JURNAL BIOEDUIN

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

Development of an SSCS-Based Electronic Student Worksheet (E-LKPD) Integrating Science Process Skills in Respiratory System Learning

Euis Yusniati[1], Nengsih Juanengsih*[2]
[1,2] Biology Education, FITK, Universitas Islam Negeri Syarif Hidayatullah, Jakarta, Indonesia
ysneuis@gmail.com, nengsih.juanengsih@uinjkt.ac.id*

Abstract

Biology learning in secondary schools requires instructional materials that facilitate students' engagement in scientific inquiry and the development of Science Process Skills (SPS). However, available learning materials often lack structured inquiry-based activities. This study aimed to develop and validate a Search, Solve, Create, and Share (SSCS)-based Electronic Student Worksheet (E-LKPD) integrated with SPS indicators for respiratory system learning. This study adopted a Research and Development (R&D) methodology based on a modified Thiagarajan's 4-D development model, encompassing three stages: Define, Design, and Develop. The participants consisted of one subject-matter expert, one media expert, two biology teachers, and 35 eleventh-grade students from SMAN 10 Depok. Data were collected through expert validation sheets and response questionnaires and analyzed descriptively using percentage analysis. The results showed that the developed E-LKPD achieved a feasibility score of 80.51% based on expert validation, with positive responses from biology teachers (92.92%) and students (98.06%). These findings indicate that the SSCS-based E-LKPD is feasible and practical as a digital learning resource for respiratory system learning. Further studies are recommended to investigate its effectiveness in improving students' science process skills and learning outcomes through experimental research designs.

Keywords: E-LKPD, SSCS, science process skills, respiratory system

INTRODUCTION

Learning Natural Sciences (IPA), particularly biology, aims to help students understand scientific concepts through systematic inquiry and scientific investigation. In biology education, learning is expected not only to facilitate conceptual understanding but also to develop students' Science Process Skills (SPS), including observing, formulating hypotheses, designing investigations, interpreting data, drawing conclusions, and communicating scientific findings. These skills enable students to construct scientific knowledge through direct experience and inquiry, thereby supporting meaningful learning and improving conceptual understanding (Sinta & Agustina, 2024).

Despite their importance, students' Science Process Skills (SPS) in Indonesia remain relatively low. Previous studies reported that students experience difficulties in formulating hypotheses, identifying variables, designing experiments, and analyzing scientific data (Angelia et al., 2022). Conventional biology instruction continues to emphasize factual knowledge over scientific investigation, limiting opportunities for students to engage in scientific inquiry (Wahyuni et al., 2024). Teacher-centered learning, reliance on printed textbooks, and limited use of interactive learning media further contribute to students' low engagement in scientific activities (Nurfitriani et al., 2025). Preliminary observations during the needs analysis at the research school also indicated that biology instruction predominantly relied on teacher explanations and printed worksheets. Interviews with the biology teacher and students revealed that existing learning materials had not systematically facilitated SPS practice, particularly in activities involving hypothesis formulation, investigation planning, data interpretation, and scientific communication. These findings demonstrate the need for instructional media that explicitly guide students through scientific inquiry activities.

The integration of digital technology into biology learning offers opportunities to address these challenges. Electronic Student Worksheets (E-LKPD) provide flexible, interactive, and student-centered learning environments that facilitate inquiry activities and encourage independent learning (Sumanik, 2022). Previous studies have shown that inquiry-oriented worksheets not only increase students' engagement but also support higher-order competencies. Worksheets developed using Socio-Scientific Inquiry-Based Learning (SSIBL), for example, have been reported to improve students' problem-solving skills and to receive highly positive responses from learners (Sa'adah et al., 2022). Likewise, biology learning that explicitly incorporates Science Process Skills has been shown to promote critical thinking through scientific activities such as observation, experimentation, hypothesis formulation, data interpretation, and communication (Wulandari et al., 2021). These findings indicate that digital worksheets have considerable potential to support inquiry-oriented biology learning.

