade VIII students of SMP Adabiah Padang.

Development followed two main phases of the Plomp model. (1) Preliminary research comprised a needs analysis (teacher interviews and item analysis of daily tests) and a curriculum analysis (reviewing the CP and TP of the Merdeka Curriculum from BSKAP, 2025 for the digestive, circulatory, respiratory, and excretory systems). (2) The prototyping phase covered drafting the product and its supporting instruments, which were evaluated stage by stage following Tessmer's formative evaluation flow:

- Self-evaluation: the researcher checked the draft for obvious surface errors, producing Prototype I.
- Expert review: three expert lecturers (content, evaluation, and media) validated the product using a Guttman-scale validation sheet (Widodo et al., 2023), producing Prototype II.
- One-to-one evaluation: readability was tested through interviews with three students of high, medium, and low academic ability, producing Prototype III.

- Small group evaluation: practicality was tested with three science teachers and 15 students using a Likert-scale questionnaire (Akbar, 2013), together with an empirical item validity analysis.

Validity and practicality data were converted to percentages with the following formula (Sudijono, 2011):

$$\text{Score} = \frac{\text{Total Empirical Score}}{\text{Total Expected Score}} \times 100\%$$

Results were classified using the criteria of Akbar (2013): 85.01%–100% (Very Valid/Practical), 70.01%–85.00% (Fairly Valid/Practical), 50.01%–70.00% (Less Valid/Practical), and 0%–50.00% (Invalid/Impractical).

III. RESULT AND DISCUSSION

➤ Preliminary Research

The needs analysis showed that daily assessments at SMP Adabiah Padang had not yet incorporated scientific literacy indicators. Of the 40 odd-semester Biology items for 2025/2026, 62.5% were non-literacy items, and PISA indicators 2 and 3 were both at 0%. The curriculum analysis translated the Phase D Learning Outcomes (CP) into Learning Objectives (TP) and Goal Indicators (IKTP) for four topics, following national curriculum guidelines (BSKAP, 2025). The E-Assessment therefore covers Grade VIII biology: the digestive, circulatory, respiratory, and excretory systems.

➤ Prototype Design

The application uses a white, green, and blue color scheme and includes an interactive dashboard, a question bank, an instrument grid, time limits, automated scoring, and real-time monitoring and reporting of individual and class performance. In total, 120 items were developed in five formats: multiple-choice, complex multiple-choice, true/false, matching, and cause-and-effect. Figures 1–6 show the login page, teacher dashboard, question bank, grid view, student question display, and teacher monitoring view.

