

Development of a Qur'an-Integrated Student Worksheet on Newton's Laws to Enhance Self-Regulated Learning: An ADDIE-Based Study in Islamic Junior Secondary School

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Abstract: Physics teaching materials in Islamic schools frequently prioritise conceptual mastery while neglecting the integration of Islamic values and the cultivation of self-regulated learning (SRL), despite both being mandated objectives of Indonesian national education. This study aimed to develop, validate, and assess the practicality and effectiveness of a Qur'an-integrated Student Worksheet (Lembar Kerja Peserta Didik, LKPD) on Newton's Laws designed to strengthen SRL among seventh-grade students. A Research and Development design following the ADDIE model was employed. Participants comprised two expert validators (subject-matter and media specialists), one physics teacher, and 59 seventh-grade students from MTs Ma'arif Gondang, Indonesia, distributed between an experimental class (VII-A, $n = 30$) and a control class (VII-B, $n = 29$). The LKPD was evaluated for validity, practicality, and effectiveness. Expert validation yielded a mean score of 4.39 out of 5.00 (87.8%), placing the product in the "Very Valid" category. Practicality assessment by students and teacher produced a mean score of 3.70 out of 4.00 (92.5%), classified as "Very Practical". Effectiveness was examined through a pre-test–post-test quasi-experimental design; the experimental group achieved a mean normalised gain (N-Gain) of 57%, exceeding the control group's 42%. An independent-samples t-test confirmed a statistically significant difference ($t = 2.989 > t = 1.673$; $df = 57$; $\alpha = .05$). These findings indicate that Qur'an-integrated instructional materials can meaningfully advance both conceptual understanding and self-regulatory capacities in secondary physics education.

Keywords: ADDIE model; Islamic integration; Newton's Laws; self-regulated learning; student worksheet

Abstrak: Bahan ajar fisika di sekolah Islam sering kali lebih menitikberatkan pada penguasaan konsep tanpa mengintegrasikan nilai-nilai Islam dan pengembangan self-regulated learning (SRL), padahal keduanya merupakan tujuan yang diamanatkan dalam pendidikan nasional Indonesia. Penelitian ini bertujuan untuk mengembangkan, memvalidasi, serta menilai kepraktisan dan efektivitas Lembar Kerja Peserta Didik (LKPD) terintegrasi Al-Qur'an pada materi Hukum Newton untuk memperkuat SRL siswa kelas VII. Penelitian menggunakan desain Research and Development dengan model ADDIE. Partisipan penelitian terdiri atas dua validator ahli (ahli materi dan ahli media), guru fisika, serta 59 siswa kelas VII MTs Ma'arif Gondang, Indonesia, yang terbagi ke dalam kelas eksperimen (VII-A, $n = 30$) dan kelas kontrol (VII-B, $n = 29$). LKPD dievaluasi berdasarkan aspek validitas, kepraktisan, dan efektivitas. Hasil validasi ahli menunjukkan skor rerata 4,39 dari 5,00 (87,8%) sehingga termasuk kategori "Sangat Valid". Penilaian kepraktisan oleh siswa dan guru memperoleh skor rata-rata 3,70 dari 4,00 (92,5%) dengan kategori "Sangat Praktis". Efektivitas diuji menggunakan desain kuasi eksperimen pre-test–post-test; kelompok eksperimen memperoleh rata-rata gain ternormalisasi (N-Gain) sebesar 57%, lebih tinggi dibandingkan kelompok kontrol sebesar 42%. Uji independent-samples t-test menunjukkan adanya perbedaan yang signifikan secara statistik ($t = 2,989 > t_{tabel} = 1,673$; $df = 57$; $\alpha = 0,05$). Temuan ini menunjukkan bahwa bahan ajar terintegrasi Al-Qur'an dapat secara bermakna meningkatkan pemahaman konsep sekaligus kemampuan regulasi diri dalam pembelajaran fisika.