Among various inquiry-oriented instructional models, the Search, Solve, Create, and Share (SSCS) model provides a structured learning sequence that encourages students to identify problems, search for relevant information, develop solutions, construct scientific products, and communicate their findings. Previous development studies have demonstrated that SSCS-based worksheets are feasible for biology learning. An SSCS-based worksheet developed for the digestive system demonstrated high feasibility, as indicated by expert validation, teacher assessment, and student readability, suggesting that the SSCS model provides a systematic framework for organizing scientific learning activities (Lele & Widyaningrum, 2022). Other studies also reported that SSCS-based E-LKPD on the excretory system was feasible for biology learning (Elvanuari et al., 2024), while similar worksheets developed for arthropod materials received highly positive student responses (Qalfin et al., 2024; Sanchia & Faizah, 2019). Furthermore, Liveworksheet-based E-LKPD has been reported to be feasible for environmental change learning (Tumaili et al., 2025), and a needs analysis also demonstrated strong demand for interactive digital worksheets that support twenty-first-century competencies (Maulana & Sopandi, 2022).

Although these studies demonstrate the potential of digital worksheets and SSCS-based learning, several important gaps remain. First, previous studies primarily focused on evaluating product feasibility, practicality, student responses, or general learning outcomes, without explicitly designing learning activities that systematically address all indicators of Science Process Skills throughout the learning process. Second, studies integrating inquiry-based worksheets have mainly emphasized problem-solving skills or critical thinking rather than explicitly organizing Science Process Skills within each instructional phase (Sa'adah et al., 2022; Wulandari et al., 2021). Third, studies involving SSCS-based worksheets have validated the instructional model in different biological topics, such as the digestive and excretory systems (Elvanuari et al., 2024; Lele & Widyaningrum, 2022), but have not explicitly mapped Science Process Skills indicators to every phase of the SSCS syntax in an interactive digital worksheet. Consequently, the theoretical relationship between the SSCS learning sequence and the systematic practice of Science Process Skills remains insufficiently addressed in the development of existing learning materials.

A further practical gap concerns the implementation of interactive digital worksheets in respiratory system learning. Most previous developments focused on different biological topics or conventional worksheet formats. Meanwhile, the respiratory system presents distinctive learning challenges

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

because students must understand microscopic mechanisms that cannot be directly observed, including pulmonary ventilation, alveolar gas exchange via diffusion, oxygen and carbon dioxide transport, and the physiological regulation of respiration. These concepts involve dynamic interactions among multiple organ systems and require students to interpret diagrams, scientific models, and biological evidence rather than merely memorizing factual information. Consequently, learning about the respiratory system requires instructional media that can systematically guide students through scientific investigation and conceptual reasoning.

Based on these considerations, this study develops a Liveworksheets-based Electronic Student Worksheet (E-LKPD) integrating the Search, Solve, Create, and Share (SSCS) model for respiratory system learning in Phase F of the Merdeka Curriculum. Unlike previous studies, the novelty of this research does not merely lie in applying the SSCS model to different subject matter or using the Liveworksheets platform. Instead, the developed E-LKPD is designed by explicitly integrating Science Process Skills indicators into each phase of the SSCS learning syntax, thereby providing structured opportunities for students to practice scientific inquiry during learning activities. As a development study, this research focuses on determining the validity and practicality of the developed E-LKPD as an instructional medium for facilitating the practice of Science Process Skills in biology learning.

RESEARCH METHOD

This study employed a Research and Development (R&D) approach to develop an SSCS-based Electronic Student Worksheet (E-LKPD) for respiratory system learning. The study adopted a modified version of Thiagarajan's 4D development model consisting of three stages: Define, Design, and Develop. The Disseminate stage was not implemented because the study focused on product development, validation, and limited-scale trials.

The purpose of this study was to develop an SSCS-based E-LKPD that integrates Science Process Skills (SPS) activities into respiratory system learning and to evaluate its feasibility and practicality through expert validation and user responses.

Development Procedure

Define Stage

The define stage aimed to identify learning needs and establish the basis for product development. A needs analysis was conducted through classroom observations, interviews with one biology teacher and three eleventh-grade students, and a review of instructional materials currently used in respiratory system learning.

