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SYNOPSIS

This book is a comprehensive compilation of scholarly articles that explore innovative approaches, models, and technologies in the fields of education, particularly focusing on character education, science learning, Islamic education, and curriculum development. Through comparative studies between Indonesia and Malaysia, as well as literature reviews on STEM, ethno-STEM, and digitalization, the authors provide diverse insights into how education systems adapt to 21st-century challenges. The articles also delve into pedagogical strategies such as gamification, RADEC model, project-based learning, and the integration of virtual laboratories in physics education, aiming to enhance both cognitive and moral development among students from elementary to high school levels.

Additionally, this volume addresses emerging issues in Islamic education, religious moderation, inclusive learning environments, and the impact of artificial intelligence and information systems on Islamic schools. It highlights the importance of aligning education with cultural values, sustainability, and technological advancements. By offering practical and theoretical perspectives, the book serves as a valuable resource for educators, researchers, and policymakers striving to improve educational quality and relevance in diverse and multicultural settings.

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Strategies for Strengthening Character Education in Primary School Children in Indonesia and Malaysia

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Abstract-This study analyzes the strategy of strengthening character education in primary school children in Indonesia and Malaysia. It aims to find effective approaches and reinforcement in the implementation of character education in elementary schools. The focus of the discussion includes character education policies, strategy strengthening, and comparative implementation applied by both countries. This research uses a descriptive qualitative method of literature study approach with analysis techniques: data reduction, data presentation, and conclusion drawing. Researchers have obtained 40 articles and used as material for theory accumulation into 30 articles related to character education and strategy strengthening in both countries. The results and discussion state that Indonesia implements Pancasila-based character education through the Merdeka Curriculum, while Malaysia uses the National Education Philosophy (FPK) with three main pillars: intellectual, spiritual, and physical. The strategy of strengthening character education in both countries involves the integration of character values in the curriculum and school activities.

Keywords: ***Character Education, Reinforcement Strategy, Elementary School***

I. INTRODUCTION

Character education, as an integral part of the education system, has a very important role in shaping children's personality and morality from an early age. Character education focuses not only on teaching moral values, but also on developing positive attitudes and behaviors that reflect integrity, responsibility, and social care. [1]. This approach is considered essential to create a generation that not only excels in cognitive aspects, but also has good emotional and social intelligence [2]. Strengthening character education at the primary school level in Indonesia and Malaysia is very urgent, given the challenges of both countries in facing complex problems. [3]. as well as the need to prepare young people who are able to compete in the global arena while adhering to strong moral values [4].

Education is one of the fundamental aspects of life. Education is a planned effort to pass on cultural values from one generation to the next. The development of education is currently very rapid, both in terms of approaches and goals to be achieved, making it a feature and benefit in an ever-evolving education system. [5]. Education is carried out systematically to educate the nation's children from cognitive, affective and psychomotor aspects. [6].

Quality education not only focuses on mastering the material, but also on building a strong character, so that students can grow into individuals who are responsible, empathetic, and able to make a positive contribution to social life. [7]. Character education in Islam is inseparable from religious education. Moral cultivation in elementary school is very important for future moral development [8]. Character education is a form of habituation of positive values so that children are able to act wisely in the future [9].

Character Education in Indonesia can be referred to the Law of the Republic of Indonesia No. 20 of 2003 concerning (Sisdiknas) that National education serves to develop potential and form dignified character in spiritual strength, intelligence, skills, with the aim of educating the lives of the nation's children. [10]. The study of character strengthening in schools based on PERPRES NO. 87/2017 emphasizes seven main points: *First*, character education is important to form a generation with morals and ready to face global challenges. *Second*, character education should be an integral part of learning. *Third*, collaboration between school and community. *Fourth*, the experience and practice of teachers and principals. *Fifth*, exemplary behavior from educators and parents. *Sixth*, dialogical and participatory approaches. *Seventh*, character education must be integrated in all learning activities. [11].

The Indonesian Ministry of National Education formulated 18 characters values derived from religion, Pancasila, culture, and national education goals to shape the character of students in order to build the nation. These values include: religion, honesty, tolerance, discipline, hard work,

creativity, independence, democracy, curiosity, nationalism, love for the country, respect for achievement, communicative, peace-loving, fond of reading, environmental care, social care, and responsibility. [12].

The Curriculum Development Center at the Malaysian Ministry of Education developed a character education curriculum that reflects the values of Malaysian society. Moral education, focused on the spiritual, humanitarian and social aspects of a diverse society. However, the curriculum was later amended to establish core values that can be accepted and agreed upon by various religious groups, such as Christian, Catholic, Hindu, Buddhist, Confucian, Taoist and others. Character education in Malaysia has been in place since 1988 and has been revised twice since then. The subject is dynamic in nature to stay in tune with the latest moral and ethical developments [9].

The Malaysian government formed a committee that formulated 16 "pure values" to be taught to students, namely kindness, independence, courtesy, respect, compassion, justice, freedom, courage, physical and mental health, honesty, craftsmanship, cooperation, simplicity, gratitude, rationality, and the spirit of gotong royong. These values are sourced from religion, tradition, community customs, and universal aspects, closely related to social interactions in families, friends, communities, and organizations. Moral education in Malaysia is implemented through social interactions at school and outside of school, including direct learning in the classroom. Teachers are required to integrate moral values in subjects, which is burdensome as teachers must also be role models for students. In addition, the memorization method is often used due to the limited capacity and skills of teachers in teaching moral education. [12].

The researcher summarized some examples of cases that contradict the objectives of the National Education System Law. In 2019, an elementary school student was arrested for stealing a cell phone to pay for his school fees. In another case, police arrested a fourth-grade student who stole worship equipment from a temple to play games. [13]. Character formation is influenced by interactions at school, home, or social environment. Education ideally not only develops skills, but also shapes human character, given the importance of character education in the midst of changing times [14]. Parenting or educators have an important role in the individual development of children. [15].

This research is motivated by the lack of comparative studies on character education strategies in primary school children in Indonesia and Malaysia. Although some previous studies have examined the strengthening of character education in each country, none has comprehensively discussed the strategies and approaches applied in both countries. This study aims to fill the gap by analyzing and evaluating the strategy of strengthening character in primary school children, as well as finding the best approach.

II. METHOD

This research uses a descriptive qualitative approach with a literature study method. Data collection was taken from various relevant primary and secondary reference sources to obtain a theoretical basis related to the problem to be studied. The data analysis technique used refers to the Miles and Huberman model, which includes three main stages: data reduction, data presentation, and conclusion drawing [16]. Researchers have obtained 40 articles and used as material for theory accumulation to 30 articles related to character education and strengthening strategies in both countries. The researcher limited the research focus to the Strategy of Strengthening Character Education in Primary School Children in Indonesia and Malaysia.

III. RESULTS AND DISCUSSION

Research Results

The results and discussion present findings on strategies to strengthen character education in primary school children in Indonesia and Malaysia. Each finding is analyzed based on relevant character education theories and policies in both countries. The discussion includes representations between the approaches implemented in Indonesia and Malaysia, as well as the supporting factors and challenges faced by each. The analysis is expected to provide comprehensive insights and practical recommendations for improving character education at the primary school level. The descriptive analysis follows:

Table 1. Representation of articles on Character Education in Indonesia and Malaysia.

Year	Author and Article Title	Research Results
2019	Rahmat Rifal Lubis "Hitority and Dynamics of Character Education in Indonesia"	The legal basis for character education is the 1945 Constitution, the National Education System Law and the 2010 Presidential Instruction. Development includes character empowerment through local wisdom and integration in subjects.
2019	Badrus Zaman "The Urgency of Character Education in Accordance with the Philosophy of the Indonesian Nation"	National Character Education is based on the values of Pancasila and embodies obligations to God, self, family, community, and the environment.
2020	Fazal Akmal Musyyari	Ki Hajar Dewantara-style Character

	"Annotation of Presidential Regulation No. 87/2017 on Strengthening Character Education"	Education needs to be implemented at all levels of higher education, with the support of the Local Content Curriculum
2020	Agustinus Tanggu Daga "A Comparison of Character Education in the Primary School Curriculum in Malaysia, India and Indonesia"	Both countries recognize the importance of character education and have integrated it in their education programs, although there are similarities and differences in values and implementation strategies.
2023	Rohil Zilfa "Between Tradition and Modernity: A Comparative Analysis of Character Education in Indonesia, England, Japan, and Malaysia"	In Indonesia, the main focus is in schools, while in Malaysia it is through moral subjects.
2023	Arif Rahman Hakim "The Concept of Basic Foundations of Character Education in Indonesia"	Indonesian education is experiencing problems adjusting to a rapidly changing curriculum, while character education is instilled through religious values, positive attitudes, and love for Pancasila.
2024	Anisa Amalia Maisaroh & Sri Untari "Character Education Transformation Through Government Policy in Indonesia Towards the Golden Generation 2045"	Character education is important to achieve a golden Indonesia 2045, involving collaboration between education, society and stakeholders to form a noble generation.
2024	Miftahul Muthoharoh "Project Concept of Strengthening the Pancasila Student Profile and Rahmatan Lil Alamin Student Profile (P5 PPRA) in the Independent Curriculum"	The Pancasila Student Strengthening Project and the Rahmatan Lil Alamin Student Profile aim to form students with 21st competencies, and character based on Pancasila.
2024	Ulfa Nur Azizah "Character Education and Moral Depth from the Perspectives of Lichona and Kohlberg"	Integration of Lichona and Kohlberg's moral concepts. Both theories emphasize the role of the social and cultural environment, and this combined approach is relevant in the 21st century.
2024	Yudistita, Ilham Suwandi & Muchamad Rifki "Character Education for Elementary School Students from an Islamic Perspective"	Education in primary schools requires a holistic approach. Teachers and parents have an important role in educating children, especially in character building and role modeling.
2024	Nonong Amalita, Azwar Ananda, Nurhizrah Gistituati, Rusdinal "A Comparative Study of Character Education in Indonesia, Malaysia, and Japan" Dedeh Rescindang Irnissa, Aa	In Indonesia, character education is integrated in the Pancasila Learner Profile and Merdeka Curriculum, while in Malaysia it is through moral subjects. Character education in Indonesia and

	Rahmawati, Taufik Muhtarom "A Comparative Study of Character Education in Indonesia and Malaysia"	Malaysia aims to strengthen moral, social and responsibility values. In Indonesia, through the Pancasila Learner Profile, and in Malaysia, through moral subjects.

Table 2: Representation of Character Education Strengthening Strategies in Indonesia and Malaysia.

Year	Author and Article Title	Results and Discussion
2020	Siti Zazak Soraya "Strengthening Character Education to Build National Civilization	The four strategies that can be applied in character education are value cultivation, modeling, facilitation and skill development.
2022	Ani Siti Anisah, Sapriya, Kama Abdul Hakam, Ernawulan Syaodih. "Model of Social Attitude Competency Development in Elementary School Students"	Teachers and schools shape students' attitudes through internalization of character values with a *scientific* approach, as well as *training, modeling, conditioning, and habituation* methods.
2022	Syahirah Rosli, Siti Firuz Mahmud, Mohd Edyazuan Azni "Integrating the Philosophy of National Education (FPK) in Waking up the Capital of Bersepedu People"	Teachers play an important role in implementing FPK to achieve educational goals, taking into account the challenges of globalization and professionalism.
2023	Ainul Yaqin "Character Building with Habituation, Exemplary and Teaching Approaches"	The teaching process involves two things: the acceptance of values and the exemplary and habituated approach of teaching students through observation of character building effectively.
2024	Agra Dwi Saputra & Analisa Tunafia. "Strengthening Character Education in Elementary School Children"	Strengthening character education in primary schools requires the integration of character values in the curriculum, the role of teachers as role models, supportive school policies, collaboration with parents and communities, and continuous evaluation.

i.

