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Development of a Research-Based Learning Model Integrated with Character Education (RBL-ICE) in Basic Science Course

Pengembangan Model Pembelajaran Berbasis Riset Terintegrasi Pendidikan Karakter (RBL-ICE) dalam Pembelajaran Sains Dasar

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Abstract

The lack of integration between research-based learning and character education remains a major challenge in Islamic higher education today, where students are required to master 21st-century skills while also developing strong character and academic integrity. This study aims to develop a Research-Based Learning model integrated with Character Education (RBL-ICE) and its associated instructional devices for the Basic Science course. The study employed a Research and Development (R&D) approach with the 4D model (define, design, develop, disseminate). The population comprised all Madrasah Ibtidaiyah (MI) pre-service teachers enrolled in the Basic Science course at IAIN Manado. The sample consisted of 15 students selected through purposive sampling. The measured variables included learning outcomes, learning motivation, and student character. Learning outcomes were obtained through pretest and posttest, learning motivation was measured using a questionnaire based on the ARCS model, and character was assessed using observation sheets. The validity of the model and instructional devices was evaluated by two material experts and two media experts. The material experts rated the research instruments, lesson plans, teaching materials, and student worksheets as very feasible, while the media experts rated the student worksheets and teaching materials as very feasible. Learning outcomes data were analyzed using prerequisite tests (normality) and hypothesis testing with a paired sample t-test, whereas motivation and character were analyzed descriptively. The implementation of the RBL-ICE model improved students' learning outcomes, with an average pretest score of 66.67 and posttest score of 77.07, and an N-gain of 0.3271 (moderate category), accompanied by increased motivation and character in the positive category. These findings indicate that the RBL-ICE model is effective in enhancing the learning outcomes, motivation, and character of prospective MI teachers in the Basic Science course at IAIN Manado.
Keywords: Research-Based Learning, Character Education, Learning Outcomes, Motivation

Abstrak

Kurangnya integrasi antara pembelajaran berbasis riset dan pendidikan karakter menjadi tantangan utama di perguruan tinggi keagamaan Islam, karena mahasiswa dituntut menguasai keterampilan Abad 21 sekaligus memiliki karakter dan integritas akademik. Penelitian ini bertujuan untuk mengembangkan model serta perangkat pembelajaran berbasis riset yang terintegrasi dengan pendidikan karakter (RBL-ICE) pada mata kuliah Sains Dasar. Penelitian ini menggunakan pendekatan Research and Development (R&D) dengan model 4D (define, design, develop, disseminate). Populasi penelitian adalah seluruh mahasiswa calon guru Madrasah Ibtidaiyah (MI) yang menempuh mata kuliah Sains Dasar di IAIN Manado, dengan sampel 15 mahasiswa yang dipilih menggunakan teknik purposive sampling. Variabel yang diukur meliputi hasil belajar, motivasi belajar, dan karakter mahasiswa. Hasil belajar diperoleh melalui pretest dan posttest, motivasi belajar diukur menggunakan angket berbasis dimensi ARCS, dan karakter diamati melalui lembar observasi. Validitas model dan perangkat dinilai oleh dua ahli materi dan dua ahli media. Hasil validasi ahli materi menunjukkan bahwa instrument penelitian, rencana pembelajaran, bahan ajar dan lembar kerja mahasiswa memperoleh penilaian sangat layak. Hasil validasi ahli media menunjukkan bahwa lembar kerja mahasiswa dan bahan ajar memperoleh penilaian sangat layak. Data hasil belajar dianalisis dengan uji prasyarat (normalitas) serta uji hipotesis menggunakan Paired Sample t-test, sedangkan motivasi dan karakter dianalisis secara deskriptif. Penerapan model RBL-ICE dapat meningkatkan hasil belajar mahasiswa dengan nilai rata-rata pretest 66,67 dan posttest 77,07 serta N-gain 0,3271 (kategori sedang), disertai peningkatan motivasi dan karakter dalam kategori positif. Temuan ini menunjukkan

bahwa model RBL-ICE efektif meningkatkan hasil belajar, motivasi, dan karakter mahasiswa calon guru MI pada mata kuliah Sains Dasar di IAIN Manado.
Kata Kunci: *Research-Based Learning, Pendidikan Karakter, Hasil Belajar, Motivasi*

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INTRODUCTION

In today's higher education, there should be a focus on both academic excellence and character development. Higher education should not only equip students with professional skills but also help shape responsible individuals with moral character and social consciousness. The National Education System, as outlined in Law No. 20/2003, mandates a well-rounded development of learners that includes intellectual, practical, and moral development. However, the learning process in higher education often prioritizes knowledge and technical skills (Vogler et al., 2018) while character development tends to receive less attention (Alorda et al., 2011; Holmes, 2012). As a result, students may perform well academically in line with their career needs but might not demonstrate suitable behavior (Nurpratiwi, 2021).