In addition, curriculum analysis was conducted based on the Biology Learning Outcomes (Capaian Pembelajaran) for Phase F of the Merdeka Curriculum. Concept and task analyses were also conducted to identify essential concepts, learning objectives, and SPS indicators relevant to respiratory system learning.

Design Stage

The design stage focused on planning the structure, content, and visual appearance of the E-LKPD. Learning activities were designed according to the four phases of the Search, Solve, Create, and Share (SSCS) model and aligned with Science Process Skills indicators.

The E-LKPD included contextual problems, interactive learning activities, concept summaries, worksheets, and reflection tasks. The product was developed using the Liveworksheet platform to enable interactive digital learning experiences.

Table 1 presents the alignment between SSCS learning stages and SPS indicators incorporated into the E-LKPD design.

Table 1. Mapping of SSCS Model Stages to Science Process Skills (SPS) Aspects

SSCS Stage	Student Activities	Science Process Skills (SPS) Aspects Practiced	Brief Explanation
Search	Identifying problems, observing, and gathering information	Observing, Asking Question	Students observe phenomena and formulate questions about them.
Solve	Planning a solution	Interpreting, Hypothesizing, Predicting, Asking Questions	Students plan a solution strategy, formulate a hypothesis, and estimate the results of the plan.
Create	Creating a knowledge product, solution, or report	Communicating, Evaluating, and Analyzing Data	Students organize the results of their analysis into a product (diagram, report, presentation) and assess their suitability to the hypothesis.
Share	Communicating results, discussing, and providing feedback.	Communicating, Evaluating	Students present their findings, discuss their results, and receive or provide peer or teacher evaluation.

Develop Stage

The develop stage involved product validation, revision, and limited-scale trials. Expert validators evaluated the initial prototype of the E-LKPD to assess its content quality, presentation, language, and media design.

Suggestions from the validators were used to revise and improve the product before its implementation in a limited trial involving teachers and students.

Participants

The study involved four categories of participants. One subject-matter expert evaluated the content's accuracy and alignment with the curriculum, while another media expert assessed the interface design, usability, and visual communication of the developed E-LKPD. In addition, two biology teachers evaluated the product's practicality, and 35 eleventh-grade students from SMAN 10 Depok participated in a limited-scale user trial. The expert validators were selected based on their academic qualifications and expertise in biology education and educational technology. The study involved four categories of participants:

1. One subject-matter expert responsible for evaluating content accuracy and curriculum alignment.
2. One media expert responsible for evaluating interface design, usability, and visual communication aspects.
3. Two biology teachers who evaluated the practicality of the developed E-LKPD.
4. Thirty-five eleventh-grade students from SMAN 10 Depok who participated in the limited-scale user trial.

The expert validators were selected based on their academic qualifications and expertise in biology education and educational technology.

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

Research Instruments

Five research instruments were employed in this study: (1) a needs analysis interview guide, (2) a material expert validation sheet, (3) a media expert validation sheet, (4) a biology teacher response questionnaire, and (5) a student response questionnaire. All validation sheets and questionnaires used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

The material validation instrument consisted of 20 items distributed across five aspects: suitability of the content with the Search, Solve, Create, and Share (SSCS) learning model (5 items), alignment of the material with the learning outcomes and learning objectives (4 items), suitability of the material to students' learning needs (3 items), content accuracy (4 items), and language appropriateness (4 items). The instrument was adapted and modified from previous studies to suit the characteristics of the developed SSCS-based E-LKPD.

The media validation instrument comprised 17 items assessing three aspects: graphical design (8 items), language (4 items), and presentation (5 items). The instrument was adapted from Hilma Arifah and modified to evaluate the visual appearance, readability, presentation quality, and technical aspects of the Liveworksheets-based E-LKPD.

The teacher response questionnaire consisted of 25 items covering four aspects: practicality (3 items), content feasibility (11 items), graphical design (7 items), and language (4 items). The questionnaire was administered to two biology teachers to evaluate the practicality of the developed E-LKPD for classroom implementation.

