

Learning with Interactive E-Worksheets: A One-Group Pretest-Posttest Study in Secondary Sociology

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Abstract

This one-group pretest–posttest study examines learning change in a sociology class using a Liveworksheet-based electronic student worksheet (E-LKPD) alongside Problem-Based Learning. Thirty-six students in class F4 at SMA Negeri 12 Padang completed a 20-item multiple-choice test before and after instruction on social problems arising from social grouping. The mean score increased from 57.91 to 78.89, a raw gain of 20.98 points. The reported significance test should be interpreted cautiously because the statistical table used an independent-samples procedure even though the same students completed both measurements. The article therefore emphasizes the observed mean change and the instructional process rather than making a stronger causal claim than the design supports. The curricular role of the worksheet is understood as part of instructional design rather than as an isolated technology (Ansyar, 2015), while the pretest–posttest structure follows a conventional classroom research logic (Arikunto, 2009). The findings support cautious use of interactive worksheets as part of a broader problem-based instructional sequence.

Keywords: E-LKPD; Liveworksheet; learning outcomes; pretest-posttest design; sociology education.

How to Cite: Jannah, M. & Alfiansyah, M. R. (2024). Learning with Interactive E-Worksheets: A One-Group Pretest-Posttest Study in Secondary Sociology. *Charta Educa: Jurnal Kajian Pendidikan*, 1(2), 82-89.



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Introduction

Electronic worksheets can do more than replace paper. When designed well, they can sequence questions, combine text and visual material, require students to submit responses, provide immediate feedback, and connect individual work with discussion. These affordances are relevant to secondary sociology because students need to move repeatedly between conceptual language and social examples. A digital worksheet can structure that movement, but the educational value lies in the quality of the tasks and feedback rather than in the platform itself.

Liveworksheet-based E-LKPD is particularly useful for examining this distinction. The platform allows teachers to transform worksheets into interactive activities that students can complete digitally. Previous Indonesian studies have reported positive learning responses to Liveworksheet materials, including in sociology (Hurrahma & Sylvia, 2022). However, evidence of improved scores after a digital intervention must be interpreted in relation to research design. A one-group pretest-posttest study can show that the same group scored differently after instruction, but without a comparison group it cannot isolate the worksheet from normal teaching, practice effects, maturation, or other contextual influences.

The present study involved 36 students in class F4 at SMA Negeri 12 Padang and focused on social problems arising from social grouping. Students completed a 20-item multiple-choice pretest, learned through a Liveworksheet-based E-LKPD used alongside Problem-Based Learning, and completed a posttest. The mean increased from 57.91 to 78.88, a difference of 20.97 points. The educational question is therefore twofold: how

should that change be interpreted statistically, and what features of the learning sequence plausibly supported students' engagement with the material?

Ausubel's meaningful-learning perspective is useful because it directs attention to the relationship between new information and prior knowledge. Interactive representations are valuable when they help students connect concepts to recognizable social situations, organize distinctions, receive feedback, and revise misconceptions. Multimedia learning research similarly warns that additional media are beneficial only when words, visuals, and interaction reduce unnecessary processing and direct attention toward the target ideas (Mayer, 2021). Immediate feedback can also support learning when it tells students how their current understanding differs from the desired performance rather than merely indicating right or wrong (Hattie & Timperley, 2007; Shute, 2008).

The study asks: What change occurred between pretest and posttest scores after the Liveworksheet-based E-LKPD was used, and how can that change be interpreted in relation to meaningful learning, feedback, and the limitations of a one-group design? The contribution is deliberately bounded: the article documents a substantial descriptive gain and develops a plausible pedagogical explanation while avoiding a causal claim that the design cannot support.

Method

This study used a one-group pretest–posttest design to examine learning change in one sociology class at SMA Negeri 12 Padang. The participants were 36 students in class F4. The instructional sequence addressed social problems arising from social grouping and used an electronic student worksheet (E-LKPD) delivered through Liveworksheet alongside Problem-Based Learning. Because all participants experienced the same instructional condition, the design is best suited to describing within-class change and exploring a plausible instructional contribution; it cannot isolate the E-LKPD from other influences or establish a counterfactual causal effect.