Kata Kunci: model ADDIE, Integrasi islam, hukum newton, SLR, LKPD

INTRODUCTION

Education in Indonesia has consistently affirmed that cognitive achievement alone does not constitute the complete aim of schooling. The national curriculum framework (Kurikulum Merdeka) explicitly mandates the formation of learners who are intellectually competent, spiritually grounded, and capable of managing their own learning processes (Tarigan et al., 2024). Among the dispositional outcomes that secondary science education is expected to cultivate, self-regulated learning (SRL) occupies a central position. Zimmerman (2002) defined SRL as a cyclical process in which learners proactively set goals, select strategies, monitor their progress, and evaluate outcomes, thereby exercising deliberate control over their own intellectual development. Empirical evidence accumulated over three decades consistently links high SRL to academic achievement, deeper conceptual processing, and greater motivational persistence (Pintrich, 2004; Zimmerman & Schunk, 2011).

However, instruction in Indonesian Islamic schools (“madrasah”) frequently fails to realise these complementary objectives simultaneously. Physics teaching in particular has been criticised for over-emphasising procedural formula application while neglecting both the spiritual dimensions of natural phenomena and the metacognitive scaffolding required for self-regulated inquiry (Marinda, 2020; Imamah, 2025). Field observations and teacher interviews conducted at MTs Ma’arif Gondang prior to this study revealed that currently available instructional materials did not systematically integrate Qur’anic perspectives with physics content, and that observable indicators of SRL including learning planning, self-monitoring, attentional control, and time management were underdeveloped among seventh-grade learners.

The integration of Islamic values into science learning rests on a substantive theological and pedagogical rationale. Sura Ali ‘Imran (3:190–191) invites believers to contemplate natural phenomena as signs of divine creation, an orientation that aligns structurally with the scientific practice of observing, questioning, and explaining the physical world (Indrayani et al., 2025). Newton’s Laws of Motion, which describe the cause-and-effect relationships governing the behaviour of objects, offer particularly fertile ground for integration with Qur’anic concepts of divine order and purposeful causality. Prior studies have reported that the incorporation of Islamic textual references into science worksheets increases learner motivation, deepens conceptual engagement, and promotes reflective practices characteristic of SRL (Utami, 2022; Hidayat & Suyanto, 2021).

Student worksheets (LKPD) remain the most widely used supplementary instructional material in Indonesian secondary classrooms. Their design directly shapes the quality of student engagement, the depth of cognitive processing, and the degree of autonomy exercised during learning (Majid, 2013). Despite their ubiquity, most LKPD in circulation at madrasah are designed for content coverage rather than SRL scaffolding, and few explicitly draw on Islamic sources as a motivational or reflective frame (Marinda, 2020). This constitutes a design gap with both curriculum and instructional significance.

The present study addresses this gap through the systematic development of a Qur’an-integrated LKPD on Newton’s Laws using the ADDIE model (Branch, 2009) a five-phase iterative framework (Analysis, Design, Development, Implementation, Evaluation) widely applied in Indonesian educational R&D for its structured and replicable character. The study sought to answer three research questions: (1) To what extent is the developed LKPD valid, as judged by subject-matter and media experts? (2) How practical is the LKPD in the perception of students and the classroom teacher? (3) How effective is the LKPD in improving students’ conceptual understanding and SRL compared with conventional instruction?

Self-regulated learning (SRL) refers to the degree to which learners are metacognitively, motivationally, and behaviourally active participants in their own learning process (Zimmerman, 2002). Pintrich’s (2004) influential framework identifies four hierarchical regulatory areas: cognition, motivation and affect, behaviour, and context. In physics learning, SRL is particularly salient because the discipline demands both procedural fluency and conceptual integration — two domains that require learners to plan strategically, monitor their understanding, and adapt their

approaches based on feedback (Schunk & Greene, 2018). Empirical studies from Indonesian secondary science contexts confirm that SRL positively predicts physics achievement (Fitriyanto, 2025; Hidayat & Suyanto, 2021), yet systematic instructional support for SRL development remains underrepresented in available teaching materials.