The student response questionnaire consisted of 27 items distributed across four aspects: graphical design (10 items), practicality (6 items), presentation (8 items), and language (3 items). The questionnaire was administered to 35 Phase F senior high school students following the limited product trial to evaluate the practicality and usability of the developed E-LKPD from the learners' perspective.

The material validation was conducted by a Biology Education lecturer holding a Master's degree (M.Si.) with expertise in biology content. In contrast, the media validation was carried out by a Biology Education lecturer holding a Master's degree in Education (M.Pd.) with expertise in instructional media development. Both validators were purposively selected for their academic qualifications and expertise in biology education and educational media development. Before implementation, the instruments underwent expert judgment to evaluate the relevance, clarity, and appropriateness of each item. Suggestions from the validators were incorporated into the revision of the research instruments before data collection.

Instrument Validity

The research instruments in this study were validated through expert judgment to ensure their content relevance, clarity, and appropriateness with the research objectives. The validation was carried out by two experts: a Biology Education lecturer with a Master's degree (M.Si.) as the material expert and a Biology Education lecturer with a Master's degree in Education (M.Pd.) as the media expert. Each expert evaluated the instruments based on their respective expertise, including content accuracy, alignment with learning objectives, instructional design, and media presentation aspects.

The experts also provided qualitative feedback and suggestions, which were used as the basis for revising and improving the instruments before they were implemented in the study. This expert judgment process ensured that the instruments were suitable for measuring the intended constructs, namely the validity and practicality of the developed SSCS-based E-LKPD.

However, due to the limited number of validators involved in this study, statistical content validity measures such as Aiken's V or Content Validity Ratio (CVR) were not applied. Therefore, the instruments' validity was assessed qualitatively through expert evaluation. This limitation is acknowledged as part of the study's methodological constraints.

Data Analysis Techniques

1. Needs Analysis Interview
Data obtained from interviews with biology teachers and students were analyzed descriptively. The results of the needs analysis served as the basis for developing the SSCS-based Electronic Student Worksheet (E-LKPD) on the respiratory system. This analysis aimed to identify learning problems and the need for instructional media that can support students' Science Process Skills (SPS) through interactive and contextual learning.

2. Expert Validation Analysis
The validation data from material and media experts were analyzed using a descriptive quantitative approach. The assessment employed a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The validation scores were then converted into percentages using the following formula adapted from Riduwan (2015):

$$P = \frac{\Sigma X}{\Sigma Xi} \times 100\%$$

Where:
P = percentage score
ΣX = total obtained score
ΣXi = maximum ideal score

The percentage score was calculated by dividing the total score obtained from all items by the maximum possible score, then multiplying by 100%.

3. Interpretation Criteria
The resulting percentage scores were interpreted using feasibility criteria adapted from Riduwan (2015) as follows (Table 2):

Table 2. Expert Validation Assessment Criteria

Percentage (%)	Criteria
81–100	Very feasible
61–80	Feasible
41–60	Fairly feasible
21–40	Less feasible
0–20	Unfeasible

The developed SSCS-based E-LKPD was considered feasible if it achieved at least the "feasible" category. Qualitative data from expert suggestions were analyzed descriptively and used to revise and improve the product before limited field testing.

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

RESULT AND DISCUSSION

Research Results

Development of the SSCS-Based E-LKPD

The SSCS-based electronic student worksheet (E-LKPD) was developed using the first three stages of the Four-D (4-D) model: Define, Design, and Develop. The dissemination stage was not conducted due to the limited scope of this study.

During the define stage, a needs analysis was carried out through interviews with one biology teacher and three Grade XI students. The teacher reported that biology instruction had used the Merdeka Curriculum, government e-modules, printed worksheets, and PowerPoint presentations, as well as learning models such as Discovery Learning, Problem-Based Learning, and Project-Based Learning. However, interactive electronic worksheets had not been implemented, and the existing worksheets did not explicitly facilitate science process skills. The teacher also expressed interest in an SSCS-based electronic worksheet as an innovative learning resource.