Discussion

b. Character Education Policies in Indonesia and Malaysia

i. Character Education in Indonesia

Character education is actually not a new thing in Indonesia. Since before independence, people have practiced character education in the form of religious or moral education, both in schools and pesantren. This process continued until the early 2000s. Then, on May 2, 2010, in commemoration of National Education Day, the Republic of Indonesia officially planned the implementation of character education in Indonesia. [9]. Character education in Indonesia has received serious attention from the government, which is reflected in the issuance of Permendikbud No. 22 of 2015 concerning the Ministry of Education and Culture Strategic Plan 2015-2019. In addition, attention to character education also comes from various groups, including non-profit institutions such as the Indonesia Heritage Foundation (IHF), which focuses on the development of character education through its various programs. IHF's vision is "Building a Nation of Character". [6].

Character education in Indonesia is supported by several main regulations, namely the Constitution No. 20 of 2003 concerning the National Education System, Presidential Regulation No. 87 of 2017 concerning strengthening character education, and the regulation of the Indonesian Minister of Education, culture, research and technology No. 47 of 2003 concerning Management Standards for Early Childhood Education, Primary Education, and Secondary Education. [17]. Over time the Indonesian Education curriculum has undergone various changes, ranging from the 1947 curriculum to the independent curriculum currently implemented. [18].

The independent curriculum gives schools the flexibility to utilize their capabilities and adapt to the resources available. It also provides freedom for learners to teach material that is considered important and urgent. [18] The main objectives of the Merdeka Curriculum are to

develop creativity and innovation, build independence in the learning process, improve life skills in 21st century abilities, and foster noble character through meaningful learning that is relevant to everyday life [17]. The principle applied in the independent curriculum is the Pancasila Student Profile Strengthening Project (P5), which has six dimensions, namely: 1) faith and devotion to God Almighty and noble character, 2) respect for global diversity, 3) mutual cooperation, 4) independence, 5) critical thinking, and 6) creativity. The Pancasila Student Profile can be realized through four main activities, namely school culture, extracurricular activities, and the Pancasila Student Profile Strengthening Project (P5). [18].

Pancasila as the basic philosophy of Indonesia has an important role, as stated by Soedarsono, namely as the foundation of the state, worldview, identity, soul of the nation, common goals, noble covenants, and principles in the life of society, nation and state. Characters based on Pancasila must reflect the values of the five precepts, namely: divinity, humanity, unity, democracy that respects the law and human rights as well as justice and welfare for the entire nation. [19].

Character education in Indonesia refers to the guidelines of the Ministry of National Education which stipulates 18 main values, such as religiosity, honesty, tolerance, hard work, love for the country, and responsibility. These values are sourced from religion, Pancasila, culture, as well as the goals of National Education to strengthen character in education units. [6].

According to the author, character education in Indonesia aims to form a generation that is superior in character, creative, critical thinking, and has an awareness of diversity and national values. Through collaboration with non-profit institutions such as the Indonesia Heritage Foundation, character education is expected to continue to develop to build a nation of character and high competitiveness.

2. Character Education in Malaysia

Character and value education is an important part of the Malaysian Education System. In the colonial era, character education was provided through Bible teaching for Christian students, while non-Christian students followed ethics lessons. After independence, Bible teaching was replaced with Islamic education for Muslim students, while character lessons were introduced for non-Muslim students. In the 1970s, citizenship subjects became compulsory for all non-Muslim students [9].

A fundamental change in Malaysian education came after the publication of the 1979 Cabinet report under the leadership of Dr. Mahatir, then Minister of Education. The report emphasized the importance of character education for non-Muslim students and pushed for it to be integrated into the new primary school curriculum from 1983, while at the secondary school level it started six years later through the implementation of the Curriculum Bersepadu Sekolah Menengah (KBSM). Character education was introduced gradually, starting from grade one at both the primary and secondary school levels. The year 1993 marked the first batch of students in Malaysia to receive character education. In this subject, non-Muslim students were required to study moral education at the same time as Muslim students attended Islamic Religious Education. [9].

The Curriculum Development Center at the Malaysian Ministry of Education then developed a character education curriculum that reflects the prevailing values in Malaysian society. Initially, moral education focused on the spiritual, humanitarian and social aspects of multicultural Malaysia that students need to understand. However, this approach was later changed to the establishment of core values that could be accepted and agreed upon by various religious groups. The committee in charge eventually established sixteen core values, known as "pure values", namely: (1) kindness, (2) independence, (3) ethics (good manners), (4) mutual respect, (5) compassion, (6) justice, (7) freedom, (8) courage, (9) physical and mental hygiene, (10) honesty, (11) hard work, (12) cooperation, (13) simplicity, (14) gratitude, (15) rationality, and (16) community spirit. The teaching method of moral education that emphasizes these pure values is done mainly through *direct teaching*, but the values are also integrated into subjects and daily life. [9].

The subject of moral and ethical education in Malaysia, has an important component that is compulsory at all levels of education, aiming to teach students moral values, ethics, and good behavior in accordance with the standards of social life. Some of the key points of this curriculum are:

b. Curriculum Structure: Moral and ethical education is structured through a syllabus that emphasizes learning core values, such as honesty, respect, responsibility, decency, and fairness. These values are considered fundamental to student character building.
c. Contextualized Learning: Moral and ethical learning often uses a contextual approach, where students are invited to understand the values in the context of everyday life, as well as in the social and cultural realities of Malaysia.
d. Attitude and Behavior Development: in addition to teaching moral values, moral and ethical education also focuses on developing positive attitudes and behaviors, such as communication skills, cooperation, and empathy for others.
e. Evaluation: the subject has an evaluation mechanism, including written exams, projects or assignments related to moral values. Assessment is done with the aim of measuring students' understanding of the values taught.
f. Integration with Subjects: Moral and ethical education is integrated with other subjects in the curriculum to ensure these values are applied in a broader context and not limited to one area of study.

Moral and ethical education in Malaysia is a comprehensive effort to shape young people with positive values. The relationship between teachers and students is expected to create an educational environment that supports the formation of ethics in accordance with the objectives of the Malaysian National Education curriculum. [20].

a. Implementation of Character Education Strengthening Strategies for Primary School Children in Indonesia and Malaysia

b. Character Education Strategy in Indonesia

Children can learn attitudes and morals through several approaches, namely: (1) *trial and error,* where children learn through social conversations to understand whether their behavior is in accordance with social norms; (2)

direct education, children learn by following the rules that exist in the family, school, and community environment; and (3) exemplary, where children imitate the behavior of adults [21]. Herlambang mentioned that there are four strategies in character education, [22] including:

a. Reinforcing. Strengthening character education is carried out through co-curricular, extracurricular programs and activities, as well as the school environment, with the participation of principals, teachers, staff, and parents. Character education is implemented through integration in subjects, thematic learning, habituation, and synergy between school, family, and community [23].
b. Habituating. Habituation or *conditioning* aims to shape behavior through repeated practice, based on the theory of behaviorism. This method includes *direct methods* to change behavior, cognitive and social development, behavior modification according to Islamic values, and strengthening faith and morals in the school environment. [24].
c. Modeling. Modeling plays a role in improving students' cognitive abilities by providing examples that can facilitate understanding and creativity. Through imitation of teacher behavior, students can develop innovative and creative abilities [25].
d. Teaching. Teaching aims to develop the character and cognitive aspects of students by helping them process information independently, improve critical thinking skills, and solve problems effectively [26].

To strengthen character education in primary schools. *First*, teachers need to increase their capacity through training that focuses on character-based learning methods. *Second*, curriculum development that is flexible and contextualized. Third, collaboration between schools, parents and communities. The implementation of these strategies is expected to increase the effectiveness of character education in primary schools. [27].

Character Education Strategy in Malaysia

In Malaysia, human development in the National Philosophy of Education (FPK) aims to produce individuals who have a strong religious grip, practice noble values in daily life, and have various skills, this development integrates various elements of holistic and balanced human development goals. There are three main aspects that are the focus of FPK including:

a. Intellectual Development. In Malaysian education, this approach is reflected through various programs such as innovation competencies, quizzes, and 21st century teaching. These programs aim to develop students' critical and creative thinking skills, as well as abilities in various fields [28].
b. Spiritual and Emotional Development. Spiritual and emotional development aims to build a balanced character, both intellectually and morally. FPK emphasizes religious and moral values, with programs such as, Sistem Sahsiah Diri Murid (SSDM) and Sahsiah Unggul Murid (SUMUR) expected to nurture students' character. [29].
c. Physical Development. Physical education promotes healthy living habits, improves physical quality, and prepares students for challenges.

These three aspects aim to produce a balanced and beneficial individual. [28]. Character strengthening strategies in Malaysia include: 1) national unity and social harmony, 2) responsibility and respect, 3) caring and hard work. 4) balance of freedom, as well as 5) social stability and law compliance [30].

IV. CONCLUSION

Character education is very important in Indonesia and Malaysia to form a generation that is moral, ethical, and contributes positively to society. In Indonesia, character education is regulated in Law No. 20 of 2003 and Presidential Regulation No. 87 of 2017, and is implemented through the Merdeka Curriculum and the Strengthening Profile of Pancasila Students (P5) and Profile of Rahmatan Lil Alamin Students (PPRA) Project. The focus is on strengthening religious values, mutual cooperation, independence, and creativity through reinforcement, habituation, role modeling, and teaching in primary schools. In Malaysia, character education is based on the National Education Philosophy (FPK) which integrates intellectual, spiritual, emotional and physical development. The curriculum emphasizes the values of unity, social harmony, justice and responsibility to accommodate the diversity of society. Both countries use similar character education strengthening strategies, including integration in subjects and holistic approaches, to face modern challenges and shape individuals of character who are ready to contribute to society.

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Enhancing Physics Learning with Virtual Labs: Insights from the Last Ten Years

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***Abstract*—This study analyzes the impact of virtual laboratories on student learning in physics, focusing on how virtual labs contribute to conceptual understanding, engagement, and learning motivation. Virtual laboratories serve as valuable educational tools, especially in schools lacking physical lab facilities. By providing interactive and flexible learning experiences, virtual labs help students grasp complex physics concepts, foster critical thinking, and promote scientific skills such as hypothesis testing and problem-solving. Using a literature review approach, this study gathered and examined data from various academic sources on virtual lab implementation in physics education. The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method was employed to identify, screen, and select relevant studies, with 18 journals ultimately included for analysis. Findings indicate that virtual labs have substantial educational benefits, supporting students' conceptual knowledge and motivating them to engage more actively in learning. However, limitations exist, such as dependence on technology and the lack of hands-on experience with physical equipment. Addressing these limitations through appropriate technology use and strategic integration can maximize the effectiveness of virtual labs. Overall, this study highlights the potential of virtual laboratories to enhance physics education by fostering independent exploration and providing versatile learning environments adaptable to various educational contexts.**

Keywords—virtual lab, physics

I. INTRODUCTION

Physics is a branch of science that studies the universe and everything that occurs within it. Since the universe we inhabit is filled with mysteries, all that we know today is the result of discoveries made by past scientists. They uncovered these findings through observation, research, and calculations to understand how nature operates and to grasp the fundamental principles that enable the universe to endure.

Over time, knowledge of the universe has indeed aligned with the calculations formulated by past scientists. However, much remains unexplained, as mysteries and unknown phenomena persist in the universe. Consequently, physics began to be taught in schools so that students can understand how nature works—and they might even be the ones to solve these unresolved mysteries in the future. Additionally, physics education [1] enables students to gain conceptual knowledge useful for daily life, while fostering scientific attitudes and broad perspectives. This knowledge starts with small experiments that help them better grasp concepts, explore ideas, deepen their understanding, and test the theories they have learned.

Laboratory facilities are necessary to support experimental learning, enabling students to better understand physics concepts. [2] Laboratories are considered essential because they aid in physics education, where comprehension of concepts often requires direct observation and experimentation. However, some schools lack adequate laboratory facilities or even have none at all. This limitation sometimes hinders students' ability to truly grasp physics concepts, leading them to think that physics is merely about calculations, when in fact, it encompasses much more. Therefore, the use of technology is crucial as a solution to support practical activities, with one such technology being the virtual laboratory.

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Virtual labs are highly beneficial in addressing the limitations of physical laboratories. [4] Virtual laboratories are not designed to replace real laboratories but rather to assist the learning process and complement the shortcomings of physical labs. Essentially, virtual labs are intended to ease the burden on educators or institutions that lack physical lab facilities. According to [5], a school laboratory is fundamentally an academic support unit that serves as a place to conduct testing, calibration, and production using specific scientific methods to support the educational process.