The integration of Islamic values into science education is not merely a theological aspiration but a curriculum mandate in Indonesian madrasah. The theoretical basis draws on the concept of *tafakkur* contemplative reflection on natural phenomena as a pathway to recognising divine wisdom which resonates with inquiry-based approaches that ask learners to observe, hypothesise, and evaluate (Imamah, 2025). Several empirical studies have demonstrated that Islamic-integrated science materials improve affective outcomes, including spiritual awareness, learning motivation, and ethical reasoning, without compromising cognitive gains (Indrayani et al., 2025; Utami, 2022). These findings suggest that value integration functions as an affective scaffold that enhances rather than competes with conceptual learning objectives.

A student worksheet (LKPD) functions as a structured learning guide that directs learner activity, scaffolds inquiry, and provides opportunity for self-assessment. Effective LKPD design incorporates clear learning objectives, meaningful task sequences, visual clarity, and explicit metacognitive prompts (Majid, 2013; Depdiknas, 2008). The ADDIE model (Analysis, Design, Development, Implementation, and Evaluation), canonically described by Branch (2009), provides a systematic, iterative procedure for developing instructional products. Its phased structure ensures that each development decision is grounded in needs analysis, validated before implementation, and evaluated rigorously, making it the most appropriate model for this study's objectives (Molenda, 2003).

METHOD

Research Design

This study employed a Research and Development (R&D) design using the ADDIE model (Branch, 2009) with an embedded quasi-experimental component for the effectiveness phase. The R&D component was guided by Nieveen's (1999) three-criteria quality framework: validity, practicality, and effectiveness. The quasi-experimental component used a non-equivalent pre-test–post-test control-group design (Creswell & Creswell, 2018) to assess the LKPD's impact on conceptual understanding and SRL relative to conventional instruction.

Participants

Participants were drawn from MTs Ma'arif Gondang, a state Islamic junior secondary school in Central Java, Indonesia. Expert validators comprised two lecturers from Universitas Sains Al-Qur'an (UNSIQ) with specialist knowledge in physics content and educational media design, respectively. The practicality assessment involved one in-service physics teacher at the school and all students in the experimental class. For the effectiveness phase, intact classes were assigned to conditions: Class VII-A ($n = 30$) served as the experimental group receiving LKPD-based instruction; Class VII-B ($n = 29$) served as the control group receiving conventional lecture-based instruction. All participants were aged approximately 12–13 years. Parental informed consent and student assent were obtained prior to data collection.

Instrument Development and Validation

Four instruments were developed and validated prior to use. (1) The expert-validation questionnaire assessed content accuracy, media quality, language clarity, and Qur'anic integration alignment on a five-point Likert scale. (2) The practicality questionnaire assessed ease of use, communicability, layout, and independent-learning support on a four-point Likert scale. (3) The self-regulated learning scale, adapted from Zimmerman's (2002) SRL framework and operationalised across planning, self-monitoring, and self-evaluation subscales (24 items). (4) The conceptual-understanding test comprised multiple-choice and essay items aligned with Polya's

(1945) problem-solving indicators. Content validity of all instruments was confirmed by the expert validators before field administration.

Development Procedure (ADDIE Phases)

Analysis

A needs analysis was conducted through semi-structured interviews with the subject teacher (Ibu Lisa Transesti) and document analysis of existing teaching materials and curriculum specifications. The analysis revealed three convergent findings: (a) current LKPD lacked Qur'anic integration, (b) students demonstrated underdeveloped planning and self-monitoring behaviours, and (c) Newton's Laws content offered structurally appropriate entry points for Islamic integration.

Design

Based on the analysis findings, the learning objectives were specified, relevant Qur'anic verses were identified and aligned with Newton's Laws sub-topics, and a design blueprint was constructed. The blueprint specified seven instructional components per LKPD unit: learning objective statement, Qur'anic verse with reflective prompt, conceptual overview, guided-inquiry activities, self-monitoring checklist, formative self-assessment, and a tafakkur (reflective) closing.