Student interviews indicated that learners preferred interactive learning materials that were visually attractive, easy to access using digital devices, and could be revisited independently. These findings directly informed the development of an electronic worksheet integrating the SSCS learning model with science process skills.

Based on the needs analysis, the E-LKPD was designed in accordance with the Biology Learning Outcomes for Phase F under the Merdeka Curriculum. The product consists of introductory sections, learning objectives, concept maps, learning summaries, and two inquiry-based learning activities on lung vital capacity and respiratory rate. Each activity follows the Search, Solve, Create, and Share learning sequence to address the identified need for a more interactive worksheet and to integrate science process skills, including observing, predicting, planning investigations, analyzing data, drawing conclusions, and communicating findings.

Expert Validation Results

The developed E-LKPD was evaluated by two expert validators: one material expert and one media expert. The validation assessed the quality of the instructional content, presentation, language, and graphical design before the product was implemented in classroom trials.
Based on the development results, the SSCS-based E-LKPD underwent validation by material and media experts. This validation aimed to assess the appropriateness of the content, presentation, and language. The assessment results showed that the E-LKPD obtained an average score of 80.25%, indicating suitability for use (Table 3). These results indicate that the material, presentation, and language used in the E-LKPD align with biology learning standards.

Table 3. Expert Validation of SSCS-Based E-LKPD

Validation Aspect	Number of Validator)	Obtained Score	Maximum Score	Percentage (%)	Category
Material validation	1	78.00	100	78.00	Feasible
Media validation	1	79.00	95.00	83.15	Very Feasible
Overall	2	157	195	80.51	Feasible

The overall expert validation yielded a validity score of 80.51%, showing that the developed E-LKPD was suitable for classroom implementation after minor revisions. Material validation scored 78.00%, while media validation reached 83.15%. These scores indicate that revisions should focus on aligning

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

learning activities with the SSCS syntax, learning objectives, anatomical illustrations, and language clarity. The media score also suggests improvements to the cover layout, the presentation of supporting information, and the readability of instructional texts.

Product Revision Based on Expert Validation

Following the first expert validation, the initial prototype of the E-LKPD was revised based on the validators' recommendations. The revisions focused on improving instructional quality, consistency with the SSCS learning model, visual presentation, and language clarity before the product was used in the limited field trial (Table 4).

Table 4. Summary of Product Revisions

Validator Comments	Product Revisions
The Search phase did not sufficiently facilitate students in identifying information.	Additional guiding questions were incorporated into the Search phase to encourage students to observe texts and illustrations before solving problems.
Learning objectives were too general.	Learning objectives were rewritten by explicitly describing the learning activities through which competencies would be achieved.
Anatomical illustrations lacked labels.	Labels were added to lung diagrams to improve conceptual understanding.
The title "Learning Form" was inappropriate.	The heading was revised to "Learning Process" to better represent the SSCS learning sequence.
The learning material lacked contextual information.	A "Bio Fact" section presenting respiratory disorders was incorporated into the worksheet.
Several instructions contained lengthy and ambiguous sentences.	Sentences were simplified using language appropriate for Grade XI students.
The cover page contained incomplete institutional information.	A separate identity page containing author, supervisor, and institutional information was added.

The revisions strengthened the alignment between learning activities and the SSCS instructional model while improving the clarity of learning objectives, language, visual presentation, and content completeness. The revised prototype was subsequently used in the teacher and student evaluations.

Practicality Evaluation

The practicality of the revised E-LKPD was evaluated by two biology teachers and 35 Grade XI students after they had used the product during learning activities (Table 5).