The urgency of character education has become even more pronounced as rapid social, technological, and globalization changes reshape value systems and create increasingly complex moral challenges for learners (Hadi et al., 2025; Singh, 2019). Character education is therefore essential not only for strengthening moral values, but also for developing students' ability to think critically, make wise decisions, and contribute positively to a complex and digitalized society (Center for Curriculum Redesign, 2015; Singh, 2019). Character education should be given equal priority to academic knowledge in the curriculum so that graduates are not only intellectually competent but also possess strong ethics and social responsibility (Khumairoh, 2022; Rudiyanto, 2024).

In this context, Research-Based Learning (RBL) has emerged as a pedagogical approach that can overcome this challenge (Guo et al., 2020). RBL combines authentic learning, problem-solving, and cooperative learning, guided by constructivist philosophy (Mulyatingsih, 2010). This approach supports continuous and sustainable student self-

development through active engagement in the research process. The Organization for Economic Cooperation and Development (OECD) emphasizes the need for RBL to be integrated into higher education at both undergraduate and postgraduate levels. In line with rapid technological and scientific advancement, students must engage in continuous learning and research-oriented activities (Sota & Peltzer, 2017). Consequently, higher education must be innovative and proactive in designing learning solutions based on a scientific framework (Marín, 2021).

RBL is intended to help students gain the skills needed for independent knowledge acquisition (Arifin et al., 2022). Recent studies show that RBL shares key characteristics with inquiry-based learning, such as problem orientation, investigation, and student-centered exploration, which together support deeper conceptual understanding (Suwanbamrung et al., 2025). Through structured research activities, students develop the ability to recognize the diversity and complexity of knowledge construction in interdisciplinary contexts. This approach is efficient for addressing real-world problems that require integrating multiple disciplinary perspectives (Al-Maktoumi et al., 2016). Moreover, RBL provides significant opportunities for students to develop their critical thinking skills, construct meaningful syntheses based on empirical data or information, and effectively present their findings through various academic formats (Rattanaprom, 2019).

RBL focuses not only on improving cognitive and academic skills, but also on developing student character. Character education aims to instill values and ethical behavior in students, preparing them to navigate a complex social and professional environment (Asri & Deviv, 2023). Therefore, if character development is the objective, learning designs must also be oriented towards achieving these competencies (Yanti et al., 2024). RBL can be an effective medium for integrating academic skill development with character education (Griffiths, 2004; Khwanchai et al., 2017). By involving students in research, RBL nurtures cognitive skills while also enhancing social and emotional competencies, including teamwork, effective communication, and empathy (Dafik et al., 2019), while simultaneously strengthening character traits like integrity and accountability (Istiningsih et al., 2024). Additionally, RBL promotes professional attitudes such as perseverance and data-driven decision-making (Singh et al., 2019). The effectiveness of character education can be significantly enhanced through experiential learning opportunities embedded in research-based projects (Camacho et al., 2017;

Ubaidah et al., 2019). This pedagogical synergy fosters a holistic educational experience in which the rigor of scientific inquiry is intrinsically linked to the cultivation of ethical reasoning and civic responsibility (Bowyer et al., 2022).

Despite its promising nature, functional models of RBL that incorporate character education principles are often found to be lacking. Many educators struggle to effectively integrate these approaches into their teaching practices, leading to noticeable inconsistencies in the implementation of character education across different subjects and levels in higher education settings (Asri & Deviv, 2023; Fitria, 2022).

Previous studies have tried to refine the RBL model through integration, aiming to align RBL with specific learning content (Arifin et al., 2022). For example, Tungkasamit & Junpeng (2012) have highlighted the need for RBL assessment systems. Wannapiroon (2014) incorporates technology to enhance critical thinking, problem-solving, self-regulation, and flexible learning styles through a structured RBL model. Usmeldi et al. (2017) proposed a science-based RBL model. Worapun (2021) focused on developing RBL curricula using a five-stage teaching plan involving analysis, creative design, action, reflection, and evaluation. While RBL outcomes vary depending on the targeted 21st-century skills, clear guidelines are essential for proper, targeted implementation to maximize their effectiveness (Arifin et al., 2022). Given RBL's adaptability with various teaching strategies, it is well-suited for higher education (Arifin et al., 2022; Sota & Peltzer, 2017). However, most studies have focused on cognitive and procedural aspects with limited attention to character development (Bowyer et al., 2022).

Although previous studies have refined the RBL model to align with specific learning content and enhance 21st-century skills, the systematic integration and empirical validation of character education within the RBL framework, especially in basic science courses at higher education institutions, remain limited. Most RBL studies focus on cognitive and procedural outcomes, with little attention to character development alongside academic learning. This gap shows the need for an RBL model that blends research-based inquiry with explicit character education, helping students achieve academic success and develop the social and emotional skills needed in higher education.

IAIN Manado's basic science course struggles to improve learning and student outcomes. SISKA (IAIN Manado Academic Information System)data show only about 58% of students score above 65, reflecting gaps in understanding and weak critical and

creative thinking skills (Alorda et al., 2011; Holmes, 2012). Therefore, integrating RBL into the basic science course is proposed to engage students actively and shift the educational focus toward the development of essential social and emotional skills. This study aims to develop an RBL model integrated with character education (RBL-ICE) to evaluate its validity, feasibility, and effectiveness in improving learning quality, student outcomes, and promoting character development in basic science courses at the higher education level.