Development

The LKPD was designed using Canva (version 2024) and produced in print-ready A4 format. Expert validators evaluated the draft product and provided both quantitative ratings (recorded in Table 1) and written feedback. Revisions were made iteratively in response to validator recommendations: Validator 1 requested the addition of real-world Newton's-Laws examples explicitly linked to Qur'anic verses; Validator 2 recommended standardising image dimensions and colour-coding mathematical formulae to improve visual consistency.

Implementation

The validated and revised LKPD was implemented over two class meetings with the experimental group (Class VII-A). Instruction was delivered by the class teacher under researcher observation. The control group received equivalent content through conventional lecture-based instruction using the school's standard textbook.

Evaluation

Validity, practicality, and effectiveness data were collected and analysed as described in section Data Analysis.

Data Analysis

Validity scores were calculated by averaging the Likert-scale ratings of both validators per evaluation aspect and converting the aggregate mean to a percentage, interpreted against the five-category validity scale (Arikunto, 2013): $\geq 80\%$ = Very Valid; 60–79% = Valid; 40–59% = Partially Valid; 20–39% = Invalid; $< 20\%$ = Very Invalid.

Practicality scores were computed analogously using a four-point scale, where $\geq 76\%$ = Very Practical; 51–75% = Practical; 26–50% = Unpractical; and $\leq 25\%$ = Very Unpractical.

For the effectiveness phase, pre-test–post-test scores were first subjected to Kolmogorov–Smirnov normality tests and Levene's test of homogeneity of variance. Normalised gain (N-Gain) was computed following Hake's (1998) formula of N-Gain score. N-Gain categories were: $\geq 70\%$ = High; 30–69% = Moderate; $< 30\%$ = Low. Differences in post-test performance between groups were tested using an independent-samples t-test ($\alpha = .05$; $df = 57$). All statistical analyses were performed using SPSS version 26.

RESULT AND DISCUSSION

Result

ADDIE Development Process

The ADDIE procedure produced a fully designed, validated, and field-tested LKPD unit on Newton's Laws comprising three sequential modules (Newton's First, Second, and Third Laws), each structurally organised around the seven components described in Section 3.4. Each module integrates at least two thematically aligned Qur'anic verses with guided reflection activities and SRL scaffolds, including explicit self-monitoring checklists and metacognitive prompts. Following expert review, 12 specific revisions were documented (content corrections: 4; image/layout adjustments: 5; language clarifications: 3), producing the finalised product submitted for field testing.

Expert Validity

Two expert validators assessed the LKPD across four evaluation aspects: content/material validity, media and design quality, language and communicability, and Qur'anic integration alignment. As presented in Table 1, all four aspects were rated in the "Very Valid" category, with individual aspect means ranging from 4.38 to 4.40 on the five-point scale. The overall mean score was 4.39 (87.8%), confirming that the LKPD meets the content-validity threshold of $\geq 80\%$ stipulated by Arikunto (2013). Qualitative feedback from Validator 1 highlighted the need to embed real-life Newton's Laws examples explicitly linked to Qur'anic verses to strengthen contextualisation; Validator 2 recommended visual standardisation of images and typographic differentiation of mathematical formulae. Both recommendations were incorporated in the revision cycle.

Table 1. Expert validation results of the Qur'an-integrated LKPD across evaluation aspects

Evaluation Aspect	Validator 1	Validator 2	Mean Score	Category
Content/Material Validity	4.40	4.38	4.39	Very Valid
Media/Design Quality	4.25	4.50	4.38	Very Valid
Language and Communicability	4.33	4.45	4.39	Very Valid
Qur'anic Integration Alignment	4.50	4.30	4.40	Very Valid
Overall Mean (Percentage)	—	—	4.39 (87.8%)	Very Valid

Statistical Assumptions for Effectiveness Testing

Prior to the t-test, the data were examined for normality and homogeneity of variance. As presented in Table 2, Kolmogorov–Smirnov tests yielded significance values of .200 for both pre-test and post-test scores in both groups (all $p > .05$), confirming normality. Levene's test produced a significance value of .309 ($p > .05$), confirming homogeneity of variance. The parametric t-test was therefore considered appropriate.