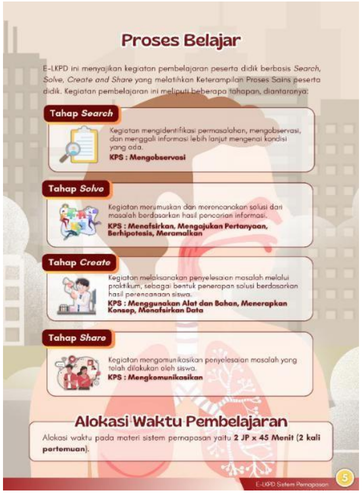
Table 5. Teacher and Student Trial

Respondents	Number of Respondents	Percentage (%)	Category
Biology teachers	2	92.92	Very Positive
Students	35	98.06	Very Positive

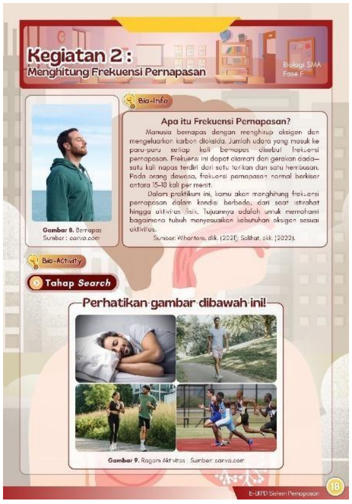
The teacher evaluation indicated that the developed E-LKPD was highly practical, with an overall score of 92.92%. Teachers particularly appreciated the practicality of implementation, language clarity, and graphical presentation. Student responses were also highly positive, yielding an overall score of 98.06%. Practicality received the highest rating, suggesting that students found the electronic worksheet easy to access, engaging, and supportive of independent learning.

To provide a visual representation of the E-LKPD, Figure 1 displays the main page and examples of activities students can undertake. This display demonstrates the integration of SSCS syntax through interactive, easily accessible search, solve, create, and share activities.

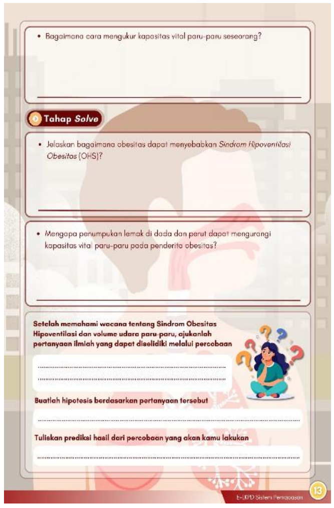
p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)



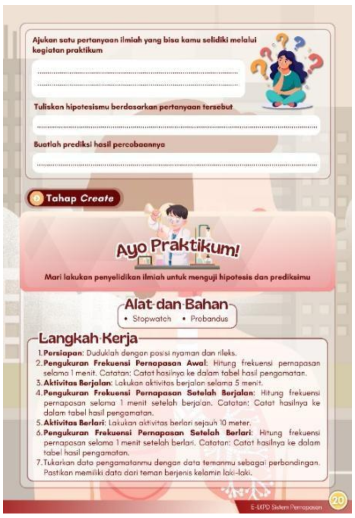
(a) Page explaining the SSCS learning process.



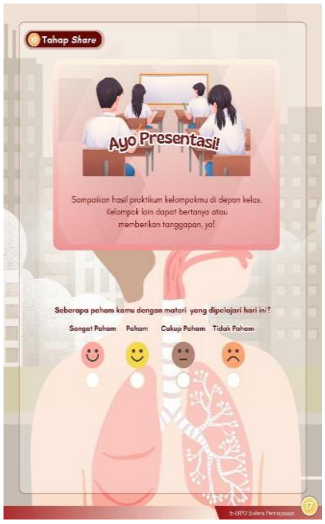
(b) Example of a "Search" activity for information retrieval.



(c) Example of a "Solve" activity for solving a scientific problem.



(d) Example of a "Create" activity for creating a knowledge product.



(e) Example of a "Share" activity for sharing results with friends.

Figure 1. Example of the main page of the SSCS-based E-LKPD for the respiratory system.

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

Research Discussion

The results of this study demonstrate that the developed SSCS-based E-LKPD is both feasible and practical for biology learning. The overall feasibility score indicates that the instructional content, presentation, language, and visual design satisfied the quality criteria for instructional materials. This result is likely attributable to the systematic development process based on the first three stages of the 4-D model, namely Define, Design, and Develop, which emphasizes needs analysis, careful instructional planning, expert validation, and product revision before implementation. This development process helps ensure that the learning materials are aligned with curriculum requirements, learning objectives, and students' characteristics, thereby enhancing instructional quality.