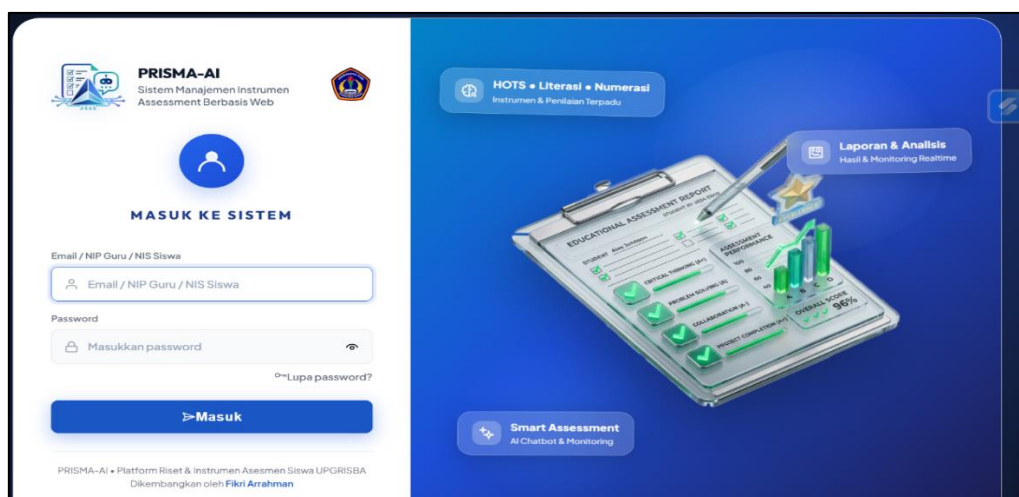


Fig 1 E-Assessment Login Page Display

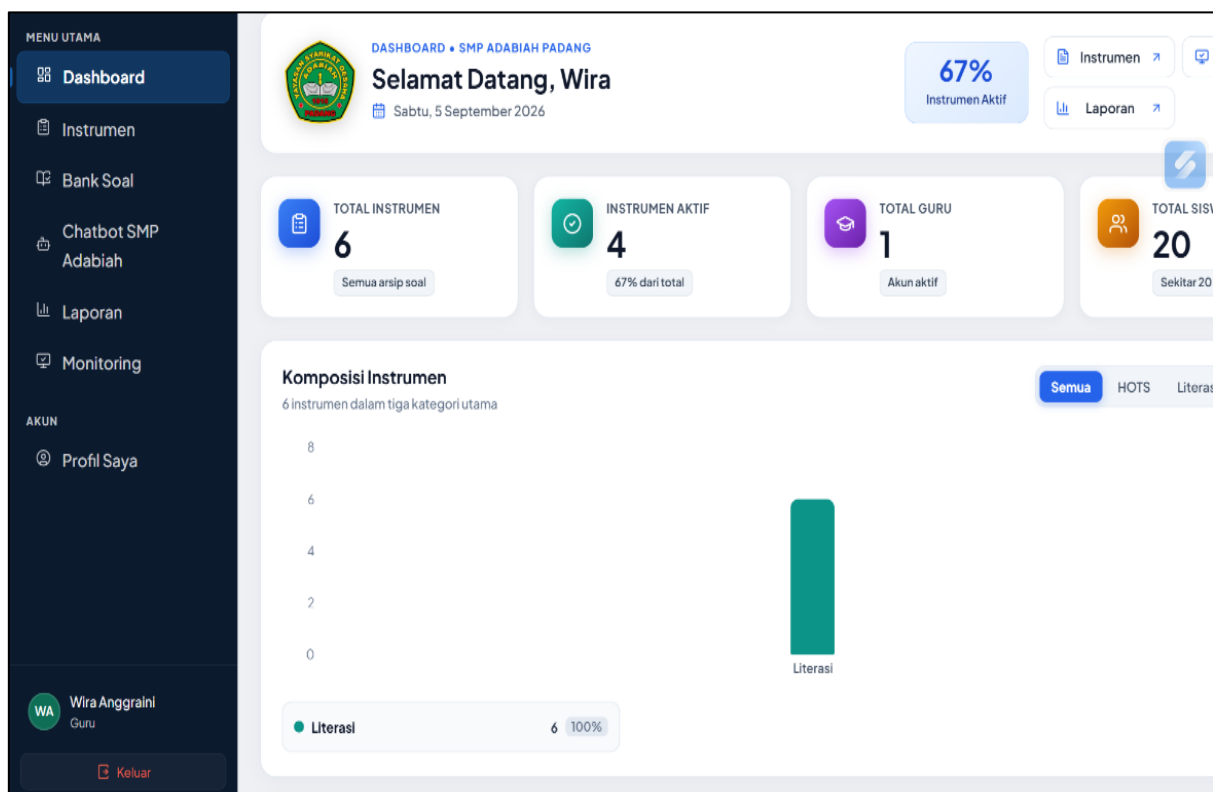


Fig 2 Teacher Dashboard View in the E-Assessment System

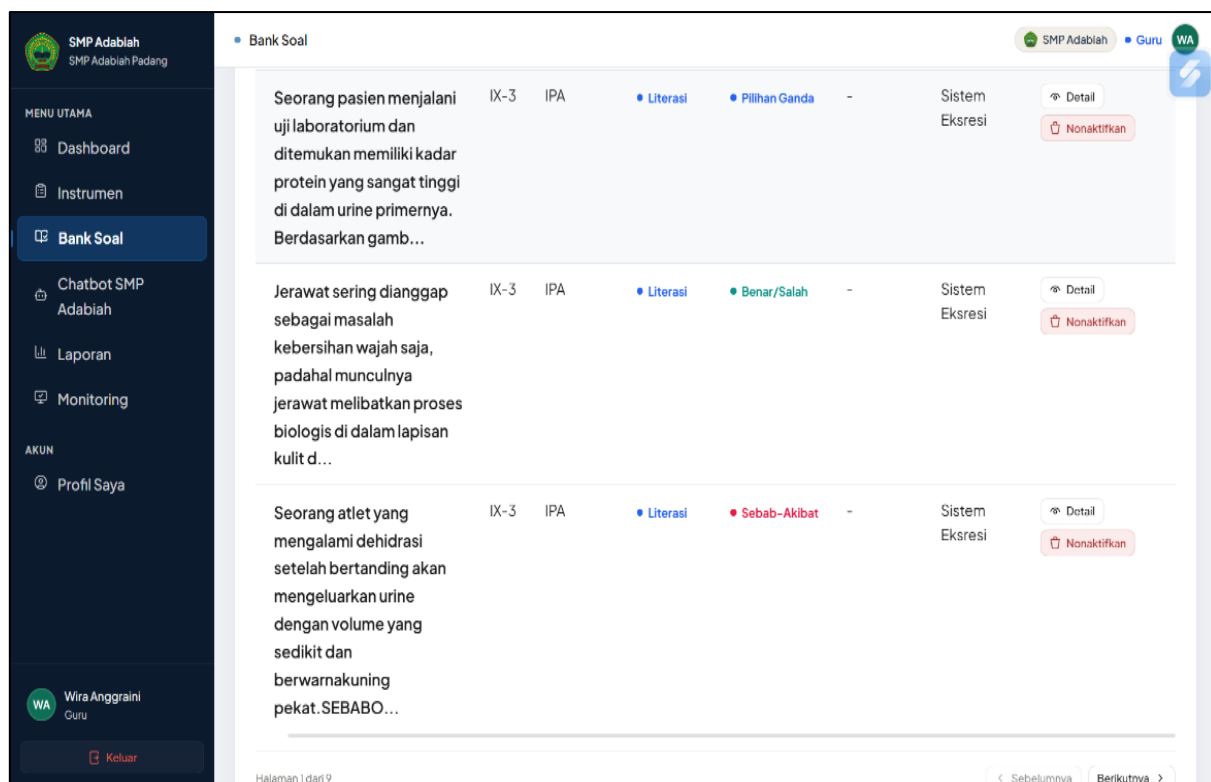


Fig 3 Question Bank Display in the E-Assessment

Kisi-Kisi Instrumen

SMP Adabiah Guru WA

Detail Kisi-Kisi

15 baris

Ukuran Teks: A- A A+ A++ + Tambah Baris

TUJUAN PEMBELAJARAN	INDIKATOR KETERCAPAIAN TUJUAN PEMBELAJARAN	INDIKATOR LITERASI SAINS	INDIKATOR SOAL
Peserta didik dapat mengevaluasi antara sistem organ dalam makhluk hidup	1. Mengidentifikasi struktur dan fungsi organ pada sistem ekskresi manusia.	dan menginterpretasikan data dan bukti ilmiah secara kritis	Disajikan gambar struktur kulit peserta didik dapat menganalisis kerja sama
Peserta didik dapat mengevaluasi antara sistem organ dalam makhluk hidup		dan menginterpretasikan data dan bukti ilmiah secara kritis	Disajikan gambar struktur ginjal dan nefron peserta didik dapat menganalisis dan
Peserta didik dapat mengevaluasi antara sistem organ dalam makhluk hidup	2. Menjelaskan mekanisme/proses pembuangan zat sisa oleh	Menjelaskan fenomena secara ilmiah	Disajikan teks perubahan suhu tubuh setelah berolahraga lalu masuk
Peserta didik dapat mengevaluasi antara sistem organ dalam makhluk hidup		Menyusun, mengevaluasi, dan menginterpretasikan data dan bukti ilmiah secara	Disajikan teks perbedaan udara di taman dan jalan raya, peserta didik dapat
Peserta didik dapat mengevaluasi antara sistem		Menyusun, mengevaluasi, dan menginterpretasikan	Disajikan teks tentang penumpukan zat amonia,