The implementation of virtual laboratories can greatly aid learning in schools. However, like any technology, virtual labs have their limitations. These drawbacks might still be somewhat manageable by educators or institutions. For instance, students cannot directly experience using physical laboratory equipment, which might ultimately lessen their understanding of laboratory tools. Essentially, [6] conducting

experiments in a physical lab is an important part of education, providing students with hands-on experience. Moreover, virtual labs could lead students to become dependent on internet connections and electronic devices, as they may become overly accustomed to these tools.

II. METHOD

This study uses a literature review method, where we conduct an examination, understanding, and search for information from various previous sources related to the topic we have chosen [7]. The study is carried out by analyzing various articles to obtain comprehensive and in-depth results. Furthermore, [8]mentions that reviewing previous research (literature review) is an essential part of research. A review of existing studies is instrumental in developing theories and identifying the appropriate research fields, guiding future research directions.

The purpose of this study is to analyze the impact of virtual laboratory usage on the learning process and outcomes of students, as well as to examine how virtual labs can increase student interest in learning. This objective serves as a guide in developing a more focused literature review, especially in selecting articles and references that align with the research focus.

The method we chose is the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method. In this approach, we are required to review several related articles and analyze whether those articles are suitable to be used as references[9]The PRISMA process involves four main stages: identification of journals to be included in the meta-analysis, followed by screening or selection of data, eligibility determination to assess the suitability of articles for use, and inclusion, which refers to the integration and reporting of results.

Table 1: Explanation Of Prisma Formulation

No.	Stages	Description
1.	Identification	We identified and selected the topic we used, utilizing the keywords "virtual lab and physics." We then found 200 discussions related to our keywords with the assistance of Scopus and Publish or Perish.
2.	Screening	In this stage, we filtered journals based on year and type. In this process, we only selected articles within a decade range, from 2013 to 2024. We also chose journals of the article type and excluded other types. We conducted this selection on 200 journals and found 89 that were classified as articles.
3.	Eligibility	In this stage, we evaluated and aligned the articles with the research needs. We reviewed the 89 selected articles to determine which were most suitable as a foundation for our article. After further examination, we found 30 articles that were most relevant to our topic. However, of those 30, we only used 18 articles, as they best aligned with our research objectives.
4.	Included	In this stage, we analyzed these 18 articles to align them with our article.

TABLE. 2 INCLUSION AND EXCLUSION CRITERIA

Criteria	Inclusion	Exclusion
Type of literature study	Article	Book, Conference, Note, Review
Timeline	2013-2024	Before 2013

The literature study we chose consisted of articles that were collected and selected based on their titles and abstracts to ensure they met the criteria we established. We obtained 200 journals from Scopus using the Publish or Perish application, then sorted these 200 journals using Excel, selecting only those categorized as articles and discarding those classified as Book, Conference, Note, or Review. We found 89 articles and further analyzed them for relevance to our research objectives, resulting in 18 relevant journals. The remaining journals included 27 related to higher education, 23 inaccessible journals, 3 related to junior high school, and 18 deemed irrelevant for other reasons.

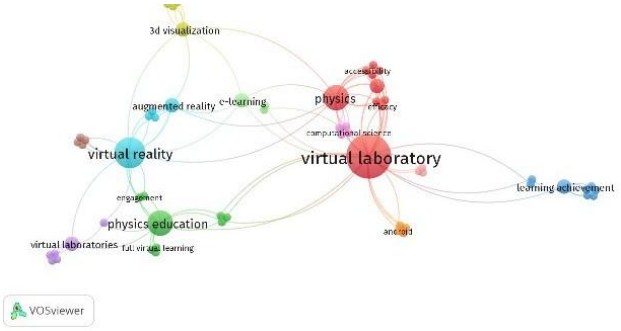

Figure 1: Relationship between each keyword

The figure above illustrates the connections between each keyword frequently appearing in research on virtual laboratories. The first keyword, "virtual laboratory," is the center of various related terms such as "physics," "learning achievement," "3D visualization," and "virtual reality." This connection shows that virtual laboratories are often used in physics education to enhance conceptual knowledge by utilizing 3D simulations and augmented reality. Additionally, the links with "accessibility" and "efficacy" highlight the advantages of virtual laboratories in providing ease of access and effectiveness in learning. The combination of "e-learning" and "android" indicates the adaptation of technology to easily accessible digital platforms, promoting more independent and interactive physics education. The relationship between "engagement" and "physics education" demonstrates that virtual laboratories help foster student engagement in understanding the material more deeply and improving their learning outcomes.

III. RESULTS AND DISCUSSION

Here are the results and discussion that we will outline regarding our literature study, based on the 17 articles we found that meet the criteria. The information below is related to the synthesis of virtual lab articles internationally, which we will explain further. We selected 17 articles that are highly relevant to our analysis needs, and we present the analysis in table form for easier understanding.

Table 3: The Impact Of Virtual Lab Usage

No.	Author Name	Title	Method	Research Findings
1.	[10] Daineko	Augmented and virtual reality	Experimental approach	3D visualization helps them

No.	Author Name	Title	Method	Research Findings
	et all.,	for physics: Experience of Kazakhstan secondary educational institutions		better understand physics concepts
2.	[11] Rahmi et all	Development of a virtual lab in sience-physics	Research and Development (R&D)	The results of using virtual laboratories are valid and practical for use in schools, aligning with curriculum standards and representing a characteristic of 21st-century education.
3.	[12]	The effect of guided inquiry learning model assisited by virtual laboratory to studenta learning achievement in temperature and heat topic in class X of SMAN 1 langsa academic	Pre-test and post-test	This learning model successfully enhances student engagement in the learning process.
4.	[13]	Evaluation of virtual laboratory package on Nigeria secondary school physics concepts	Quantitative-based evaluation	Improving students' achievement in the taught physics concepts
5.	[14]	Guided inquiry model through virtual laboratory to enchane students sience process skills on heat concept	Quantitative and qualitative data	Enhancing skills in hypothesis, practice, and communication
7.	[15]	Improving teaching techniques using virtual phyton : acase study in physics laboratories	This case study focuses on both quantitative and qualitative approaches.	After the experiment, students showed an improvement in their understanding of physics concepts, as evidenced by higher test scores compared to the control group.
8.	[16]	Analysis of high school students' mastery in light wave theory using structured inquiry learning assisted by a virtual laboratory	Quantitative Analysis	Students showed improvement in their conceptual assignments. However, some students still encountered difficulties in certain aspects.
9.	[17]	A comparison of students' approaches to inquiry, conceptual learning, and attitudes in simulation-based and microcomputer-based laboratory	Quasi-experimental	Shows a more positive attitude toward the virtual lab compared to traditional labs
10.	[18]	Effects of guided inquiry virtual and physical lab	Quasi-experimental	Shows a more positive attitude toward the virtual lab compared to traditional labs.
11.	[19]	educational technology of virtual physics laboratory	Research and Development (R&D)	Trials with students demonstrate the effectiveness of the medium for physics learning.
14.	[20]	Moving labs out of labs: teachers' perceived effectiveness of virtual laboratories duting pandemic schools closures	Descriptive Survey-Based	Allows time flexibility and access, enhancing student engagement in deeper concept understanding.
15.	[21]	The experiment editor: supporting inquiry-based learning with virtual lab	Pre-test and post-test	Helps students understand complex scientific concepts through an inquiry-based approach.
16.	[22]	Virtual physics laboratory application based on the android smartphone to improve learning independence and conceptual understanding	Experimental research using an experimental group	Students find this application useful, easy to use, and effective in supporting independent physics learning.
17.	[23]	The physics classroom in an 3D virtual world: a thai highschool theacher needs analysis	Qualitative approach with surveys and interviews	Several challenges, such as limited hardware and unstable internet connections, were also identified.
18.	[24]	Virtual Laboratory as a Step to Maximize Student Skills	Study literature	Virtual lab is able to provide motivation for student learning.

Based on Table 3, the results show that using virtual labs is highly beneficial for physics learning as it provides many

positive impacts on the teaching and learning process. Virtual labs also motivate students to engage more enthusiastically in their studies. Additionally, there are various virtual lab platforms to choose from, such as PhET Simulations, OLabs, ChemCollective, and others [25]

The overall impact of virtual labs on student learning from the data above shows a positive trend. Most research findings indicate that virtual labs help students achieve a deeper understanding of physics concepts [17][21]. By emphasizing student engagement in the learning process and providing an interactive learning experience, virtual labs enable students to explore complex physics concepts independently, fostering critical thinking and other scientific skills such as formulation, hypothesis development, practical application, and communication skills [14]18].

Virtual labs also have a significant impact on students' learning motivation [24], as the engaging features of virtual labs boost curiosity and make students more enthusiastic about their studies. However, the effectiveness of virtual labs also depends on several factors, particularly on how this tool is utilized within the learning process [26]

The results indicate that students' understanding of concepts improves significantly through virtual labs, primarily due to the guided inquiry-based approach. Guided inquiry helps students take on a more active role and fosters an awareness of the importance of the learning process [27] Since physics education emphasizes practical activities, students should choose the right learning model. One effective model for learning scientific concepts is inquiry-based learning, which encourages students to observe natural phenomena and motivates them to experiment [28]

The use of virtual labs is also highly flexible, as it can be implemented anywhere, which was especially beneficial during the pandemic when remote learning became necessary. In a short time, educators were required to confront and adapt to technology to ensure that learning could continue [29]One technology adaptable for virtual labs allows students to conduct experiments without needing to be in a school environment or meet face-to-face with teachers. Virtual labs are expected to give students the opportunity to conduct practical work anywhere [30]. Improved accessibility through technology, such as Android devices or digital media, provides students with the chance to deepen their understanding of the physics concepts being taught [20] [22].

One of the advantages of virtual labs, which is not found in traditional labs, besides being flexible and assisting institutions without laboratory facilities, is that virtual labs help reduce the risk of errors or accidents that can occur during real laboratory work [31]This is especially important in physics, where mistakes in handling electrical equipment can be hazardous to students. The use of virtual labs also helps to save time because teachers do not need to write the steps of the experiment on the board [32] they can directly explain the application and provide live examples for students to follow.

Virtual labs have many advantages that greatly assist in the teaching and learning process, especially in the fields of science and physics. However, like any technology, virtual labs also have their limitations. One of the technical challenges is the occasional instability of internet connections [23]. Additionally, students do not gain hands-on experience with actual laboratory work, such as the skills needed to handle equipment. The use of virtual labs can also limit student interaction with their peers. Furthermore, virtual labs may reduce students' ability to solve unforeseen problems that typically arise in real lab settings [33]

Despite its limitations, virtual labs continue to be utilized because of the substantial benefits they offer students. Potential challenges can be addressed through appropriate adjustments and the strategic use of technology, helping to minimize these issues and maximize the effectiveness of virtual labs. Virtual labs are tools that can be applied across various educational levels and knowledge domains. With proper planning, this technology can sustainably support effective learning processes. Adjustments in virtual lab usage can also help improve problem-solving abilities; according to research [34] virtual labs enable students to find solutions independently, ultimately enhancing their critical thinking skills and fostering innovation in problem-solving.

IV. CONCLUSION

Based on the analysis we conducted, we concluded that the use of laboratories in physics learning has many positive impacts. Virtual laboratories not only improve students' understanding of physics concepts but also engage students actively and increase their learning motivation. There are many virtual lab platforms such as PhET simulations, OLabs, and ChemCollective, which provide many options for both teachers and students to study the material.

Overall, virtual labs offer numerous benefits and contribute to the enhancement of physics learning. However, their success depends on how this tool is utilized in the learning process. Therefore, appropriate adjustments are needed in the implementation of this technology to ensure it is accepted and produces optimal results.

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Analysis the Problem-Based Learning Model in Physics Education: How Did It Work?