This study contributes to the literature by developing the RBL-ICE model. The model combines cognitive outcomes, scientific inquiry, and character formation in Basic Science learning in higher education. It is expected to offer a more holistic RBL framework that supports academic achievement and students' affective and social development. The RBL-ICE model also provides operational guidelines for lecturers and curriculum designers. These include structured learning steps, teaching materials, and assessment systems. This enables the integration of character education into research-based classroom activities, thereby improving learning quality, student outcomes, and character development at IAIN Manado and similar institutions.

METHOD

This study was conducted in the odd semester of the 2024/2025 academic year using a research and development (R&D) design based on the 4-D model by Thiagarajan, Semmel, and Semmel (Trianto, 2011). This model has four systematic stages: define, design, develop, and disseminate. Figure 1 show the development procedure that followed these stages: (1) define: analyzing curriculum, learner characteristics, and learning needs to identify the gap between current practices and the desired RBL-ICE model; (2) design: formulating the RBL-ICE syntax, designing lesson plans, student worksheets, and teaching materials, and constructing research instruments; (3) develop: producing and revising prototypes through expert validation and limited trials; and (4) disseminate: implementing the validated products in field tests and refining them based on empirical findings.

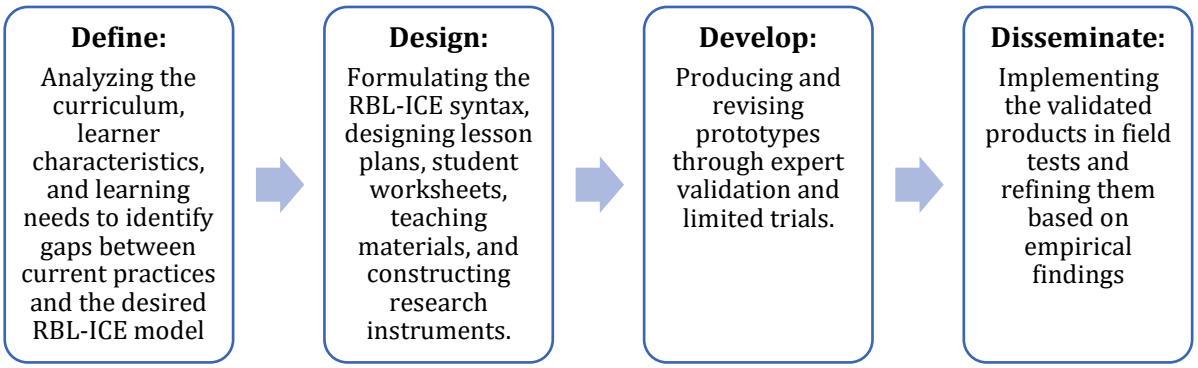

Figure 1. RBL-ICE Model Development Procedure

The population comprised all Madrasah Ibtidaiyah (MI) pre-service teachers enrolled in the Basic Science course at IAIN Manado. The sample consisted of 15 students selected through purposive sampling, based on their enrollment in the course and accessibility for field testing.

The RBL-ICE model developed included lesson plans, student worksheets, and teaching materials. The research instruments were: (1) prototype evaluation sheets for the model, instructional devices, and instruments; (2) learning activity observation sheets; (3) student character observation sheets; (4) formative tests (pretest and posttest); and (5) student response questionnaires. Data were collected through expert judgment (for prototype evaluation), classroom observation (for learning activities and student character), written tests (for learning outcomes), and questionnaires (for learning motivation based on the ARCS model).

The prototype evaluation sheets were used to assess the prototypes' validity through expert evaluation. The learning activity sheets were designed to analyze the implementation of the RBL-ICE model and to evaluate students' and instructors' engagement during the learning process (A'yun et al., 2023). Student character observation sheets were utilized to collect data on students' character traits observed during learning, focusing on the development of scientific characteristics (Slameto, 2015). The expected traits to emerge from the learning process included curiosity, responsibility, critical thinking, creativity, and discipline. To assess students' mastery of the learning material, formative tests were conducted, with items constructed to align with the intended learning outcomes. Furthermore, student response questionnaires gathered feedback on the RBL-ICE model and instructional devices. The questionnaires measured four main aspects of motivation based on the ARCS model: Attention,

Relevance, Confidence, and Satisfaction. The questionnaire items were adapted from Chang et al. (2018) and tailored to the specific needs of this study.

Several steps ensured validity and reliability. For quantitative instruments (formative tests and student response questionnaires) content validity was established by expert review. Formative test reliability was measured using Cronbach's alpha. Questionnaires were pilot-tested to assess consistency and internal reliability. For qualitative instruments (prototype evaluations and observation sheets) expert validation established validity. Reliability was upheld with a four-point rating scale and inter-rater agreement checks. All instruments were iteratively reviewed and revised based on expert feedback and pilot testing to ensure robustness for qualitative and quantitative data collection.