Another factor contributing to the feasibility of the developed E-LKPD is the explicit integration of Science Process Skills (SPS) into each phase of the SSCS learning model. Rather than presenting SPS as separate learning activities, the worksheet embeds these skills throughout the learning sequence. The Search phase encourages students to observe phenomena and identify problems; the Solve phase guides them in planning solutions based on available evidence; the Create phase facilitates data interpretation and the construction of explanations; and the Share phase provides opportunities to communicate findings through discussion and presentation. Organizing learning activities in this sequence supports inquiry-based learning by engaging students in a structured scientific process. These findings are consistent with previous studies reporting that SSCS-based worksheets are feasible for classroom implementation following expert validation (Lele & Widyaningrum, 2022). Similarly, previous development research has demonstrated that integrating science process skills into electronic worksheets provides learning activities that support scientific inquiry while meeting established validity standards (Aldi et al., 2022). Compared with these earlier studies, the present study contributes by explicitly mapping science process skills indicators to every phase of the SSCS model, thereby offering a more systematic framework for designing inquiry-oriented biology learning materials.

The developed E-LKPD also demonstrated a very high level of practicality, as indicated by teacher and student evaluations. This finding suggests that the worksheet was considered easy to use, visually appealing, and appropriate for classroom learning. The high practicality ratings may be explained by the interactive features of the Liveworksheet platform, which allow students to access worksheets digitally, complete learning activities directly, and receive immediate feedback. These features reduce procedural barriers commonly associated with conventional printed worksheets and encourage students to participate more actively in learning activities. From a constructivist perspective, meaningful learning occurs when students actively construct knowledge through interaction with learning tasks rather than passively receiving information. The interactive design of the E-LKPD supports this process by encouraging learners to explore information, analyze evidence, and communicate their ideas during each learning activity. This interpretation is consistent with previous research showing that inquiry-oriented worksheets can promote student engagement and active participation by providing authentic and structured learning experiences (Sa'adah et al., 2022).

This study was limited to the development, expert validation, and practicality evaluation of the SSCS-based E-LKPD. Therefore, the findings provide evidence only of the product's feasibility and practicality, and do not demonstrate its effectiveness in improving students' science process skills or learning outcomes. Future studies are recommended to evaluate the effectiveness of the developed E-LKPD through experimental or quasi-experimental research designs involving pretest-posttest measurements to examine its impact on students' science process skills and academic achievement.

p-ISSN : 2338-7173
e- ISSN : 2615-0417
(Agustus 2026), Vol. (16), No. (2)

CONCLUSION

This study successfully developed an SSCS-based electronic student worksheet (E-LKPD) that integrates science process skills for respiratory system learning, using the first three stages of the 4-D development model (Define, Design, and Develop). Expert validation indicated that the developed E-LKPD was feasible for classroom use, while teacher and student evaluations demonstrated a very high level of practicality. These findings suggest that the developed E-LKPD is an appropriate digital learning resource to support biology instruction on the respiratory system. However, because this study focused on product development, validation, and practicality evaluation, its effectiveness in improving students' science process skills was not examined. Future studies are therefore recommended to investigate the effectiveness of the E-LKPD through experimental or quasi-experimental research designs.

BIBLIOGRAPHY

Aldi, S., Adnan, A., & Ismail, I. (2022). Validity Test of Electronic Student Worksheets (e-LKPD) Based on Scientific Processing Skills. *Jurnal Pendidikan Biologi*, *11*(2), 10–20. https://doi.org/10.24114/jpb.v11i2.33248

Angelia, Y., Supeno, & Suparti. (2022). Keterampilan Proses Sains Siswa Sekolah Dasar dalam Pembelajaran IPA Menggunakan Model Pembelajaran Inkuiri. *Jurnal BASICEDU*, *6*(5), 8296–8303.