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Abstract— **This research is motivated by the conventional methods still employed by teachers in the teaching process, especially in physics education. These methods are not sufficient to facilitate the understanding of complex physics concepts, impacting students' comprehension of the material. The aim of this study is to examine the impact of applying the Problem Based Learning (PBL) model on students' conceptual understanding and skill development, s well as identifying the components that can be combined with the Problem-Based Learning (PBL) model. The method used in this study is a literature review with a PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) design, which includes steps such as identification, screening, eligibility, and analysis of the final set of articles. Data collection was conducted using the Scopus database. The search process resulted in 11 articles focused on the PBL model, conceptual understanding, and skill enhancement among students. The research outcomes suggest that the PBL model has a very significant impact on students' conceptual understanding in physics, as well as aiding in the improvement of critical thinking and problem-solving skills.**

Keywords—problem-based learning, critical thinking, understanding of concepts

I. INTRODUCTION

Physics is a branch of Natural Sciences that fundamentally consists of two aspects: product and process. As a product, physics is a collection of knowledge that includes facts, concepts, generalizations, principles, theories, and laws of physics. As a process, physics involves a series of scientific processes used to discover new knowledge in the field of physics[1].

A common problem in physics education is the insufficient understanding of the material by students, resulting in unsatisfactory learning outcomes. This is often due to the use of conventional and non-contextual teaching methods, which make students passive, while future life demands them to be able to solve problems and think critically [2]. Most teachers use conventional teaching methods that are teacher-centered and emphasize rote memorization. This creates a passive learning process and reduces students' conceptual understanding. Therefore, the lecture or conventional method is less suitable for teaching physics because it does not actively involve students, thus limiting their ability to think, work, adopt scientific attitudes, and communicate with teachers and peers [3]. Physics learning should be an interactive activity, where students are anticipated to actively participate in the learning process. In this way, students can acquire knowledge through their active involvement[4]. To master physics concepts, the teacher's role is crucial not only in delivering general material but also in creating an effective learning process. To address these issues, efforts are needed to improve the learning process by implementing engaging, active, and innovative learning models. Selecting the right learning model can enhance conceptual understanding, students' critical thinking and problem-solving abilities.

The learning process is a crucial aspect of education. Teachers need to consider various factors when choosing models and methods to use in the classroom, such as the characteristics of the material, student characteristics, available facilities, and the teaching models and methods. One model that supports active student engagement is Problem Based Learning (PBL), where students are first presented with a problem before the teacher provides an explanation of the physics material. Problem Based Learning, which is student-centered, is essential for fostering a scientific attitude in physics learning. Effective learning occurs when students are actively involved in problem-solving during the learning process [5]. The problem-based learning model is characterized by using real-life problems as the material or concept for students to learn. This approach aims to train and enhance critical thinking and problem-solving skills, as well as to achieve a deeper understanding of essential concepts in physics education [6].

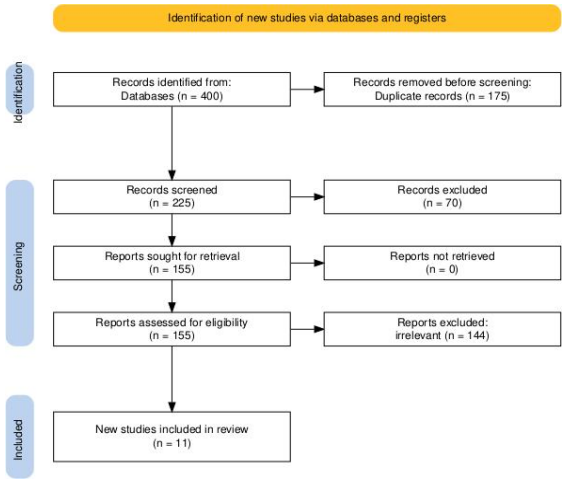
Based on the background presented, the objective of this study is to analyze the impact of implementing the Problem Based Learning (PBL) model on students' conceptual understanding and skill development, as well as to identify the components that can be integrated with the Problem Based Learning model.

II. METHOD

This study employs a literature review method using PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) design. PRISMA is a set of evidence-based guidelines designed to assist authors in reporting systematic reviews and meta-analyses. It emphasizes methods that authors can apply to ensure clear and thorough reporting across various research types[7]. The articles used in this study are Scopus-indexed and were retrieved using the Publish or Perish software, which facilitates the search, management, selection, and filtering of scientific articles relevant to the research topic.

The questions addressed in this study are as follows: (1) How does the Problem-Based Learning model affect students' conceptual understanding in physics learning? (2) What skills are developed through the application of the Problem Based Learning model? and (3) What components are integrated into the Problem-Based Learning model?

Figure 1. Preferred Reporting Items for Systematic Reviews and Meta Analyses

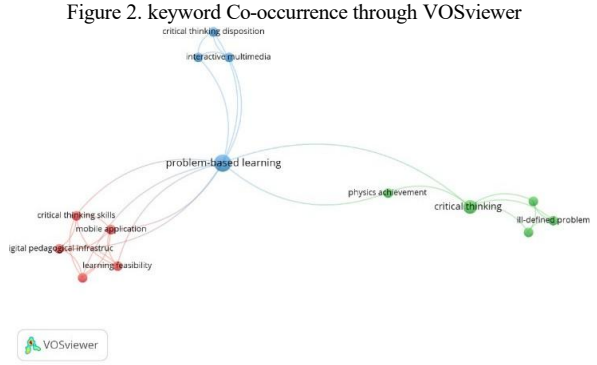


Based on the search results in Scopus using the Publish or Perish software with the keywords *Problem-Based Learning*, *Physics*, *High School*, and *Student*, a total of 400 files were obtained. Of these, 175 files consisting of book chapters and conference papers were excluded, leaving 225 articles. Among these, 70 articles were inaccessible, resulting in 155 remaining articles. Out of the 155 accessible articles, 144 were deemed irrelevant, leaving 11 relevant articles that became the focus of the research analysis.

III. RESULTS AND DISCUSSION

The initial analysis was conducted based on the keyword co-occurrence from the article search results. Using this method, we identified the frequency with which primary keywords appeared together across various articles selected for the study, uncovering relationships or patterns between key concepts in the published literature. This approach facilitated an understanding of the topic structure and revealed thematic relationships that might not be explicitly evident, providing a solid foundation for a more in-depth exploration of the topics covered in these articles.

Figure 2. keyword Co-occurrence through VOSviewer



Based on Figure 2, the keyword relationships reveal the connections between topics emerging from this literature review. “Problem Based Learning” is placed at the center, functioning as the main topic that links to various other keywords. “Critical thinking” is directly related to Problem Based Learning and connects to other keywords such as “ill-defined problem” and “physics achievement”. This shows that the application of Problem Based Learning model can enhance students' thinking abilities, particularly in handling ill-defined problems and improving physics achievement. In the red cluster, the keywords “critical thinking skills”, “mobile application”, “digital pedagogical infrastructure”, and learning “feasibility” are grouped together, highlighting that the implementation of Problem-Based Learning is associated with the use of technology to enhance critical thinking skills. Additionally, in the blue cluster, *critical thinking disposition* and *interactive multimedia* suggest that the integrating interactive multimedia in Problem-Based Learning influences students' disposition toward critical thinking. Overall, Figure 2 illustrates how Problem-Based Learning not only serves as a means to develop critical thinking skills but also involves the use of technology in education to improve students' conceptual understanding.

The subsequent analysis was based on the metadata, including title, author, publisher, and citation count. By examining these elements, we aimed to gain insights into the distribution of research themes, the influence and expertise of authors, the prominence of specific publishers, and the impact of each article as indicated by citation frequency. This metadata analysis provided a deeper contextual understanding of the literature landscape, helping to identify influential works, prominent contributors, and potential trends in the field.

Table 1. Result of Relevant Article Search

Article Code	Authors	Journal	Citation
A1	A Shishigu A et al [8]	Eurasia Journal of Mathematics, Science and Technology Education	112
A2	Mundilarto et al [9].	Baltic Science Education Journal	43
A3	Parno et al [10].	Science Education Journal	26
A4	Gunawan et al [11].	Education of Gifted Young Scientists Journal	21
A5	F Savall et al [12].	Physical Review Physics Education Research	14
A6	N Erceg et al [13].	Revista Mexicana de Fisica E	11
A7	R. Sujanem and I N Putu Suwindra [14].	Indonesian Science Education Journal	5
A8	A Olatide O and N Govender [15].	Baltic Science Education Journal	5
A9	Suhirman and S Prayogi [16].	Humanities and Social Sciences Letters	2
A10	A Rahmasari and H Kuswanto [17].	Journal of Technology and Science Education	2
A11	N Gumisirizah et al [18].	Physics Education	1

Table 2. Mapping of Researcher Country Origins

Article Code	Country of Origin	Citations
A1	Ethiopia, East Africa	112
A2	Yogyakarta, Indonesia	43
A3	Malang, Indonesia	26
A4	Mataram, Indonesia	21
A5	Spanyol	14
A6	Croatia, Bosnia and Herzegovina	11
A7	Bali, Indonesia	5
A8	South Africa	5
A9	Mataram, Indonesia	2
A10	Yogyakarta, Indonesia	2
A11	Uganda, East Africa	1

Based on table above, there is a variance in the citation counts for Problem-Based Learning research across different countries. A significant difference is observed, with studies from Ethiopia and Uganda, in East Africa, having the highest citation count at 113 citations. Indonesia ranks second with 99 citations, showing a broad representation in Problem-Based Learning research, encompassing areas such as Yogyakarta, Malang, Mataram, and Bali. This indicates a high level of interest in conducting research in this field. Thus, East African countries and Indonesia have a substantial influence compared to other countries. For research findings, please refer to Table 3.

Table 3. Research Findings

Article code	Integration with Problem-Based Learning	Research Findings
A1	Problem Based Learning method and conventional teaching.	Students' problem-solving skills improve by using PBL.
A2	Experimental method and the demonstration method.	The study's results suggest that Problem-Based Learning, when combined with the experimental method, can notably enhance students' critical thinking skills.
A3	Comparing the Problem-Based Learning method integrated with STEM, Problem-Based Learning, and the conventional method.	Problem-Based Learning-STEM can enhance students' scientific literacy more effectively than Problem-Based Learning or the Conventional method.
A4	Problem Based Learning approach was used with the help of interactive multimedia created with Adobe CS3 software, and a basic media approach such as static images and videos without interactivity, only demonstrations.	The study's results demonstrate that the thermodynamics interactive multimedia, designed around problem-based learning, serves as an effective support tool in the learning process, leading to the most significant improvement in students' critical thinking disposition.
A5	Problem Structure of the Teaching-Learning Sequence approach was used.	The results of the study show that Problem-Based Learning with the Teaching-Learning Sequence approach is effective in enhancing students' understanding of quantum physics concepts, particularly atomic spectra.

Article code	Integration with Problem-Based Learning	Research Findings
A6	Experimental approach by presenting student with ill-defined physics problem.	Ill-defined problems have significant potential to develop students' critical thinking skills.
A7	Interactive physics e-module based on problems (Probinphys).	Probinphys e-module in Blended-Problem Based Learning significantly improves students' critical thinking skills.
A8	Polya Problem-Solving, Target-Task Collaborative Learning, and conventional methods.	Students become more understanding in physics lessons.
A9	Problem-Based Learning approach with PHET virtual simulations and expository teaching.	The research findings show that the implementation of Problem Based Learning with PHET virtual simulations significantly enhances students' critical thinking skills compared to the expository method.
A10	Augmented Reality-based Problem-Based Learning approach with Pocketbooks and local wisdom, as well as an approach using PPT media and school textbooks.	Students' skills in mathematical and graphical representation on the topic of elasticity have improved.
A11	Problem Based Learning and Content-Based Learning.	The understanding of concepts, learning outcomes, and student skills have improved in Uganda in the physics topic of simple machines.

The ability of students to understand physics concepts in school influences their learning outcomes. When students can grasp physics concepts well, they will be able to solve problems related to these concepts in their daily lives. In other words, they will be able to handle problems effectively [9].

To face the current challenges, it is necessary to have human resources with skills such as collaboration, communication, critical thinking, and problem-solving. Hese skills can be developed through the learning process [19], [20], [21]. Problem-Based Learning (PBL) is an instructional method that can motivate students in the learning process through concrete problem-solving. This approach involves students in the learning process by using problems as stimuli, enabling students to play a key role in it [21].