Qualitative data from needs analysis, expert validation, and student responses were categorized using a four-point rating scale. Quantitative data on learning outcomes were analyzed using N-gain to describe the effectiveness of the intervention in improving students' scores (Hake, 1998) and a paired-sample t-test to test the statistical significance of differences between pretest and posttest scores (Pallant, 2020). Before conducting the t-test, prerequisite analyses (normality tests) were performed to ensure that the data met the assumptions for parametric testing.

RESULT AND DISCUSSION

Development of the RBL-ICE Model

An initial investigation into the RBL-ICE model looked at how basic science courses are currently taught and how RBL is applied. Interviews with lecturers showed that basic science teaching mainly focuses on Problem-Based Learning. However, implementing RBL poses challenges due to a lack of supporting infrastructure, such as laboratories and practical guidelines specific to the subjects. As a result, skills such as independence, creativity, and innovation remain underdeveloped. Other issues include inadequate learning materials and limited teaching time. From the students' perspective, low motivation and unfamiliarity with independent research present technical barriers to effective RBL implementation.

Preliminary investigations of learning devices also examined student conditions and the suitability of the content. Evaluation data revealed a low course achievement rate of 58%. Additionally, lesson plans, student worksheets, and assessment instruments had not yet incorporated RBL aspects, and the expected character traits were not explicitly

stated. Classroom observations further revealed that learning activities did not align with the lesson plans. Basic science courses in the Madrasah Ibtidaiyah (MI) teacher education program are subject-specific skills courses with a 3-credit load, addressing scientific concepts suitable for an RBL approach.

The development of RBL-ICE was carried out through field and literature studies, resulting in a constructivist model for basic science courses, supported by a prototype of the model and learning devices, including lesson plans, worksheets, and teaching materials. The development process primarily involved building this model prototype. The results of this model development are summarized in Table 1.

Table 1. Learning Syntax Framework for RBL-ICE.

No	Stage	RBL Focus	CE Integration
1	Problem Orientation	Identify and understand real-world problems or phenomena to investigate critically.	Encourage curiosity by motivating students to ask questions and explore real-world phenomena; foster responsibility in addressing meaningful problems.
2	Problem Statement	Formulate clear, concise, and researchable questions based on the problem.	Strengthen critical thinking and creativity by guiding students to formulate clear, innovative, and researchable questions; promote responsibility in considering the impact of questions on society and self.
3	Data Collection	Gather relevant, valid, and reliable information through appropriate methods.	Cultivate discipline through systematic, ethical, and reliable information gathering; reinforce curiosity in seeking comprehensive data and responsibility toward respectful practices.
4	Analyzing and Data Interpretation	Critically analyze data to find patterns, relationships, and insights.	Develop critical thinking in evaluating evidence, finding patterns, and drawing insightful conclusions; foster discipline in maintaining integrity and accuracy, and creativity in interpreting results.
5	Result Presentation	Share findings clearly and effectively using various media.	Promote creativity in presenting findings through various media; emphasize discipline in delivering transparent, ethical communication, and responsibility by acknowledging contributors.
6	Reflection and Evaluation	Reflect on the research process, findings, and personal learning. Evaluate outcomes critically.	Build critical thinking in self-assessment and evaluation of outcomes; encourage responsibility for personal growth, continued discipline in research, and ongoing curiosity and creativity for improvement.

The design and development of instructional devices focused on creating lesson plans, worksheets, and teaching material. These instructional devices were specifically designed to facilitate students ' understanding of fundamental scientific concepts through an RBL approach integrated with character education. The designed lesson plans align with the learning outcomes outlined in the KKNI curriculum and follow the steps of the RBL-ICE model. They promote active participation, analytical thinking, critical reasoning, and open exchange of opinions among students. In line with the National Higher

Education Standards (SN Dikti), the lesson plans explicitly encourage students to engage in inquiry, exploration, and investigation, promoting both collaborative and independent learning. The worksheets developed are tailored to facilitate the RBL approach, incorporating character education, serving as tools that support the learning process and deepen understanding of scientific principles.

The teaching materials also follow the same pedagogical framework, including key components such as competencies to be achieved, work instructions, exercises, and supporting information (Majid, 2011). This integrated design aims to enhance both cognitive skills and character development in science learning contexts. Figures 2-4 illustrate the results of the instructional devices developed.