Table 2. Results of normality (Kolmogorov–Smirnov) and homogeneity (Levene) tests

Class / Test	Pre-test Sig.	Post-test Sig.	Decision	Notes
Experimental (VII-A, n = 30)	0.200	0.200	Normal	Both sig. > 0.05
Control (VII-B, n = 29)	0.200	0.200	Normal	Both sig. > 0.05
Levene's Homogeneity (post-test)	—	0.309	Homogeneous	Sig. based on mean > 0.05

Effectiveness: N-Gain and t-test

The effectiveness results are summarised in Table 3. The experimental group achieved a mean N-Gain of 57% (Moderate category), outperforming the control group's 42% (Low category). The independent-samples t-test confirmed a statistically significant difference between post-test means: $t(57) = 2.989$, $p < .05$ (one-tailed; $t = 1.673$). The null hypothesis was therefore rejected, indicating that LKPD-based instruction produced significantly greater learning gains than conventional instruction.

Table 3. Independent-samples t-test and normalised gain (N-Gain) results

Parameter	Experimental	Control	Statistical Value	Decision
Mean N-Gain (%)	57.00	42.00	—	Moderately Effective vs. Low Effective
N-Gain Category (Hake, 1998)	Moderate	Low	—	—
t-value (t-calc vs t-table)	—	—	$t = 2.989 > 1.673$	H_0 rejected; H_1 accepted ($\alpha = .05$, $df = 57$)

Practicality

Student and teacher practicality ratings are presented in Table 4. Students (VII-A, $n = 30$) rated the LKPD at a mean of 3.70 out of 4.00 (92.5%), categorised as “Very Practical”. Qualitative responses indicated that students found the LKPD compact, visually appealing, and conducive to independent study. Teacher feedback similarly reported strong usability and curricular alignment.

Table 4. Practicality assessment results from students and teacher (4-point Likert scale)

Respondent Group	Mean Score	Percentage (%)	Category
Students (VII-A, $n = 30$)	3.70	92.5	Very Practical
Physics Teacher	3.70	92.5	Very Practical
Combined Average	3.70	92.5%	Very Practical

Discussion

Validity of the Qur'an-Integrated LKPD

The LKPD's overall validity rating of 87.8% confirms that expert validators regarded the product as substantially aligned with physics content standards, Islamic curriculum requirements, and principles of effective instructional material design. This finding is consistent with the growing body of R&D literature demonstrating that systematically integrated Islamic-science materials can achieve high validity ratings when both theological accuracy and scientific correctness are verified through multi-domain expert review (Indrayani et al., 2025; Utami, 2022). The validator feedback also reveals an important design principle: mere textual juxtaposition of Qur'anic verses with science content is insufficient; effective integration requires that the selected verses bear genuine conceptual resonance with the physical phenomena under study, as exemplified by the alignment of Newton's First Law with Qur'anic verses describing the stability of created order. This principle echoes Imamah's (2025) argument that meaningful integration must operate at the level of conceptual structure, not surface decoration.

Effectiveness and Self-Regulated Learning

The experimental group's N-Gain of 57% (Moderate category) compared with the control group's 42% (Low category) indicates a practically meaningful advantage for LKPD-based

instruction. The statistically significant t-test result ($t = 2.989 > 1.673$) further confirms that the observed difference is unlikely to be attributable to chance. These findings align with the broader literature on worksheet-mediated science learning, which consistently reports N-Gain advantages of 10–20 percentage points for structured inquiry-based worksheets over conventional lecture instruction (Hidayat & Suyanto, 2021; Majid, 2013).