In Article A1, students view physics as the most challenging subject, with the belief that only students with special abilities can understand its concepts. However, the research conducted shows that Problem-Based Learning (PBL) can improve students' problem-solving skills and performance in physics. This is evidenced by the results of a problem-solving inventory test, where the experimental group using PBL achieved a higher average score increase of 50.25, in contrast to the control group, which achieved an average score of only 38.54 on the post-learning test. [8].

In Article A2, alongside learning outcomes, thinking styles also influence success in the learning process, with critical thinking being one key skill[9]. Critical thinking involves analyzing and evaluating, requiring strong analytical skills to improve it [22]. The Problem-Based Learning (PBL) model supports students in gaining comprehensive knowledge and applying it effectively to solve problems [9], aligning with the view that PBL problems should be relevant and applicable to real-life issues students may encounter in the future [23]. A quasi-experimental research design using a pretest-Posttest method was implemented with control (demonstration method) and experimental (PBL model) groups among 10th-grade high school students in Yogyakarta from 2015 to 2016. The study confirmed that PBL implementation positively impacted students' learning outcomes and critical thinking skills, with the experimental group showing an average score increase of 0.49 compared to 0.34 in the control group [9].

In the research presented in Article A3, various approaches are suggested to align with 21st-century learning. One example is STEM (Science, Technology, Engineering, and Mathematics). STEM is an interdisciplinary approach that combines science, technology, and mathematics [24], [25] aimed at advancing societal knowledge and innovation in technology [26]. The research findings show that Problem-Based Learning-STEM achieved the highest scores in enhancing students' scientific literacy [10].

In Article A4, an interactive multimedia approach is used. Interactive multimedia can enhance students' conceptual understanding and motivate them to learn, as it makes complex concepts easier to comprehend by combining text, video, animation, simulation, sound, and images [27]. Research findings confirm that Problem-Based Learning integrated with interactive multimedia can support the learning process, thereby enhancing students' critical thinking disposition [11].

In Article A5, the approach used is Structured Teaching-Learning. The learning process begins with presenting a problem, after which the teacher guides the students, making them aware that they are dealing with

an important and engaging issue. The teacher then asks the students to consider the steps necessary to solve the problem. In this approach, the teacher and students collaboratively plan the sequence of tackling the problem. This helps students gradually understand the issue at hand, fostering a sense of active involvement in the learning process (Becerra-Labra, Gras-Martí, and Torregrosa [28], [29]. This Structured Teaching-Learning approach has been shown to improve understanding of physics concepts, specifically atomic spectra [12]

In Article A6, an approach using ill-defined physics problems is employed to assess students' critical thinking skills. A total of 276 students from various educational levels in Croatia were asked to solve less specific problems. The results show that using these ill-defined problems encouraged diverse ideas from students regarding their understanding of the issues and potential solutions. This approach also motivated students to think critically [13].

In Article A7, a problem-based interactive physics e-module, or "probinphys e-module," is used. This innovative approach integrates technology into education, particularly through blended learning [30]. The probinphys e-module is designed with a Blended Problem Based Learning model, combining face-to-face and online sessions. The problems presented to students are highly complex, real-life, and unstructured, aimed at enhancing students' thinking skills [31], [32]. Research conducted at Senior High School 1 Singajaya demonstrates that this approach significantly improves students' critical thinking skills in physics [14].

In Article A8, the Polya Problem Solving integrated with Target Task Collaborative learning, emphasizing group work and collaboration among students to solve physics problems. The study results indicate that the Polya Problem Solving approach combined with Target Task Collaborative learning, which prioritizes student collaboration and active involvement, effectively improves academic performance among lower-achieving students. This approach encourages interaction and discussion, enabling higher-ability students to assist their peers within the group [15].

In Article A9, it is emphasized that integrating various technologies is essential to adjust to students' learning needs [33] The key to fulfilling these needs is not just the delivery of content, but the management of engaging, motivating, and enjoyable learning experiences [34]. One activity to achieve this is integrating Problem-Based Learning with PHET virtual simulations, which can be accessed through mobile applications [16]. PHET is an online laboratory-based learning medium used to create simulations of physical phenomena [35], making complex concepts easier to understand [36]. The research shows that utilizing PHET virtual simulations significantly enhances critical thinking skills [16].

In Article A10, a new discovery is highlighted with the use of Augmented Reality (AR), which has become increasingly popular in education. AR can transform two-dimensional objects into three-dimensional ones, making them appear more realistic, which helps in explaining complex physics concepts such as material elasticity. The goal is to present physics lessons in the most engaging way to aid in understanding difficult concepts. In this study, Augmented Reality (AR) is combined with local cultural elements, such as the traditional game of *ketepel*, to motivate students and make it easier for them to grasp the concept of elasticity. Through this approach, students are expected to develop their mathematic and graphic visualization skills in physics lessons [17].

In Article A11, the study compares Problem Based Learning (PBL) with Content Based Learning (CBL). In CBL, instruction is more teacher-centered, focusing on content delivery, which often becomes monotonous for students as they passively receive information without active engagement [37]. The study in Article A11 used a sample of 829 students from eight secondary schools in Sheema District, Uganda. These students were divided into two groups, with one group learning through Problem-Based Learning and the other through Content-Based Learning. Student learning outcomes improved, as evidenced by an average score of 57.53 in the Problem-Based Learning group and 51.57 in the Content-Based Learning group [18].

IV. CONCLUSION

Problem-based learning is an approach that requires students to conduct research on a problem through procedures such as presenting students with a problem, grouping them, investigating the issue to find a solution, presenting the research findings, and reflecting on the results [38]. This model emphasizes student-centered learning, where students are expected to actively seek information and decide what they need to learn to support their learning process [9]. Various approaches can be combined Problem-Based Learning, such as the use of STEM, interactive digital media, the Structure of the Teaching-Learning Sequence, ill-defined physics problems, interactive physics e-modules, PHET virtual simulations, Augmented Reality, and other tools that enhance the learning process.

Based on the analysis conducted, Problem-Based Learning has a significant impact on conceptual understanding, especially in physics. Additionally, Problem-Based Learning modules help improve 21st-century skills, including critical thinking and problem-solving abilities.

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Volcanoes and Earthquakes Flipbook: Enhancing Students' Critical Thinking Skills Through Education for Sustainable Development (ESD)-Based Teaching Material

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***Abstract*—Critical thinking skills are essential competencies for students to develop in order to succeed in the 21st century. This study aimed to evaluate the effectiveness of an Education for Sustainable Development (ESD)-based flipbook in enhancing the students' critical thinking skills during lessons on volcanic and seismic activity. A quantitative quasi-experimental design was employed, involving a control group (n = 21) and an experimental group (n = 27). The instruments used included critical thinking test items and a student response questionnaire. The results demonstrated a significant improvement in the experimental group, with a mean post-test score of 78.83% (categorized as good) compared to 63.49% (categorized as adequate) in the control group. An independent sample t-test revealed a p-value of 0.001 (< 0.05), indicating statistically significant differences between the two groups. The experimental group's N-Gain score of 0.72 was categorized as high effectiveness, while the control group's N-Gain score of 0.50 was classified as medium effectiveness. Furthermore, 88.2% of students in the experimental group reported positive responses to learning with the ESD-based flipbook. These findings suggest that the use of ESD-based flipbooks significantly enhances critical thinking skills and fosters greater engagement in science education.**

Keywords—critical thinking, volcano and earthquake flipbook, education for sustainable development

I. INTRODUCTION

Education is a process that shapes the character, habits, and skills of individuals through teaching and learning activities. Its primary aim is to prepare students for life within society. In 21st-century education, four fundamental skills have been recognized: critical thinking, collaboration, communication, and creativity, often referred to as the 4Cs. Among these, critical thinking is crucial as it equips students to effectively solve complex challenges. Plethora of research highlights the importance of developing and training critical thinking skills [1][2][3].

Science is a discipline that requires critical thinking, using a systematic and structured methodology to explore natural phenomena. Topics in science such as volcanoes and earthquakes are important concepts that need to be mastered, although their abstract and unobservable nature often leads to low student engagement and understanding [4][5]. Nonetheless, understanding these topics is crucial due to their relevance to society [6][7]. Garut, for example, is geographically important due to the presence of active volcanoes such as Mount Papandayan and its proximity to the Australian plate, which poses earthquake risks [8].

Students' critical thinking skills remain notably low. Research indicates that many students still struggle with critical thinking [2][4][9]. One contributing factor is the lack of diversity in learning resources, which leads to lower student engagement and reduced interest in science learning, ultimately resulting in suboptimal learning outcomes [9].

Reference [10] found that students show greater interest in teaching materials that incorporate text, images, and animations in digital formats. This challenge can be addressed through the use of electronic based teaching materials, such as flipbooks. Flipbooks can be effectively integrated with Education for Sustainable Development (ESD), which fosters critical thinking by enabling students to make informed decisions and take responsible actions [11] [12]. ESD encourages students to engage with real-world problems, such as environmental degradation and social inequality. This engagement requires them to analyze complex situations, weigh different perspectives, and develop informed solutions [13]. ESD also promotes higher-order thinking skills by challenging students to not only absorb information but also to question its validity and relevance [14].

Implementing ESD-based resources is expected to enhance students' critical thinking skills. This study, therefore, applied an ESD-integrated flipbook on

volcanoes and earthquakes to improve the critical thinking skills of students.

II. METHOD

This study employs a quantitative research methodology with experimental techniques to examine the impact of independent variables (treatment) on dependent variables (outcomes). The research design selected is a quasi-experimental design, as random sampling is not feasible. Specifically, two classes will be utilized: Class VII-A as the experimental group, which will be exposed to a flipbook based on ESD, and Class VII-D as the control group, which will use textbooks not grounded in ESD principles.

Both groups will undergo a pretest prior to the intervention and a posttest following the treatment. The study adopts a non-equivalent control group design, as the two groups are not randomly assigned but are selected based on existing class structures. The sampling technique used is non-probability sampling, specifically purposive sampling, where students from Class VII at a school in Garut Regency will serve as the research population. The inclusion criterion for both groups is that they have not previously studied the topic of volcanoes and earthquakes.

Data will be collected through a pretest-posttest descriptive question instrument to assess improvements in students' critical thinking skills. Additionally, a student questionnaire will be administered to evaluate their perceptions of learning with a flipbook based on ESD.

III. RESULTS AND DISCUSSION

The results of this study were derived from pretest-posttest scores obtained from both the control group, which used textbooks, and the experimental group, which used an ESD-based flipbook. Additionally, the study includes a questionnaire assessing the experimental group students' responses to learning with a flipbook grounded in ESD. The pretest-posttest design was employed to measure the improvement in students' critical thinking skills.

Both the experimental group, which utilized an ESD-based flipbook, and the control group, which used conventional textbooks, completed essay questions before and after the intervention. The pretest and posttest scores were subsequently analyzed to identify any significant differences in the students' critical thinking skills. A summary of the pretest and posttest data, including the calculation of students' critical thinking skills, is presented in Table 1.

TABEL 1. STUDENTS' CRITICAL THINKING SKILLS IN THE EXPERIMENTAL AND CONTROL GROUPS

Group	Test	Average		Category
		Score	*Percentage (%)*	
Control	Pretest	11.05	26.30	Poor
	Posttest	26.67	63.49	Adequate
Experiment	Pretest	11.33	26.98	Very poor
	Posttest	33.11	78.83	Good

Based on the data presented in Table 1, the initial critical thinking skills of students in the experimental group, which utilized an ESD-based flipbook, showed an average score of 26.98%. After the intervention, the posttest results indicated a significant improvement, with the average score rising to 78.83%. In contrast, the control group, which used conventional textbooks, exhibited an initial average score of 26.30% on the pretest, and a posttest score of 63.49%. These results suggest a notable difference in the improvement of critical thinking skills between the experimental and control groups before and after the treatment.

Flipbooks, as digital textbooks, are electronic versions of traditional textbooks designed for educational purposes and can be accessed on various devices. They combine data, text, sound, and various types of images in a digital format, offering an alternative medium to enhance science education [15]. Flipbook has several advantages, such as integrating text, images, animations, and videos, alongside interactive tools and connections. These features support the development of students' critical thinking skills by enabling them to engage, navigate, and communicate effectively [3].