Mgg Ke-	Kemampuan Akhir Tiap Tahapan Belajar (Sub-CPMK)	Penilaian		Bentuk Pembelajaran, Metode Pembelajaran, Penugasan Mahasiswa, [Estimasi Waktu]		Materi Pembelajaran [Pustaka]	Bobot Penilaian (%)
		Indikator	Kriteria & Bentuk	Luring	Daring		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
6-7	Mampu memahami dan menyelidiki konsep rangkaian listrik seri dan paralel melalui kegiatan penelitian sederhana serta menunjukkan sikap ilmiah dan karakter positif (jujur, tanggung jawab, kerja sama, disiplin, dan berpikir kritis).	1. Mampu mengidentifikasi fenomena kelistrikan dalam kehidupan nyata; 2. Mampu merumuskan masalah, tujuan riset, dan hipotesis sederhana; 3. Mampu melakukan eksperimen rangkaian seri dan paralel serta mengumpulkan data; 4. Mampu menganalisis data hasil eksperimen dan membandingkan dengan teori hukum Ohm; 5. Mampu menyajikan hasil penelitian secara tertulis dan lisan secara runtut 6. Mampu merefleksi proses penelitian dan nilai karakter ilmiah.	Unjuk Kerja	**Bentuk dan Metode:** RBL terintegrasi CE **Kegiatan Tatap Muka:** – Diskusi pemantik berbasis masalah; – Penyusunan rencana mini riset; – Praktikum riset mini; – Diskusi kelompok dan analisis data; – Presentasi hasil; – Refleksi individu. **TM: [2 x 3 x 50 menit]** **Kegiatan Penugasan Terstruktur:** Melakukan riset sederhana terkait fenomena kelistrikan dalam kehidupan sehari-hari. **PT: [2 x 3 x 60 menit]** **Kegiatan Mandiri:** Membaca buku/referensi tentang topik perkuliahan. **BM: [2 x 3 x 60 menit]**		1. Gejala Kelistrikan; 2. Rangkaian seri dan paralel; 3. Hukum Ohm. **[4, 5, 8]**	16

Figure 2. Lesson Plan Design

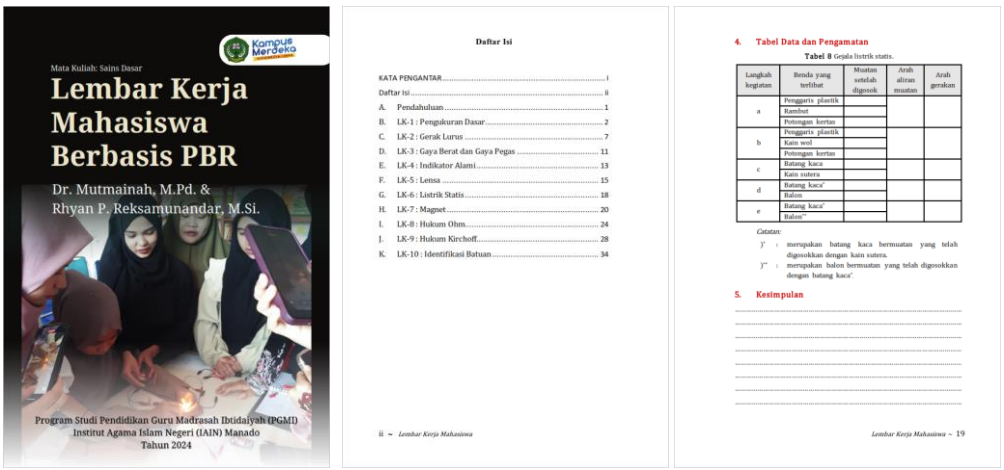

Figure 3. Worksheet Design

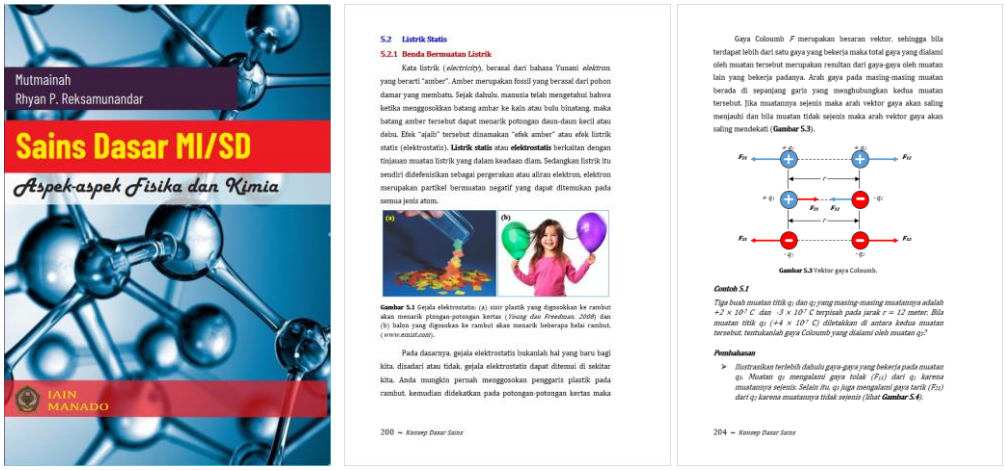

Figure 4. Teaching Material Design

Feasibility of the RBL-ICE Model

The feasibility of the instructional devices and the research instrument was assessed through a comprehensive evaluation conducted by two material validators and two media validators. These panel members were selected for their expertise and experience to ensure a thorough evaluation. The validation of the lesson plan focused on key elements, including course identity, learning outcomes, competency goals, content relevance, instructional methodologies, time allocation, assessment criteria, and references (Muhsinin & Fatmawati, 2020). The validation of worksheets focused on format, content quality, and linguistic appropriateness to guarantee user-friendliness and practical learning support (A'yun et al., 2023). The teaching materials were also subjected to systematic validation for content suitability, language accuracy, clarity of presentation, and graphic design (Yulia, 2021). All feedback and validation results were documented and utilized to guide iterative improvements. The validation results are summarized in Tables 2 and 3.