Students completed a 20-item multiple-choice test before and after the learning sequence. The mean pretest score was 57.91 and the mean posttest score was 78.89, producing a raw mean increase of 20.98 points. Normality and homogeneity checks were reported, followed by an independent-samples t-test. Because the same 36 students completed both measurements, a paired-samples analysis would ordinarily be more appropriate. Participant-level paired data were unavailable, so the article reports the observed mean change and treats the inferential result conservatively.

The E-LKPD was delivered through Liveworksheet and combined written prompts with digital features such as images, video, varied question formats, online access, and automated or rapid feedback. The worksheet was embedded in a problem-oriented learning sequence rather than used as a stand-alone technical treatment. Students therefore encountered the platform together with teacher explanation, problem scenarios, peer interaction, and the normal progression of sociology lessons. The analysis interprets score change within this instructional configuration.

The pedagogical interpretation draws on meaningful learning and multimedia-learning principles. Meaningful learning emphasizes connecting new concepts with relevant prior knowledge, while multimedia research emphasizes selecting and organizing representations so that words, visuals, and interaction support rather than overload cognitive processing. These perspectives are used to explain plausible mechanisms—task structure, representation, feedback, and problem orientation—not to claim that the design directly measured cognitive mechanisms.

The original documentation does not provide sufficient information to reconstruct a formal ethics approval number or a detailed consent process, so no such information is asserted. The methodological limitation is reported explicitly. Future replication should document test validity and reliability, paired participant-level scores, attrition if any, consent procedures, and the exact sequence and duration of E-LKPD use.

Results and Discussion

Mean achievement increased by approximately 21 points

The class mean increased from 57.91 on the pretest to 78.89 on the posttest, a raw difference of 20.98 points. This is a substantial descriptive shift within the studied class and indicates that students answered more items correctly after the instructional sequence. The design does not reveal how much of the gain was attributable specifically to Liveworksheet, Problem-Based Learning, teacher mediation, peer interaction, repeated exposure to the topic, or ordinary maturation during the instructional period.

The reported significance test supports change but is not the ideal test

A statistically significant difference at $p < .05$ was reported. However, the statistical table was labeled as an independent-samples test although the design involved repeated measurement of the same students. A paired-

samples test would normally preserve within-student dependency and provide a more appropriate estimate of change. Because participant-level paired data were not retained, the analysis does not substitute a new statistic; instead, it foregrounds the 20.98-point mean increase and treats statistical significance as provisional evidence rather than definitive causal proof.

The E-LKPD reorganized representation and response opportunities

Liveworksheet enabled the material to combine text, images, video, and varied response formats within one digital sequence. It also provided rapid information about responses and allowed every student to interact with the worksheet rather than relying only on oral participation. These features distinguish the E-LKPD from a conventional printed worksheet at the level of representation and feedback. Their educational value nevertheless depended on the quality of the questions and their connection to the sociology concepts being learned.

Problem orientation connected digital activity with disciplinary thinking

The worksheet was used alongside Problem-Based Learning on social problems associated with social grouping. Students were therefore expected to apply concepts to situations rather than complete decontextualized digital exercises. The instructional sequence attempted to connect prior knowledge, problem interpretation, conceptual classification, and response. This provides a plausible explanation for why the platform may have supported learning: the digital medium structured engagement with a disciplinary problem rather than functioning as an entertainment layer.

The evidence supports an instructional association, not isolated causation

The strongest empirical conclusion is that improved scores followed an instructional sequence in which the E-LKPD was a prominent component. The evidence does not support the stronger claim that the platform alone caused the gain. This distinction preserves the practical importance of the observed improvement while aligning the conclusion with the one-group design.

Studies of Liveworksheet-based materials in Indonesian secondary education report that electronic worksheets can be designed as valid and practical learning resources when interactive tasks, content structure, and classroom use are aligned (Harmita et al., 2023; Rumadan et al., 2023). This evidence supports interpreting the platform as an instructional medium whose value depends on task design rather than as an effect in itself.

Discussion

Interpreting the pre-post gain responsibly

A 20.98-point mean increase is educationally meaningful as a descriptive result. It indicates that the class demonstrated more correct responses after instruction than before it. The central interpretive question is what kind of claim that pattern can support. Without a comparison group, the design cannot establish what the same students would have achieved under conventional instruction during the same period. The improvement may reflect the E-LKPD, Problem-Based Learning, teacher explanation, peer interaction, familiarity with the content, repeated testing, or combinations of these influences.