Critical thinking skills are composed of five key aspects: providing basic clarification, developing basic support, making inference, offering advanced clarifications, and formulating strategy and tactics. A summary of the results for each aspect of students' critical thinking skills is presented in Table 2.

TABEL 2. STUDENTS' CRITICAL THINKING SKILLS IN EACH ASPECT, PRESENTED AS PERCENTAGES

Critical Thinking Skills	Control Group		Category	Experiment Group		Category
	Pretest	*Posttest*		*Pretest*	*Posttest*	
Basic clarification	22.22	54.94	Poor	23.46	89.51	Very good
Basic support	33.52	61.37	Adequate	43.41	80.04	Good
Inference	14.81	32.10	Very poor	28.39	67.90	Adequate
Advanced clarifications	15.43	51.23	Poor	18.10	81.07	Good
Strategy and tactics	14.20	31.48	Very poor	69.75	69.75	Adequate

Based on the data presented in Table 2, the results indicate the following: First, in terms of providing basic clarification, the control group showed a lack of proficiency, whereas the experimental group performed very well. Second, in terms of developing basic support, the control group demonstrated a moderate level of proficiency, while the experimental group performed well. Third, regarding making inference, the control group showed significant deficiencies, while the experimental group performed

at a moderate level. Fourth, in the aspect of providing advanced calrifications, the control group exhibited a lack of proficiency, while the experimental group showed good performance. Finally, in terms of organizing strategy and tactics, the control group displayed significant deficiencies, while the experimental group performed at a moderate level.

The data in Table 2 also provide evidence of improvements in students' critical thinking skills, both overall and across individual aspects of critical thinking, for both the control and experimental groups. However, the control group showed limited improvement across the various aspects: providing basic clarification remained below expectations, developing basic support improved moderately, making inference was particularly deficient, providing advanced clarifications showed only slight improvement, and organizing strategy and tactics also remained weak. In contrast, the experimental group demonstrated more pronounced improvements: providing basic clarification was rated as very good, developing basic support was good, making inference was very good, providing advanced clarifications was good, and organizing strategy and tactics was rated as moderately good.

The increase in students' critical thinking skills can be attributed to the use of a flipbook based on ESD, which provided students with reflective practices where students assess their learning experiences and the impact of their decisions on sustainability. This reflection helps deepen their understanding of the subject matter and cultivates a habit of questioning assumptions, which is fundamental to critical thinking development [16]. Additionally, the integration of interactive features in flipbook, such as video barcodes and evaluations, made the learning process more engaging, allowing students to better grasp the material. The use of flipbooks significantly improves student learning outcomes, helping students better understand lesson content and mitigate boredom [17].

To quantify the improvement in students' critical thinking skills, the Gain formula was applied to the pretest and posttest results from both the control group (using textbooks) and the experimental group (using an ESD-based flipbook). To assess the effectiveness of an ESD-based flipbook in improving critical thinking skills, the Normalized Gain (N-Gain) formula was used. The results of these calculations, along with the differences in improvement between the groups, are summarized in Table 3.

TABEL 3. IMPROVEMENT OF CRITICAL THINKING SKILLS AND THE EFFECTIVENESS (N-GAIN) OF USING ESD-BASED FLIPBOOKS

Group	Score		N-Gain	Category
	Pretest	*Posttest*		
Control	11.05	26.67	0.50	Medium
Experiment	11.33	33.11	0.72	High

Table 3 reveals the effectiveness of using an ESD-based flipbook in science education, with an N-Gain value of 0.50, which falls within the medium effectiveness range. In comparison, the use of textbooks in the control group had a higher N-Gain value of 0.72, indicating high effectiveness. However, the results suggest that ESD-based flipbooks are more effective in enhancing students' critical thinking skills compared to traditional textbooks. Overall, both the control and experimental groups experienced improvements in critical thinking skills, with the experimental group showing a more pronounced increase. This supports the conclusion that ESD-based flipbooks offer distinct advantages over conventional science textbooks.

These findings align with previous studies, which highlight flipbooks as an innovative tool that leverages interactive digital e-books to strengthen students' logical and critical thinking skills [17][18][19]. Additionally, flipbooks enhance the teaching and learning process by incorporating videos, images, animations, and audio, making learning more interactive and engaging, thus fostering the development of critical thinking skills [8][9].

In addition to the use of flipbooks, the integration of ESD also plays a pivotal role in enhancing students' critical thinking skills. Through ESD, students are encouraged to apply critical thinking when formulating problems related to the topics of volcanoes and earthquakes, analyzing the social, economic, and environmental impacts of these disasters, and devising alternative solutions to mitigate or avoid these impacts [20]. ESD enhances student competence by fostering critical thinking, problem-solving, communication skills, teamwork, conflict management, and organizational abilities [21]. Consequently, the use of ESD-based flipbooks significantly contributes to the development of critical thinking skills, as students analyze the interplay between the material they study and its real-world implications, particularly in the context of environmental, social, and economic dimensions.

During lessons using an ESD-based flipbook, students are presented with real-world phenomena, such as natural disasters, that encourage them to analyze the causes, effects, and potential solutions related to these events. This problem-solving approach, embedded in the ESD-based flipbooks, effectively trains students' critical thinking skills, as evidenced by the research of [5] who emphasize the importance of problem-solving, decision-making, and assumption evaluation in the development of critical thinking.

In addition to the academic performance data, student responses to the use of an ESD-based flipbook were collected through a questionnaire distributed to students in the experimental group. The questionnaire aimed to assess students' perceptions of learning with an ESD-based flipbook on the topics of volcanoes and earthquakes. The questionnaire included 10 indicators related to the integration of ESD-based flipbooks into student learning. The results showed that students

found the flipbook to be accessible from anywhere, engaging, and helpful in understanding the material. Students also reported that the flipbook increased their interest in the subject, made learning more enjoyable, and encouraged active participation in the learning process. The detailed results of the student response questionnaire are presented in Table 4.

TABEL 4. QUESTIONNAIRE DATA RESULTS PRESENTED AS PERCENTAGES

No.	Item	Response	Category
1.	Accessible and easy to use in various educational settings.	88	Strongly agree
2.	The design is engaging and attractive.	90	Strongly agree
3.	Includes images that help understand concepts.	92	Strongly agree
4.	Includes learning videos that help understand the content better.	87	Strongly agree
5.	Enhances the learning experience.	89	Strongly agree
6.	Stimulates interest in learning.	90	Strongly agree
7.	Fosters the development of critical thinking skills.	86	Strongly agree
8.	Promotes greater student engagement in the learning process.	86	Strongly agree
9.	An innovative tool for improving the learning experience.	82	Strongly agree
10.	Enhances the quality and effectiveness of learning activities.	92	Strongly agree
Average		88.2	Strongly agree

The results of the student response questionnaire, presented in Table 4, indicate that learning with an ESD-based flipbook was met with a strongly agree respons from the students. This feedback aligns with the pretest-posttest data, suggesting that students not only demonstrated measurable improvements in critical thinking but also felt a significant difference in their learning experience when comparing the use of textbooks to the use of ESD-based flipbooks.

Flipbooks are designed to be engaging and visually appealing, thereby increasing student involvement, enthusiasm, and interest in learning activities. These types of teaching materials help students understand lesson content by providing real-world examples [3] [22]. Additionally, [23] highlighted that flipbooks utilize a variety of multimedia elements—including text, images, animations, videos, and background music—to create an interactive and enjoyable learning experience. This is particularly important in the context of 21st-century education, where students are expected to be comfortable with a range of technological tools for learning. These results further emphasize the effectiveness and appeal of ESD-based flipbooks in fostering a more engaging and stimulating learning environment for students.

IV. CONCLUSION

Based on the results of this study on the impact of ESD-based flipbooks on students' critical thinking skills, it can be concluded that the integration of ESD-based flipbooks significantly enhances students' critical thinking abilities, both overall and across individual aspects of critical thinking. This conclusion is supported by the post-test results, which indicate that the experimental group, utilizing ESD-based flipbooks, outperformed the control group, which only used traditional textbooks. Furthermore, the ESD-based flipbooks demonstrated high effectiveness in improving students' critical thinking skills in science education, as evidenced by an N-Gain value of 0.72, categorizing the effect as high effectiveness.

Student responses to the use of ESD-based flipbooks were overwhelmingly positive, with an average student response rate of 88.2%. This positive feedback can be attributed to the ease of use of the ESD-based flipbooks, which are accessible anywhere, and the engaging features they offer, including multimedia elements that contribute to the development of students' critical thinking skills.

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The Role of Muslim Scientists in Enhancing Students Interest and Religious Values in Physics Learning

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***Abstract*— Learning interest and religious values are essential components in meaningful and holistic physics education. However, a primary challenge in teaching physics lies in students' low interest in the subject, often due to perceptions that physics is difficult and abstract. An innovative approach that integrates the roles of Muslim scientists, such as Ibn al-Haytham, Al-Khwarizmi, and Al-Biruni, into physics education can effectively enhance students' motivation and understanding. This article explores how the contributions of Muslim scientists in science can inspire students by presenting role models relevant to their religious identity while demonstrating that science and religious values can coexist. Using a literature review method, this study finds that integrating religious values into physics learning not only improves students' interest but also fosters deeper moral awareness. Embedding religious values in physics education allows students to connect scientific concepts with the greatness of God's creation, motivating them to learn with a balanced scientific and spiritual enthusiasm. This study recommends developing field studies to evaluate the effectiveness of learning strategies that include historical case studies of Muslim scientists, reflective discussions, and value-based projects to create a more meaningful and relevant physics learning experience in the modern context.**

Keywords— integration, science, Islam, history of physics, learning interest, religious values

I. INTRODUCTION

Student interest in learning is an essential factor in achieving meaningful physics education. Internal factors influencing student learning outcomes include interest and motivation [1]. Intrinsic interest and motivation in physics encourage active student engagement in the learning process, enabling them to understand concepts deeply and contextualize them effectively. Empirical studies show that strong learning interest significantly contributes to students' conceptual understanding and critical thinking skills in physics [2]. Thus, developing teaching strategies that enhance student interest is vital for achieving optimal learning outcomes and establishing a robust foundation for applying physics in broader contexts.

The integration of religious values is also a critical factor in meaningful education, as it shapes students' positive character and morality in an educational context. Incorporating religious values into physics learning can increase students' awareness of their responsibilities toward nature, encouraging them not only to understand theoretical physics concepts but also to apply them with ethics and integrity. Embedding religious values in the science curriculum significantly contributes to improving students' motivation and conceptual understanding [3]. Therefore, incorporating religious values into teaching not only enriches the curriculum but also creates a more holistic and meaningful learning experience.

However, teaching physics often faces significant challenges, particularly students' low interest in the subject. This lack of interest results in inadequate understanding and skills in physics. Students often perceive physics as an abstract subject, leading to low engagement and disappointing learning outcomes [4]. Factors contributing to this low interest include students' perceptions of physics as a challenging subject and unengaging teaching methods.

Furthermore, physics teaching has frequently not integrated religious values, missing the potential to cultivate students' moral and spiritual character through scientific understanding of the universe. Character education's role in embedding spiritual, moral, and ethical values cannot be overlooked in today's global era [5]. Integrating religious values through character education can be incorporated into all subjects, including physics [6].

To enhance students' interest in learning and their religious values, educational strategies are needed to connect physics concepts with elements that are relevant and engaging for students. Physics teaching requires systematic approaches [7]. One promising approach is integrating the roles of Muslim scientists into physics education. The scientific advancements in the West were significantly influenced by the progress achieved in the Islamic world [8]. Muslim scientists like Ibn al-Haytham, known for his contributions to optics, Al-Biruni for mechanics and astronomy, and Jabir Ibn Hayyan for physical chemistry, are examples of figures

who can inspire students through their remarkable scientific achievements [9]. Highlighting their roles not only helps students understand the historical contributions of Muslims to science but also fosters a sense of pride and religious values that can strengthen their motivation to learn.

Integrating religious values into physics learning offers a holistic approach that combines cognitive and affective aspects. Teaching physics becomes not merely about concepts and formulas but also about instilling the awareness that science is a means to understand the greatness of God's creation. By studying the roles of Muslim scientists in physics, students are encouraged to appreciate how science can align with faith. This approach has the potential to develop students' character, making them academically proficient and grounded in ethics and religious values.