Table 2. Material Expert Validation Result

No	Component	Score	Category
1	Lesson Plan	89,20	very feasible
2	Worksheet	81,25	very feasible
3	Teaching Material	83,33	very feasible

The expert validation results demonstrate that both material and media aspects of the instructional devices meet very feasible criteria. Material experts rated the lesson plan (89.20), worksheet (81.25), and teaching material (83.33) in the "very feasible" category. Similarly, media experts assessed the worksheet (84.38) and teaching material (89.58) as "very feasible".

Table 3. Media Expert Validation Result

No	Component	Score	Category
1	Worksheet	84,38	very feasible
2	Teaching Material	89,58	very feasible

These findings indicate that all components of the RBL-ICE model are of high quality and suitable for implementation in the learning process. The importance of expert validation in educational product development supports the development of effective and reliable teaching materials (Safitri et al., 2022). In the broader context of educational development, the pivotal role of high-quality teaching materials in achieving educational success cannot be overstated. High-quality teaching components contribute to improved educational outcomes, increased learner satisfaction, and enhanced students' learning experiences (Rembielak & Marciniak, 2021; Wea et al., 2023).

The Effectiveness of the RBL-ICE Model

The field trial aimed to assess how well the proposed RBL-ICE model improved students' understanding of basic science concepts. The field trial was conducted among 15 pre-service Madrasah Ibtidaiyah (MI) teacher education students enrolled in the basic science course. The implementation phase used the RBL-ICE model, integrated with character education, across seven instructional sessions. Data collection took place during the 3rd, 5th, and 7th sessions, following the completion of specific material blocks.

Implementation of Learning Syntax

Observation of the syntax implementation revealed a steady rise in adherence to character education integrated in the RBL stages, as shown in Table 3. The lecturer's implementation consistency increased from 83.33% to 93.75%, while student engagement went up from 66.67% to 83.33%. The overall average increased from 75.00% to 88.54%, indicating that the RBL-ICE model was applied more effectively as the sessions progressed.

Table 4. Implementation of the RBL-ICE Learning Syntax.

No	Component	Implementation of Syntax (%)		
		I	II	III
1	Lecturer	83,33 (High)	91,67 (Very High)	93,75 (Very High)
2	Students	66,67 (Low)	79,17 (Medium)	83,33 (High)
3	Average	75,00 (Medium)	85,42 (High)	88,54 (High)

The progressive improvement in the implementation data reflects both increased familiarity with the RBL-ICE model and enhanced instructional management. The third data set exhibited the highest level of syntax implementation. Two main factors contributed to this outcome. First, students had already adapted to the learning schedule

and had a clearer understanding of the procedural steps within the RBL-ICE model. Second, the lecturer demonstrated improved planning and preparation, leading to a more effective learning process. In contrast, the first data set had the lowest implementation percentage, likely due to students' and lecturers' initial adjustment to the model's new instructional structure.

The overall improvement in average performance shows that the RBL-ICE model was practically implemented as the sessions progressed. Engaging in inquiry-based learning helps students develop a deeper conceptual understanding, which translates into better performance over time (Nguyen et al., 2024; Polanin et al., 2024). A core component of RBL-ICE is its alignment with active learning strategies that boost cognitive engagement. These strategies promote attentional control, create a supportive learning environment, stimulate independent thought, and elevate students' participation. Another significant aspect of student engagement in the context of RBL-ICE is agentic engagement, in which students take an active role in their learning. Such proactive engagement can lead to supportive learning environments, promote participatory classroom dynamics, and contribute to positive educational outcomes (Reeve, 2013).

Analysis of Learning Outcomes

Learning outcomes refer to the abilities students acquire upon completing a learning process (Sudjana, 2005). The effectiveness of the RBL-ICE model in improving these outcomes can be shown through pretest and posttest scores. Prerequisite tests (normality) and a paired-sample t-test result are presented in Table 5.

Table 5. Analysis of Learning Outcomes.

No	Test	Type of Test	Results	Conclusion
1	Normality	Kolmogorov-Smirnov	Sig. Pretest = 0.200 Sig. Posttest = 0.200	Normal Normal
2	Mean Comparison	Paired t-test	Sig. = 0.000	Significant Difference

The application of the RBL-ICE model in the basic science course can enhance students' learning outcomes. These outcomes reflect how well students grasp the material after engaging in the learning process and include various intellectual abilities, such as understanding, application, and analysis (Kusmiyati, 2023). The paired-sample t-test results show a significant difference in students' learning outcomes before and after applying the RBL-ICE model (sig. 0.000 < 0.05). Figure 5 shows the average score increases from 66.67 in the pretest to 77.07 in the posttest, with an average N-gain of

0.3271, indicating 32,71% of the maximum possible improvement in the moderate category (Hake, 1998).