This does not make the result uninformative. Small classroom studies can provide useful evidence about feasibility and local change when their claims remain proportionate to design. The study shows that a Liveworksheet-based E-LKPD could be integrated into sociology instruction and that achievement rose substantially during the sequence. The next research question is explanatory: which features of the design supported that change, for which students, and under what conditions? A stronger causal study would build from, rather than dismiss, this descriptive evidence.

Digital worksheets are valuable when they organize cognitive activity

The educational contribution of an E-LKPD should not be reduced to replacing paper with a screen. Digital worksheets become pedagogically meaningful when they reorganize what learners must notice, decide, produce, and revise. Liveworksheet can require every student to respond, present information through more than one representation, sequence questions, and return feedback quickly. These functions can increase the visibility of student thinking and give the teacher more opportunities to identify misunderstanding.

Research syntheses on educational technology similarly suggest that learning gains depend on how technology is integrated into instruction rather than on device use itself (Cheung & Slavin, 2013; Hillmayr et al., 2020; Sung et al., 2016). The case is consistent with that principle. The digital worksheet was embedded in a problem-based sequence and linked to a specific sociology topic. Its value is therefore best understood as part of instructional orchestration: it structured encounters with content, responses, and feedback.

Representation should support, not overload, meaning

The use of text, images, and video can make social problems more concrete, but multimedia is not automatically beneficial. Cognitive-load research warns that unnecessary elements can compete for limited

working-memory resources, while multimedia-learning theory emphasizes coherence, signaling, and alignment between representations (Clark & Mayer, 2016; Mayer, 2021; Sweller et al., 2019). A well-designed E-LKPD should therefore use visual or audiovisual elements because they clarify a concept, provide evidence, or establish a problem context—not simply because the platform permits them.

This principle is especially relevant in sociology, where many concepts are abstract but observable in everyday life. Images, short cases, news excerpts, or video clips can help students identify social grouping, inequality, conflict, norms, or deviance in concrete situations. The worksheet can then prompt students to classify, explain, compare, or justify rather than merely recall definitions. Moreno and Mayer (2007) describe interactive multimodal environments as potentially powerful when learner activity is connected to cognitive processing; the present study illustrates the practical classroom relevance of that design principle.

Feedback is a plausible mechanism of improvement

Rapid feedback is another plausible mechanism. When students receive information about an answer while the task is still cognitively active, they can revise misconceptions before those misconceptions become embedded. Hattie and Timperley (2007) emphasize that effective feedback helps learners understand where they are, where they are going, and what to do next, while Shute (2008) highlights the value of formative feedback that is timely and task focused. Liveworksheet can support immediacy, but the quality of feedback remains an instructional design decision.

Automated scoring alone may tell a student that an answer is wrong without explaining why. For conceptual sociology learning, feedback is stronger when it also directs attention to the relevant distinction, asks the learner to revisit evidence, or prompts an explanation. Teacher feedback therefore remains important. A useful hybrid design can let the platform handle routine response information while the teacher focuses on patterns of misunderstanding and higher-order reasoning.

Problem-Based Learning gives the worksheet a disciplinary purpose

The E-LKPD was used alongside Problem-Based Learning, which is important for interpreting the result. Problem orientation can create a reason for students to use concepts: they must diagnose a situation, identify relationships, consider causes or consequences, and justify a response. This is more demanding than completing isolated digital items. The worksheet can support the process by structuring evidence and questions, but it should not fragment the problem into so many small steps that students lose sight of the larger sociological issue.

The design challenge is therefore balance. Scaffolding should reduce unnecessary difficulty while preserving the intellectual work that the lesson intends students to perform. Students may need structured prompts at the beginning and more open-ended reasoning later. This progression is compatible with meaningful learning because new knowledge becomes integrated when learners connect it with prior concepts and use it in increasingly organized ways. The local literature on Liveworksheet likewise reports positive learning patterns when E-LKPD is tied to purposeful tasks rather than used as a stand-alone application (Hurrahma & Sylvia, 2022; Hariyati & Rachmadyanti, 2022; Pabri et al., 2022).