This study aims to explore how integrating the roles of Muslim scientists in physics learning can increase students' interest and nurture their religious values. It is expected that the findings of this study will provide a solid foundation for developing relevant integrative teaching strategies in the modern era, inspiring the younger generation through the contributions of Muslim scientists to explore their potential by studying physics in a more meaningful framework.

II. METHOD

This article employs a literature review method, focusing on collecting and analyzing data from various relevant sources such as books, scientific journals, and classical works of Muslim scientists to examine their roles in physics education and their impact on enhancing students' interest and nurturing their religious values. This method was chosen as it allows researchers to gather and analyze a wide range of relevant literature to gain a comprehensive understanding of the studied topic [10].

III. RESULTS AND DISCUSSION

The Role of Learning Interest and Religious Values in Physics Education

High learning interest and the reinforcement of religious values play a vital role in physics education, particularly in shaping students' character and scientific understanding. Strong learning interest motivates students to actively participate in the learning process, enhancing their critical thinking skills and creativity in comprehending complex physics concepts [11]. Additionally, integrating religious values in physics education provides a robust moral and ethical framework, guiding students to understand that science is not merely a tool for solving technical problems but also a means of drawing closer to the Creator and appreciating the universe's beauty. These religious values foster students' awareness of using knowledge wisely and responsibly [12]. Developing students' learning interest and religious values in physics education not only has the potential to improve academic performance but also builds a generation with moral integrity, capable of facing global challenges with ethical and sustainable perspectives.

Contributions of Muslim Scientists to the Development of Physics

Muslim scientists like Ibn al-Haytham, Al-Khwarizmi, Al-Biruni, and Nasir al-Din al-Tusi significantly contributed to the development of science, especially physics, with their experimental approaches and foundational theories that influenced modern science. Ibn al-Haytham, through Kitab al-Manazir, laid the foundation for optics and the scientific method [13], while Al-Khwarizmi introduced algebra, an essential tool in physics calculations [14]. Al-Biruni conducted precise measurements of Earth's radius and developed theories on planetary rotation [15], and Nasir al-Din al-Tusi advanced the Tusi Couple, which influenced heliocentric theories [16]. Their works, translated into Latin, became critical foundations for the development of Western science and enriched the understanding of nature through accurate empirical methods.

Historical Connections in Physics Education: Inspiring Motivation

The contributions of Muslim scientists to science provide students with a strong historical connection to physics education. When students realize that scientists from the same religious background as theirs made significant discoveries, they feel a deeper sense of pride and enthusiasm for physics. This realization creates intrinsic motivation by presenting tangible examples of success relevant to their identity, fostering the belief that they too can contribute to science. This historical understanding not only increases students' interest in learning but also inspires them to emulate the scientific spirit and actively participate in continuing the rich intellectual legacy [17].

The Role of Muslim Scientists in Enhancing Religious Values

The role of Muslim scientists in enhancing religious values focuses on their contributions in linking science with spiritual beliefs, inspiring students to associate science with religious values. Figures like Ibn al-Haytham, Al-Khwarizmi, and Al-Biruni pursued science with the view that knowledge is a means of understanding God's greatness, making scientific endeavors a form of worship and appreciation of His creation [18]. By studying their dedication and contributions, students gain not only deeper scientific understanding but also develop religious values, such as

awareness of God's greatness, gratitude, and moral responsibility in applying knowledge constructively.

Transforming Students' Perception of Physics Through Religious Integration

The achievements of Muslim scientists help transform students' perception of physics from being merely abstract to being closely connected with religious values and Islamic history. By observing how these scientists pursued knowledge within the frameworks of ethics, spirituality, and a noble purpose to understand God's creation, students can associate physics with moral and religious principles. This integration eliminates the perception of science and religion as separate entities. Instead, it demonstrates that science can be a means of drawing closer to God and appreciating the marvels of the universe [19]. Consequently, students not only acquire scientific knowledge but also view physics as a path to holistic self-development, enriching both their intellect and spirituality.

Introducing Muslim Scientists to Reshape Students' Views on Physics

Introducing Muslim scientists in physics reshapes students' views, making physics more relatable and inspiring. Students no longer see physics as a challenging and abstract subject but as a cultural heritage rooted in Islamic history and imbued with religious values. Recognizing that physics can be used to understand God's creation and improve lives [20], students feel more emotionally connected and motivated, perceiving physics as a meaningful and beneficial discipline.

Embedding Religious Values to Enhance Learning Motivation

Embedding religious values in physics education enhances student motivation by giving spiritual meaning to academic pursuits. When students perceive physics as a way to understand God's greatness, their intrinsic motivation grows, turning learning into a meaningful act of worship. Additionally, understanding that knowledge can be used for social and environmental good deepens their commitment, aligning academic goals with moral missions [21]. This correlation demonstrates that spiritual development through religious values strengthens students' motivation to learn physics more deeply and sustainably.

The Emotional Engagement Fostered by the Legacy of Muslim Scientists

The exemplary contributions of Muslim scientists foster emotional engagement in students by instilling a sense of pride in Islamic history within science [22]. This pride creates an emotional bond that deepens their interest, making them feel more connected to physics as part of their cultural and intellectual heritage. Learning motivation increases as students begin to see physics as a way to continue a proud scientific tradition, inspiring them to study diligently and draw inspiration from the roles of Muslim scientists in exploring natural phenomena. This underscores that when students are introduced to Muslim scientists, they not only learn physics but also understand how faith-driven work ethics influence scientific advancements. This inspires students to see science as part of their religious understanding, enhancing their interest and appreciation of science alongside stronger spiritual values [23].

Integrating Religious Values in the Physics Curriculum

Integrating the history of Muslim scientists into physics lessons significantly contributes to enhancing students' religious values. By introducing Muslim scientists, students are encouraged to understand that science and religion harmoniously coexist within Islamic civilization. Muslim scientists not only pursued knowledge for scientific progress but also to draw closer to Allah and comprehend His greatness through the marvels of nature [24]. This approach teaches students that mastering physics is inseparable from spiritual goals, such as recognizing the signs of the Creator's greatness. When students realize that the physics studied by these figures was part of an effort to understand God's creation, they are motivated to see physics as a means of increasing faith and devotion. Additionally, values like perseverance, honesty in research, and moral responsibility in applying knowledge also become relevant examples in shaping students' religious character [25].

Educational Strategies for Science-Religion Integration

Teaching that integrates science and religion (Islam) provides more meaningful contexts for students by demonstrating that scientific knowledge is inseparable from spiritual and moral values. This perspective redefines science as not merely technical knowledge but as a means of understanding the signs of God's greatness in His creation. This helps students see the relevance of science lessons in their lives, increasing their motivation to learn while fostering reflective and ethical attitudes in applying knowledge [26].

Integrating religious values into the physics curriculum can be realized by including the history of Muslim scientists and the concept of scientific ethics within the Islamic context. The curriculum can be designed so that physics phenomena are understood not only scientifically but also in relation to religious

concepts, such as marveling at the order of nature as an appreciation of God's creation.

Educational practices that integrate religious values and science can be implemented through several relevant strategies. First, teachers can use case studies of Muslim scientists like Ibn al-Haytham, illustrating how scientific knowledge aligns with Islamic values. This approach introduces not only physics concepts but also inspiring examples of integrating science with spirituality [27]. Second, reflective discussions can encourage students to contemplate how the natural laws studied in science reflect God's greatness, thereby strengthening their understanding of monotheism. Third, project-based learning that connects physics applications to daily life and religious values can be implemented, such as exploring natural phenomena as signs of Allah's power.

These strategies aim to create meaningful learning experiences, foster deeper interest in science, and strengthen students' religious values. Reflection sessions and discussions after studying specific physics concepts are also essential to enable students to connect scientific understanding with ethics and spirituality, reinforcing religious values while deepening their motivation to study science.

Challenges and Future Research Opportunities

An integrative approach that connects physics with religious values holds significant potential to enhance students' learning motivation, deepen conceptual understanding, and strengthen religious character. By understanding physics as a discipline with academic, spiritual, and social significance, students perceive learning as a holistic and relevant experience. However, implementing this approach faces several significant challenges, including limited comprehensive teaching materials, difficulties in measuring the attainment of religious values, and the diverse backgrounds of students that necessitate an inclusive approach. Additionally, teachers require specialized training to effectively integrate religious values without diminishing the scientific substance of physics, ensuring that the learning process maintains the accuracy and depth of scientific content.

Opportunities for further research in integrating religious values and science offer a wide scope for exploration, particularly in the areas of educational psychology and the impact of religiosity on science learning. More in-depth studies can be conducted to understand how religious values integrated into physics lessons influence intrinsic motivation, learning interest, and students' perceptions of the relevance of science in their lives. Research recommendations include developing experimental or field studies to evaluate the effectiveness of teaching approaches that incorporate the contributions of Muslim scientists in enhancing students' learning interest and religious values. Such studies can provide empirical evidence of the relationship between teaching the history of Muslim scientists and the formation of religious character, as well as help identify the most effective pedagogical approaches for integrating religious dimensions without compromising the scientific rigor of physics.

IV. CONCLUSION

This study demonstrates that integrating the roles of Muslim scientists into physics education can enhance students' learning interest and religious values. By teaching the historical contributions of Muslim scientists, students not only gain physics knowledge but are also inspired to emulate their scientific spirit within a religious context. This approach enables students to view physics as a discipline that is intertwined with spiritual values, linking scientific understanding to the belief that science serves as a means to comprehend the greatness of God's creation. Integrating religious values into physics education provides students with a holistic and meaningful learning experience.

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Design and Impact of Local Wisdom-Based STEM Modules in Indonesia: A Literature Review

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Abstract*—This study aims to review various designs of *STEM-based learning modules integrated with local wisdom in Indonesia and to evaluate their impact on students' skills and understanding. This research uses a literature review approach with four main stages: determining the study topic, searching and selecting literature, analyzing and synthesizing literature, and organizing the analysis results. The literature review findings show that the design of STEM modules based on local wisdom leverages local cultural contexts as an integrated part of presenting science materials. The local wisdom incorporated in the modules includes traditional musical instruments, agricultural activities, and local building structures. Furthermore, the literature review results indicate that the use of modules based on local wisdom can enhance various student skills, such as critical thinking, science literacy, and communication. Additionally, these modules help build relevance between the science concepts learned and local wisdom, as well as increase students' appreciation and love for local cultural heritage. The positive impact of these modules suggests that STEM modules based on local wisdom can improve the quality of science learning relevant to the local cultural context of students.

Keywords—Module, STEM, local wisdom, science learning

I. INTRODUCTION

Learning Natural Sciences (IPA) has an important role in improving students' understanding of scientific concepts related to nature and the surrounding environment. [1][2]. Science learning aims to teach students how to understand and explain various natural phenomena using a systematic approach and based on scientific evidence. In the process of learning science, students are trained to develop and apply scientific methods that involve the process of observation, investigation, independent search, and drawing conclusions from various investigative processes.

Science learning not only trains 21st century skills, but also builds oriented to the development of scientific attitudes, curiosity, and openness to change. [3]. This is very important so that students are not only fixated on ideas that they already know, but also want to learn and solve real-world problems. Science learning that is related to everyday life is expected to make students more sensitive to environmental problems and have the ability to think scientifically in facing future challenges. One way to link science learning with everyday life can be done by developing modules that are more contextual.

Learning modules are teaching tools that are systematically designed to support the teaching and learning process and are organized in the form of self-study materials. [4]. This module presents the subject matter coherently, complete with learning objectives, learning activities, and evaluations designed to help students understand the material and become more involved. In science learning, learning modules have a role in helping students understand scientific condopts in a more structured way [5]. The use of modules can make science material described in more detail, ranging from basic concepts to applications in everyday life. In its development, modules in science learning are modified in various aspects including through the integration of STEM approaches and local wisdom, or known as STEM modules based on local wisdom. The use of STEM modules based on local wisdom in science learning makes students not only gain scientific knowledge but also learn to link scientific ideas with the values and culture that exist in the surrounding environment. [6]. Furthermore, local wisdom-based modules encourage students to see natural phenomena and science from a more contextualized perspective that can make science learning more meaningful.