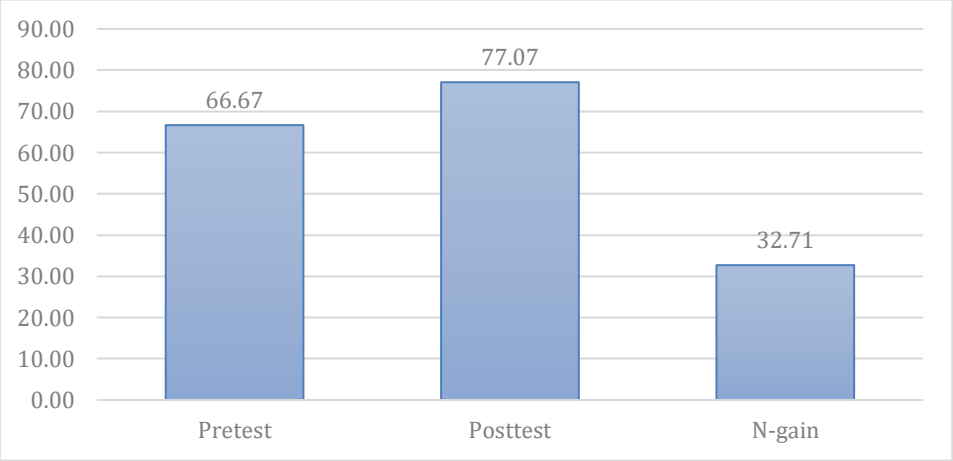

Figure 5. Learning Outcomes Comparison: Pretest, Posttest, and N-Gain

This study's findings consistently support the positive effect of the RBL-ICE model on students' learning outcomes. This approach promotes not only knowledge acquisition but also essential skills like higher-order thinking and creativity, as reported in previous studies that RBL can significantly improve analytical thinking, cognitive skills, and scientific writing ability (Afridona et al., 2019; Sota & Peltzer, 2017; Suyatman et al., 2021). Implementing RBL through diverse instructional strategies meaningfully engages students in the learning process (Arifin et al., 2022; Dintarini & Kusumawardhana, 2020). Such engagement enables learners to move beyond rote memorization, allowing them to construct knowledge through exploration, inquiry, and reflection that are crucial for mastering complex subject matter and achieving deeper learning outcomes (Suwanbamrung et al., 2025).

Furthermore, the findings align with previous research showing that RBL acts as a bridge between theoretical understanding and practical application (Camacho et al., 2017; Hunter et al., 2007; Marín, 2021). By situating learning within real-world problem-solving contexts, RBL encourages the development of transferable skills necessary for professional competence, such as research literacy, collaboration, and communication. These outcomes suggest that RBL not only strengthens intellectual capacity but also enhances students' readiness for future careers. Thus, integrating RBL provides a robust framework for higher education that fosters both cognitive and professional growth.

Analysis of Observed Character

Character is defined as a positive personal quality, which means knowing goodness, a desire to do good, and actually behaving reasonably. Character is consistently reflected in mature thinking, a good heart, physical actions, and focused feelings and determination (Said, 2020). To identify the characters observed during the learning process, an observation sheet was used throughout the study. The observation criteria were formulated as qualitative statements and assessed on a 1–4 scale. A score of 1 indicated the complete absence of a character, while a score of 4 signified its clear presence and alignment with the observation items. The specific characters under observation included curiosity, responsibility, critical thinking, creativity, and discipline. The results of these character observations are presented in Figure 6.

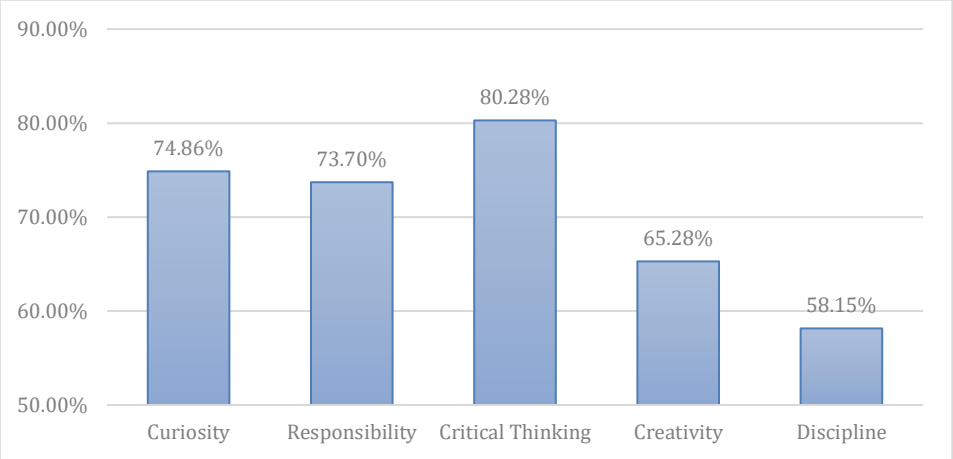

Figure 6. Character Observed

The findings show that critical thinking received the highest rating, with an average score of 80.28%, categorized as excellent, while discipline received the lowest score of 58.15%, still within the good category. This pattern highlights the dominance of cognitive skill development over behavioral regulation aspects in the implementation of the RBL-ICE model. As an inquiry-oriented approach, RBL encourages learners to analyze problems critically, formulate arguments, and synthesize diverse perspectives, thus enhancing higher-order thinking skills (Bhuttah et al., 2024; Widiastuti et al., 2023). The high achievement in critical thinking aligns with RBL's theoretical foundation, which emphasizes exploration, reflection, and evaluation throughout the learning process.