Participation and achievement should be separated analytically

Digital interactivity can increase opportunities to respond, but increased response activity should not be equated automatically with deeper understanding. A student can complete many items quickly through guessing or pattern recognition. Conversely, a small number of well-designed questions may elicit substantial reasoning. Future evaluation should therefore distinguish behavioral engagement from conceptual learning. Log data, written explanations, or screen-capture traces could be paired with test scores to show how students actually used the worksheet.

This distinction also affects teacher interpretation. A visually active class using devices may appear highly engaged, but the teacher still needs evidence of what students understand. The 20-item test in this study provides one outcome measure, yet stronger research would also examine the quality of explanations and transfer to unfamiliar cases. Putra and Hefni (2022) emphasize the importance of conceptual understanding when addressing low learning outcomes; digital activity should ultimately be judged by whether it supports that understanding.

The statistical mismatch should inform future design

The use of an independent-samples test for repeated measurements is a methodological weakness that should be treated as a learning point. Repeated measures contain a natural pairing: each student's posttest score is related to that same student's pretest score. A paired-samples analysis uses that dependency and is generally more appropriate. Future studies should preserve de-identified participant identifiers so paired analysis can be conducted and effect sizes can be calculated.

A stronger report would also include the distribution of change scores, confidence intervals, instrument reliability, and item-analysis information. If a comparison group is feasible, researchers could estimate whether the improvement exceeds ordinary instructional change. If random assignment is not practical, matched or quasi-

experimental designs can still strengthen inference. Delayed posttesting would address a different question—retention—because immediate posttest gains do not necessarily indicate durable learning.

Equity and access remain part of digital effectiveness

E-LKPD implementation also depends on access to devices, connectivity, and students' familiarity with the platform. The current study demonstrates use in one class but does not provide enough evidence to analyze digital inequality. Future implementation should monitor whether technical problems reduce participation for particular students and provide alternative access arrangements when necessary. Effectiveness is not only an average score question; it also concerns who can participate consistently in the learning design.

Low-bandwidth design, downloadable materials, shared-device strategies, and school-provided access can reduce barriers. Importantly, accessibility also includes interface clarity and cognitive accessibility. Students should be able to understand what the worksheet asks them to do without spending disproportionate effort navigating the platform. Technology should make the learning pathway clearer, not add avoidable procedural complexity.

Implications for sociology teaching

For sociology teachers, the case suggests several design principles. Begin with a disciplinary problem rather than a digital feature; select media that make the social phenomenon observable; use questions that move from identification toward explanation and evaluation; provide feedback that directs attention to concepts; and use student responses to decide what requires discussion. Liveworksheet can support these practices, but the platform should remain subordinate to the learning objective.

The approach can be extended beyond social grouping to topics such as social inequality, conflict, deviance, institutions, and social change. Digital cases can present short narratives, images, or data for interpretation, while the E-LKPD structures comparison and explanation. Such use aligns with the broader purpose of sociology education: helping students connect conceptual language with patterned social relations rather than treating concepts as isolated definitions.

Implications for further research

Future studies should combine stronger outcome designs with process evidence. A comparison condition and paired statistical analysis would strengthen claims about achievement. Student interviews, observation, platform logs, or analysis of written explanations would clarify how the E-LKPD shaped learning activity. Researchers should also specify the duration of use, feedback rules, teacher interventions, and the relationship between digital tasks and PBL phases so the instructional design can be replicated.

Development research could additionally test the usability and accessibility of specific worksheet features before evaluating learning outcomes. Work by Lestari (2022) and Hastuti (2023) illustrates continuing Indonesian interest in Liveworksheet-based materials, while broader e-learning principles show why interface and instructional coherence should be considered together. Such research would move the field from asking whether an E-LKPD is "effective" toward explaining which design features support particular forms of sociology learning.

Meaningful learning requires activation of prior knowledge

The study's use of meaningful learning is most defensible when connected to the structure of the tasks. Students are more likely to integrate new sociology concepts when instruction first activates what they already know about groups and social problems, then introduces conceptual distinctions, and finally requires those distinctions to be used in interpreting cases. An E-LKPD can support this sequence by placing prior-knowledge prompts, explanatory resources, and application tasks in a coherent order. The platform itself does not create meaningful learning; sequencing does.