Fig 4 Grid View in E-Assessment

Kerjakan Soal

SMP Adabiah Siswa GD

Aplikasi Penghitung Kalori

Roni selesai berolahraga lari dan melihat pada jam pintarnya (*smartwatch*) bahwa ia telah membakar energi sebesar 400 kalori. Ia ingin mencari makanan di kantin sekolah yang jumlah kalorinya seimbang untuk menggantikan energi yang hilang tersebut. Sebelum membeli, Roni menggunakan aplikasi penghitung kalori di ponselnya untuk melihat kandungan energi dari menu kantin. Hasil aplikasi menunjukkan data sebagai berikut:

PILIHAN MENU	JUMLAH KALORI
Menu X (Bubur Ayam)	250 kalori
Menu Y (Gado-gado)	430 kalori

Berdasarkan data di atas, makanan yang paling baik dan seimbang untuk memenuhi kebutuhan kalori Roni setelah berolahraga adalah.....

☐ A. Menu X, karena rendah kalori sehingga mempercepat penurunan berat badan.

☐ B. Menu Y, karena jumlah kalorinya paling mendekati total energi yang hilang.

☐ C. Menu X, karena kalori yang rendah dapat mencegah asam lambung naik.

☐ D. Menu Y, karena kandungan seratnya mempercepat penyerapan energi.

Fig 5 Display of Questions in the E-Assessment.



Fig 6 Teacher Monitoring View on the E-assessment System.

➤ Self-Evaluation and Expert Review

Self-evaluation confirmed that the first prototype had no typographical errors or major technical bugs, yielding

Prototype I. The expert team then reviewed Prototype I; the results are given in Table 1.

Table 1 E-Assessment Validation Results by the Expert Review Team

No	Organ System Material	Average Validity (%)	Feasibility Criteria
1.	Digestive	96,7	Very Valid
2.	Circulatory	97,8	Very Valid
3.	Respiratory	98,3	Very Valid
4.	Excretory	98,1	Very Valid
Average		97,7	Very Valid

All four topics fell in the "Very Valid" category, with an overall mean of 97.7% (about 98%). The validators suggested clarifying the stimulus sources, aligning the IKTP with the question indicators, and improving the layout of the answer options.

➤ One-to-One Evaluation

The three students found the interface attractive, easy to use, and free of navigation problems. Based on their feedback, the stimulus images were enlarged and the instructions simplified. Practicality was then tested in the small group evaluation. Teacher ratings are shown in Table 2.

Table 2 Teacher Practicality Results for E-Assessment

No	Aspect	Practicality Score	Criteria
1.	Ease of Use	95,5	Very Practical
2.	Time Efficiency and Management	97,7	Very Practical
3.	Benefits	97,7	Very Practical
Average		97,0	Very Practical

Student ratings from the small group phase are shown in Table 3.

Table 3 Student Practicality Results for E-Assessment

No	Aspect	Practicality Score	Criteria
1.	Ease of Use	85,3	Very Practical
2.	Interface/Display	87,1	Very Practical
3.	Benefits	86,6	Very Practical
Average		86,3	Very Practical

Both groups rated the E-Assessment as "Very Practical" (teachers 97.0%, students 86.3%). This suggests that the tool is easy to operate, saves time in managing evaluations, and helps map students' scientific literacy interactively (Asrial et al., 2022). Note that the students' "Ease of Use" score (85.3%) is only just above the "Very Practical" threshold of 85.01%, so navigation and instructions still deserve attention in further refinement.

IV. CONCLUSION

The scientific literacy E-Assessment for Grade VIII biology (SMP/MTs), developed with the Plomp model, was judged valid and practical at the prototype stage. Expert validation averaged 97.7% (very valid), and practicality reached 97.0% from teachers and 86.3% from students, both very practical. Science teachers can use this tool as an efficient digital means of mapping students' scientific literacy. Further testing is recommended to examine its effectiveness in wider settings.

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