From an SRL perspective, the LKPD's effectiveness can be explained through several mechanisms. First, the explicit self-monitoring checklists embedded at the end of each sub-topic activity operationalise Zimmerman's (2002) self-reflection phase by prompting learners to evaluate the completeness and accuracy of their understanding before proceeding. Second, the Qur'anic reflection activities function as intrinsic motivation anchors: by framing conceptual understanding within a spiritually meaningful narrative, they activate what Pintrich (2004) terms "task value beliefs" — the perception that the learning activity matters beyond its instrumental utility. Third, the structured sequence of observation, guided inquiry, and independent problem-solving scaffolds the kind of self-regulatory goal-setting and strategy selection that characterises high-SRL learners (Schunk & Greene, 2018). Taken together, these design features constitute a coherent SRL scaffolding architecture whose effectiveness is partially evidenced by the significant post-test gains.

The Moderate rather than High N-Gain category warrants interpretive caution. Hake's (1998) threshold for High gain is $\geq 70\%$, suggesting that the current LKPD design, while effective, leaves substantial room for improvement. Factors that may have constrained gains include the limited duration of the implementation phase, the novelty effect of both the instructional format and the researcher's presence, and the difficulty of adequately scaffolding SRL within a single-semester instructional unit. Future iterations should consider extending the implementation duration, incorporating digital interactive elements to increase engagement, and adding explicit metacognitive instruction on goal-setting and self-monitoring strategies.

Practicality Implications

The Very Practical rating (92.5%) reflects positively on the usability dimension of the LKPD as a classroom instrument. It is important, however, to resist conflating practicality with effectiveness. As Nieveen (1999) emphasised, practicality the ease with which a material is used is a necessary but not sufficient quality criterion; a product may be both highly practical and ineffective if its design does not adequately promote the intended learning outcomes. The present data suggest that both conditions are met: the LKPD is usable in ordinary classroom conditions and produces significantly better learning outcomes than the comparator condition. This dual quality profile is comparatively rare in the Indonesian R&D literature, where validity and practicality are frequently reported without a rigorously controlled effectiveness test (Molenda, 2003).

Limitations

Several limitations constrain the generalisability of these findings. The sample was restricted to a single school with two intact classes, limiting both statistical power and contextual diversity. The implementation phase was conducted by the class teacher under researcher observation, introducing the possibility that implementation fidelity varied from what would be observed in fully naturalistic conditions. Researcher presence may also have inflated practicality ratings through demand characteristics. Additionally, the self-regulation outcome was assessed through pre-post questionnaire and behavioural observation, rather than through validated psychometric instruments with established test-retest reliability, which limits the precision of SRL outcome claims. Future studies should employ randomised or matched sampling designs, longer implementation windows, and validated SRL instruments such as the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1991).

CONCLUSION

This study developed and evaluated a Qur'an-integrated Student Worksheet (LKPD) on Newton's Laws using the ADDIE model. The product achieved validity ($\bar{x} = 4.39$; 87.8%),

practicality ($\bar{x} = 3.70$; 92.5%), and effectiveness (N-Gain: 57% vs. 42%; $t = 2.989$, $\alpha = .05$) criteria, demonstrating that an Islamic-integrated instructional material can simultaneously advance physics conceptual understanding and self-regulated learning among junior secondary students. The findings support the integration of Qur'anic perspectives as a structurally meaningful, rather than merely decorative, design feature of science instructional materials in madrasah contexts. Future research should extend this design to broader samples, longer implementation durations, and additional physics topics, and should assess the long-term durability of SRL gains through longitudinal measurement.

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Ethics Approval: This study was conducted in accordance with Indonesian research ethics guidelines for educational research. Written parental informed consent and verbal student assent were obtained prior to data collection. School identification has been withheld to protect participant privacy; the school is referred to as MTs Ma'arif Gondang.

Data Availability: The datasets generated during this study are available from the corresponding author upon reasonable request.

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