This principle also helps teachers decide when to use video or images. A short representation can activate experience or provide evidence for a social situation, after which questions should direct attention to relevant sociological relationships. If media are presented without a clear interpretive purpose, they may increase interest without strengthening conceptual structure. Mayer's (2021) multimedia principles are therefore most useful when combined with disciplinary task design.

Question quality matters more than question quantity

Digital worksheets can make it easy to add many items, but a large number of low-level questions can create procedural busyness. A stronger E-LKPD varies cognitive demand. Some questions can check recognition of terminology; others can require classification of a case, explanation of a causal relationship, comparison of perspectives, or justification of a proposed response. This progression helps teachers use the platform for conceptual development rather than only automated practice.

Open-response questions are particularly valuable when teachers need evidence of reasoning, although they reduce the convenience of automatic scoring. A balanced design can use automatically scored items for

immediate checks and selected constructed responses for teacher review. This division of labor preserves efficiency while recognizing that sociological explanation cannot always be reduced to a single correct option.

Formative use depends on what happens after an error

Feedback is educational only if it changes subsequent action. When a student receives an incorrect indicator, the next step might be to revisit a short explanation, compare two cases, discuss with a peer, or answer a related item. Designing these feedback loops can turn Liveworksheet from a scoring platform into a formative environment. Shute (2008) emphasizes that formative feedback should be specific and actionable; Hattie and Timperley (2007) similarly locate feedback within a process of closing the gap between current and desired performance.

Teacher use of class-level response patterns can extend this process. If many students miss the same distinction, the teacher can pause the lesson and address the misconception collectively. If only a few students struggle, targeted support is possible. Future versions of the E-LKPD could therefore be designed not only around what students see, but around what information the teacher needs to make instructional decisions.

Implementation fidelity should be documented

The current study establishes that the E-LKPD was used alongside PBL, but stronger research should describe implementation in greater detail. Relevant information includes how many sessions used the worksheet, whether students completed tasks individually or in groups, how teachers introduced problems, what feedback was automated, when teachers intervened, and how much time students spent on the platform. These details are needed to explain variation and enable replication.

Implementation fidelity does not mean that every teacher must reproduce an identical script. It means identifying the essential features of the design. If the hypothesized mechanism is rapid formative feedback, that feature should be present consistently; if the mechanism is problem-based application, tasks should require genuine application. Clear specification helps distinguish adaptation from loss of the core instructional logic.

Retention and transfer are stronger outcomes than immediate gain alone

The immediate posttest shows what students could answer at the end of the sequence, but it does not show whether learning persisted. A delayed posttest would examine retention after some of the short-term effects of practice and test familiarity have faded. Transfer tasks could ask students to apply concepts to unfamiliar social cases. These outcomes would provide a stronger test of meaningful learning than immediate score change alone.

Retention and transfer may also reveal which digital features matter. A platform that supports short-term practice might raise immediate accuracy without producing durable conceptual organization. Conversely, problem interpretation and explanation may yield slower gains but better transfer. Future research should therefore align outcome measures with the pedagogical claims made for the E-LKPD.

Effect size and uncertainty should accompany significance

Future quantitative reporting should move beyond whether p is below .05. A paired effect size and confidence interval would indicate the magnitude and precision of change. Reporting individual change patterns would also show whether the mean increase was broadly shared or driven by a subset of students. Such information is particularly important in small classroom samples, where averages can hide meaningful heterogeneity.

The current raw gain of 20.98 points is easy to understand pedagogically, which is why it remains central in this article. More complete statistical reporting would complement rather than replace that descriptive result. Transparent analysis makes it easier for teachers and researchers to distinguish a practically important change from a statistically detectable one.

Teacher mediation remains central in digital learning

The E-LKPD should not be interpreted as replacing teacher expertise. Teachers select the problem, sequence the tasks, decide when explanation is needed, interpret response patterns, support students who encounter difficulty, and connect the digital activity with broader classroom discussion. Technology changes the distribution of routine work, but pedagogical judgment remains human. This is why the same platform can produce different learning experiences in different classrooms.