Elvanuari, T. A., Zulfiani, Z., & Supriyati, E. (2024). Development of e-worksheet based on search , solve , create , and share (SSCS) Islamic context to improve science process skills on excretory system material. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *10*(1), 195–210.

Lele, D. R. U., & Widyaningrum, D. A. (2022). Pengembangan Lembar Kerja Siswa (LKS) Berbasis Model Pembelajaran Search , Solve , Create and Share (SSCS) Pada Materi Sistem Pencernaan Makanan. *BioEdUIN Jurnal Program Studi Pendidikan Biologi*, *12*(1), 24–29. https://doi.org/10.15575/bioeduin.v12i1.22254

Maulana, Y., & Sopandi, W. (2022). Needs Analysis of Electronic Student Worksheets to Practice 4C Skills. *Jurnal BASICEDU*, *6*(1), 602–611.

Nurfitriani, W. Y., Sjaifuddin, S., & Vitasari, M. (2025). Pengembangan E-LKPD Berbasis Guided Discovery Learning dengan Pendekatan Keterampilan Proses Sains pada Tema Zat yang Terkandung pada Makananku. *Jurnal Pendidikan MIPA*, *15*(2021), 9–19.

Qalfin, M., Saptono, S., Ellianawati, E., & Dewi, N. R. (2024). Unnes Science Education Journal Accredited Sinta 2 Effectiveness of Differentiated Digital Student Worksheets Based on Socio-Scientific Issues to Improve Students ' Science Literacy. *Unnes Science Education Journal*, *13*(2), 86–93.

Riduwan. (2015). *Skala Pengukuran Variabel-Variabel Penelitian, 11th ed.* (Alfabeta).

Sa'adah, S., Noerfatimah, F., & Yusup, I. R. (2022). (LKPD) Berbasis Socio-Scientific Inquiry Based Learning (SSIBL) untuk Meningkatkan Keterampilan Pemecahan Masalah Siswa pada Materi Perubahan Lingkungan. *BioEdUIN Jurnal Program Studi Pendidikan Biologi*, *12*(2), 120–136. https://doi.org/10.15575/bioeduin.v12i2.23022

Sanchia, A. I., & Faizah, U. (2019). Pengembangan LKPD Berbasis Search, Solve, Create and Share (SSCS) untuk Melatih Keterampilan Proses Sains pada Materi Arthropoda Kelas X SMA. *Jurnal Riset Biologi Dan Aplikasinya*, *1*(1), 9–17.

Sinta, A. D., & Agustina, P. (2024). Science process skills and biology learning outcomes of high school students through the application of the guided inquiry learning model. *Edubiotik : Jurnal Pendidikan, Biologi Dan Terapan*, *9*(01), 45–53. https://doi.org/10.33503/ebio.v9i01.4021

Sumanik, N. B. (2022). Developing Students' Electronic Worksheet Based on Science Literacy to Train Critical Thinking Ability. *Paedagogia*, *25*(2), 148–161.

Tumaili, R., Husain, I. H., Kumaji, S. S., Yusuf, F. M., & Zakaria, Z. (2025). Development of E-LKPD Liveworksheet to Improve Learning Outcomes on Environmental Change Material for Class X of SMA Negeri 1. *Biodik: Jurnal Ilmiah Pendidikan Biologi*, *11*(02), 377–389.

Wahyuni, S., Irmawanty, & Hambali, H. (2024). Keterampilan Proses Sains untuk Meningkatkan Hasil Belajar IPA Siswa Sekolah Dasar. *Jurnal Ilmu Pendidikan Dasar Indonesia*, *3*(2), 85–95.

Wulandari, I. A., Mu'min, M. B., & Firdaus, M. G. (2021). Peningkatan Keterampilan Berpikir Kritis (KBKr) Melalui Pembelajaran Biologi Berbasis Keterampilan Proses Sains. *BioEdUIN Jurnal Program Studi Pendidikan Biologi*, *11*(1), 63–70. https://doi.org/10.15575/bioeduin.v11i1.12081