However, the relatively lower discipline rating suggests that while RBL effectively promotes cognitive engagement, the behavioral aspects of time management, task

completion, and consistency still need reinforcement. Wibowo et al. (2024) state that the integrative nature of inquiry-based learning requires active student participation and responsibility, which are vital for fostering discipline. Additionally, Widiastuti et al. (2023) note that clear deadlines and performance benchmarks can promote students' self-regulation within the RBL framework. Therefore, implementing RBL should include behavioral scaffolds such as progress monitoring tools and reflective self-assessment to enhance students' discipline alongside their cognitive development.

Analysis of Learning Motivation

The student learning response questionnaire was designed to assess student motivation after engaging in lessons that applied an RBL-ICE model. The assessment focused on the four dimensions of the ARCS motivation model: Attention, Relevance, Confidence, and Satisfaction. As illustrated in Figure 7, the Attention dimension achieved the highest percentage (78.75%), indicating strong student engagement during the learning process, while the Satisfaction dimension showed the lowest percentage (73.33%). Overall, student motivation averaged 75.87%, placing it in the high category.

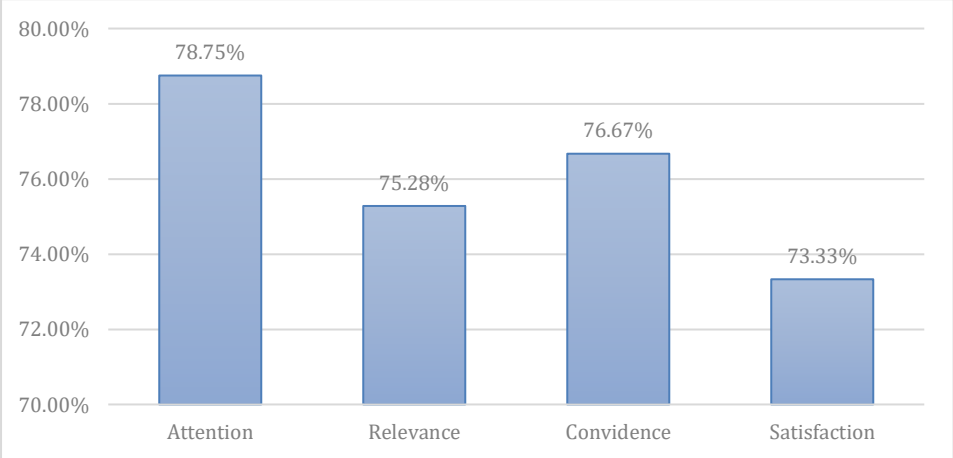

Figure 7. Student Motivation based on the ARCS Model

Learning motivation plays a critical role in education and significantly impacts learning effectiveness. Motivation functions as a key psychological driver that affects how students engage with educational tasks and tackle challenges (Bredenkamp et al., 2023). Motivation is an internal impulse to learn that arises from the satisfaction derived from the learning process itself rather than from external rewards. This intrinsic motivation encourages students to participate actively and persevere in understanding complex materials. As a result, motivation closely relates to students' learning outcomes (Fang et

al., 2024). Students with high learning motivation often show better academic performance and sustained effort in learning activities (Pintrich & De Groot, 1990).

Within this framework, the RBL-ICE model proves effective in enhancing learners' motivation. RBL focuses on inquiry, discovery, and active participation, allowing students to act as researchers in the learning process. By involving students in real-world problem-solving and research activities, RBL boosts curiosity and interest, increasing intrinsic motivation. Furthermore, RBL supports character development and critical thinking, two important educational aspects tied to long-term motivation (Shin, 2018). Continuous feedback, peer interaction, and a positive learning environment reinforce sustained motivation in RBL settings. These factors are crucial for motivating students in science education (Glynn et al., 2011). RBL serves as both an instructional framework and a motivational tool, enhancing students' engagement, independence, and cognitive development.

This study has several limitations that should be acknowledged. First, the sample size was relatively small, limiting the generalizability of the findings. Second, the implementation of the RBL-ICE model lasted only briefly, so its long-term impact on learning outcomes, character development, and motivation could not be fully examined. Finally, this study focused solely on basic science courses, so further research is needed to test and refine the RBL-ICE model across different subjects, institutions, and larger, more diverse samples.

CONCLUSION

The RBL-ICE model has demonstrated validity, feasibility, and effectiveness in enhancing the quality of learning in basic science courses at the higher education level. Findings reveal a significant increase in students' learning outcomes, along with the development of positive character traits and learning motivation. The model provides a practical framework for lecturers. Future studies are recommended to apply the model across different disciplines to explore its consistency and adaptability in various learning contexts. Longitudinal research is also needed to explore the model's long-term impact on students' professional character and academic integrity.

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