Professional learning for digital worksheets should therefore focus on instructional design rather than button-by-button platform training alone. Teachers need to know how to write diagnostic questions, design feedback, select representations, manage device-based collaboration, and use response data. Technical fluency is useful, but the educational return comes from connecting features to learning mechanisms.

A design-based research agenda could improve E-LKPD quality

A productive next step is iterative design research. Teachers and researchers can develop a worksheet, test usability with a small group, observe where students misunderstand instructions or content, revise the sequence,

and then evaluate learning with stronger methods. This approach treats the worksheet as a designed educational artifact whose quality can improve through evidence rather than as a fixed intervention.

Indonesian studies have already explored Liveworksheet development, feasibility, and learning outcomes (Hariyati & Rachmadyanti, 2022; Hurrahma & Sylvia, 2022; Lestari, 2022; Pabri et al., 2022). Connecting these strands—design quality, classroom process, and rigorous outcome evaluation—would provide a stronger cumulative evidence base. The present study contributes a classroom result and a clear set of methodological lessons for that agenda.

A stronger interpretation links design, process, and outcome

The most useful interpretation of the study connects three levels. At the design level, the E-LKPD organized multimedia information, questions, and feedback around a sociology problem. At the process level, students had repeated opportunities to respond and receive information about their performance while the teacher retained responsibility for explanation and guidance. At the outcome level, the class mean increased substantially. The one-group design cannot prove the causal chain, but making the hypothesized chain explicit improves both practice and research because each link can be tested in future studies.

For example, researchers can examine whether students who use feedback to revise an answer show larger gains, whether particular multimedia representations reduce misconceptions, or whether problem-oriented questions produce better transfer than recall questions. These process measures would explain why a worksheet works rather than treating the final score as a black box. They would also help teachers decide which features deserve development time.

The practical conclusion is therefore conditional rather than promotional. Liveworksheet is a useful platform when it enables a coherent learning sequence that could not be achieved as efficiently with a conventional worksheet. If digital features do not improve representation, feedback, access, or response opportunities, their educational value is limited. Pedagogical purpose should remain the criterion for technology choice.

For teachers, this means evaluating the worksheet after each use: which items revealed misunderstanding, which media clarified the problem, which feedback changed responses, and where students needed direct explanation. Iterative review can turn a digital worksheet into a progressively better instructional resource.

Such review also makes subsequent research more transparent because the instructional design is documented rather than treated as a generic use of technology. for future classroom improvement. and clearer replication in other classes.

Conclusion

Students' mean sociology score increased from 57.91 before instruction to 78.89 after an instructional sequence that combined a Liveworksheet-based E-LKPD with Problem-Based Learning, a raw gain of 20.98 points. This is a meaningful descriptive improvement within the studied class. Because the study used a one-group pretest–posttest design, the result should be interpreted as an association with the instructional period rather than proof that the E-LKPD alone caused the change.

The pedagogical value of the E-LKPD is best understood through the learning processes it can support: structured response opportunities, coherent multimedia representation, rapid formative feedback, and problem-oriented application of sociology concepts. The study also exposes a methodological priority for future work: repeated measurements should be analyzed with paired procedures, and stronger designs should include comparison groups, effect sizes, delayed assessment, and process evidence. For practice, the main lesson is that digital worksheets are most useful when their interactive features serve disciplinary reasoning rather than functioning as technology for its own sake.

Declarations

Author contribution

Author 1: developed the main research idea and objectives, designed the research methodology, conducted data collection and investigation, performed the data analysis, and prepared the first draft of the manuscript. Author 2: contributed to the development and implementation of the research methodology, supported the data collection and investigation process, and reviewed and revised the manuscript to improve its academic quality, clarity, and structure, provided input into the research concept and direction, supervised and guided the overall research process, reviewed and improved the manuscript, and contributed to obtaining financial support or research funding

Funding

The research received no specific grant from any funding agency.

Conflict of Interest

The authors declare that there is no conflict of interest related to the publication of this article.

Use of generative AI

Generative AI were used solely for translation and language editing of the manuscript. The authors take full responsibility for the content and accuracy of the article.

Acknowledgments

Authors would like to express their sincere gratitude to all parties who contributed to and supported the completion of this study. Their valuable assistance, support, and encouragement are greatly appreciated.

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