Several studies have shown that the implementation of local wisdom-based STEM learning modules in schools has different design characteristics, with various challenges and obstacles. [7][8]. These

challenges include teachers' readiness to understand and implement the module, the availability of adequate supporting facilities, and teachers' and students' understanding of local wisdom values found in their respective regions. These three aspects often become obstacles in maximizing the effectiveness of STEM learning that is relevant to the local culture and environment. Furthermore, the characteristics of different modules with diverse local wisdom are also an interesting part of local wisdom-based STEM modules that need to be studied systematically.

Based on some of these studies, it shows that STEM modules based on local wisdom in Indonesia have diversity in design, local wisdom characteristics, and challenges. Thus, it is necessary to review the literature to obtain a picture of the design of STEM modules based on local wisdom that can be used in science learning. Therefore, this study focuses on examining the design of STEM modules based on local wisdom in Indonesia, as well as the impact of using STEM modules based on local wisdom on science learning.

II. METHOD

This research uses a literature study through four main stages, namely determining the topic, theme, and focus of the study, searching and selecting relevant literature, analyzing and synthesizing the literature, and organizing the results of the analysis in the form of literature study findings. [9]. The topic chosen in this study focuses on the design of local wisdom-based STEM modules and their impact in science learning. The article search process uses various sources, such as google scholar, springer, and various other journal accesses that have relevance to the theme. The articles that have been collected are selected to ensure that the articles analyzed have good credibility. The selection was based on the year of publication, relevance to topics related to local wisdom-based STEM modules, and completeness of journal identification. The analysis and synthesis process was carried out using an analysis table matrix consisting of title, author's name, year, and analysis results in the form of design and impact of local wisdom-based STEM modules. In the final stage, the results of the analysis and synthesis were organized in the form of writing.

III. RESULTS AND DISCUSSION

In this section, the results of the literature study on STEM Module Design based on Local Wisdom in Indonesia and its impact on science learning are presented. The discussion consists of two main parts, namely a discussion of the form of STEM Module Design based on local wisdom that tries to describe various forms of STEM modules based on local wisdom. The second part describes the results of the study on the impact or results of using STEM Modules based on local wisdom on science learning.

Design form of STEM module based on Local Wisdom

Based on the literature review on ten articles that have been determined ccording to the topic, a description of the design of STEM modules based on local wisdom is obtained. The diversity of this module design is determined by he module development procces, differences in local wisdom, and the procces of use in learning. The following Table 1 describes the design of local wisdom-based STEM modules that science learning procces

Table 1. Local Wisdom-based STEM Module Design and Impact on Science Learning

Module name	Module design	Local Wisdom	Impact/ Outcome
[10]	Modern bioteknologi module	Manggo Cultivation	This module received very positive student responses, so this module is considered effective and can be used as an interesting and useful teaching material.
[11]	Teksbooks and worksheet	Traditional Musical Instruments	This module received positive responses from students, namely 78.83% in the small class test (good criteria) and 83.00% in the limited class test (very good criteria).
[12]	STEM module in motion material	Local Wisdom Gitar	Improved students' science literacy, with the highest improvement in the ability to interpret scientific data and evidence **(1.68)**. Overall, the improvement of students' science literacy was in the **moderate category**. So, this module is quite effective in helping students understand science concepts in a real context.
[8]	STEM module with	Beduk Instrumen	Students' creative thinking

	with Beduk Local Wisdom		skills improved significantly with an N-gain of 0.92, which was categorized as high.
[13]	Canva-assisted module	Gondang Sambilan Instrument	The Ethno-STEM-based e-module assisted by Canva and integrated with traditional musical instrument Gordang Sambilan provided a significant increase in students' communication skills in physics learning with a score of 83.11%. This E-Module was rated highly valid with a score of 89%, and its practicality scored 88.27%.
[14]	STEM module with picture illustrations	Palembang Limas House	This module supports mathematics learning on flat building materials in elementary schools and is designed with picture illustrations and concise but clear material, aiming to attract students' attention, foster learning motivation, and facilitate understanding of flat building materials.
[15]	Development of STEM-based Physics learning tools	**Timba Laor** coastal communities Maluku	This learning tool, which was developed using the **Plomp** model. The final product of this research is a **STEM-based physics learning tool** integrated with Timba Laor local wisdom, which successfully improves students' understanding of physics through a contextual approach and local culture.
[16]	*Guided inquiry-based teaching e-modules*	Batik craftssmen Kudus	Improve students' critical thinking skills in chemistry, and students gave a positive response to this e-module with a score of 85%,
[17]	Digital Microscope Module	Borneo forest (leaves)	Improve science process skills in all aspects of KPS with presentations between 31.25%-64.58%.
[18]	Modules as thematic teaching materials	Sago seeding, birds of paradise and Kaswari birds typical of Merauke	This teaching material is suitable to be applied in the learning process, because it improves student learning outcomes.

Based on the literature review on ten scientific articles that have the topic of STEMmodules integrated with the local wisdom, it shows that there are various forms ofmodules designed to stregthen students' understanding through cultural approaches and local contexts. These modules incorporate aspects of Indonesian local wisdom to facilitate more relevant and engaging elearning for students. For example, a biotechnology module integrates teh culture of Manggo Cultivation as a scientific context. [10]. Furthermore, the analysis shows that there are modules that link physics lessons with traditional musical instruments [11], such as Guitar [12], Beduk [8], and Gondang Sambilan [13]. This shows that physics modules can be more interesting through the integration of local wisdom in the form of traditional musical instruments from various regions in Indonesia.

The module design will make students more interested in physics concepts. In addition, there are also STEM modules that discuss physics concepts that use the local wisdom of Timba Laor as a tradition that is integrated in the module [15]. The use of STEM modules integrated with various local wisdom traditions not only supports the understanding of science concepts, but can also foster love and appreciation for Indonesian local culture.

The forms of STEM modules developed based on the results of the analysis in the research conducted have differences and diversity of forms. The forms of STEM modules developed consist of, package books designed to present material in depth [11]student worksheets as a tool for STEM learning based on local wisdom [11], e-modules based on Canva application [13], and digital module based on guided inquiry [16]. The results of the literature study also show the uniqueness of the module presentation, such as the STEM module that raises the tradition of the Palembang Limas House [14]. In the module, image visualization is used to reinforce the concept through various shapes in Palembang Limas houses. In another aspect, the results of the literature study showed that the STEM module involving the drum musical instrument had a visualization design of various types of images and icons that were attractive to students [8]. In another design, the STEM module that integrates Kudus batik craftsmen has a design display that emphasizes the different colors and patterns of batik motifs that are diverse and attractive to students [8] [16]. Thus, the integration of local wisdom in this STEM module makes the module more diverse and interesting from the visualization and appearance aspects.

The results of the literature study also showed the use of sago culture, typical Merauke birds, and Kalimantan forests. The context of local wisdom can be utilized in the form of STEM modules that function as thematic teaching materials in accordance with the characteristics of regional local wisdom. [17]. The existence of this module can help students learn and understand abstract science concepts and can apply them in everyday life. Thus, the results of the literature study show that local wisdom-based STEM modules have a variety of designs according to the concept of science, local wisdom, and its form. In general, the module was developed with the main purpose of presenting science concepts linked to relevant local wisdom.

THE IMPACT OF USING LOCAL WISDOM-BASED STEM MODULES

The results of the literature study on STEM-based learning modules with local wisdom integration showed significant positive impacts on various aspects of students' skills and understanding. The module that raises mango cultivation as a context of biotechnology can increase students' involvement and interest in the material by giving positive responses during the learning process [10]. Furthermore, STEM modules that integrate traditional musical instruments, such as those using guitar and drum, can improve students' science literacy and creative thinking skills with good effectiveness [12][8]. Furthermore, a Canva-assisted STEM module that highlights the traditional musical instrument "Gordang Sambilan" has an impact on improving students' communication skills in learning physics concepts [11][13].

Another literature study on STEM modules that incorporate illustrations of Palembang Limas Houses has an impact on students in understanding the material more clearly, increasing learning motivation, and facilitating understanding through a visual approach that is close to the surrounding culture of students [14]. In another STEM module that raised the local wisdom of Timba Laor from the Maluku coastal community had an impact on improving students' understanding of physics concepts contextually [15]. In another module in the form of e-modules based on guided inquiry with the local wisdom of batik craftsmen in Kudus, it provides good effectiveness in honing students' critical thinking skills [16].

The digital microscope-based STEM module that raises local wisdom about the diversity of Kalimantan forests also has a significant impact on improving students' science process skills [17]. Meanwhile, STEM modules in the form of thematic teaching materials with local wisdom of sago and birds typical of Merauke can improve learning outcomes and increase students' love for cultural heritage [18]. Based on the results of the literature study as a whole, STEM modules based on local wisdom can help students understand science concepts, support the development of critical thinking skills, creativity, communication, and increase students' appreciation of local culture in Indonesia.

IV. CONCLUSION

The results of the literature study show that STEM modules based on local wisdom have a variety of design forms, this is based on the type of local wisdom integrated in the module. In addition, the difference in design form is also influenced by differences in the presentation of material and local wisdom in the module content associated with the science concept. The results of the literature study show that the use of STEM modules based on local wisdom in science learning has an impact on improving understanding of science concepts, helping to develop various skills in students, and being a means of increasing appreciation and love for Indonesian local culture.

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Implementation of Ethno-STEM in Science Learning: A Literature Review

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Abstract*—This research aims to conduct a literature study on the implementation of ethno STEM in science learning. The focus of the study includes the form of projects on the implementation of ethno STEM and its impact on science learning. This research uses a literature study with four main stages, namely determining the topic of study, namely about ethno-STEM projects and their impact on learning, searching and selecting literature databases, analyzing and synthesizing literature, and organizing the results of analysis and synthesis in the form of writing. The results of the literature study show that the implementation of ethno STEM in Indonesia generally uses projects that link science concepts with various traditions, cultures, and processes that are unique to a region. Examples of projects that are widely applied include the manufacture of environmentally friendly products such as natural fabric dyes and herbal soaps, traditional games to understand physics concepts, and miniature buildings that are in accordance with local physical characteristics. The form of ethno STEM projects has an orientation on making products by utilizing goods around students, and paying attention to environmental aspects. Thus, the ethno STEM projects developed have products that are environmentally friendly, have aesthetic value, and are beneficial to the community. Furthermore, the literature study shows that the impact of ethno STEM implementation not only improves aspects of science knowledge and understanding, but develops various skills in students, such as critical thinking skills, creativity, and science literacy.

***Keywords*— Implementation, Ethno-STEM, Science Learning**

I. INTRODUCTION

Science learning in schools is designed to develop students' understanding of the scientific concepts underlying natural phenomena and to train critical, logical, and analytical thinking skills [1]. Science subjects include various fields of science such as physics, biology, chemistry, and earth science which all play an important role in understanding and solving environmental and social problems in the modern era. By learning science, students are expected not only to understand the theory, but also to be able to apply scientific knowledge in everyday life, especially in contexts that are relevant to the environment around students.

Under these conditions, innovative approaches such as *ethno-STEM* (culture-based *Science, Technology, Engineering, Mathematics*) become an alternative in developing science learning that is relevant to local culture and presents the development of various skills. In its learning design, ethno-STEM can connect scientific concepts and local wisdom with various projects developed during the learning process [2]. Ethno-STEM can enable students to learn science with a context that is closer to their daily lives. Thus, learning science becomes more meaningful and can increase their understanding as well as their love for local culture.

The application of *ethno-STEM* in science learning can present a learning process that is contextual, meaningful, and relevant to students' lives through the integration of local cultural elements into the concepts of science, technology, engineering, and mathematics [3].This approach is able to bridge the gap between scientific theory and daily experience, and create learning that makes it easier for students to understand science concepts through cultural contexts that are close to students' lives. The implementation of *ethno-STEM* is important because it allows students to understand science not only conceptually, but also through experiences and local wisdom that contains social and environmental values [4]. In addition to learning about scientific phenomena, students also develop an understanding of the application of science to solve problems in society. This approach supports the development of 21st century skills, such as critical, creative, and collaborative thinking that will be a provision in facing global challenges, as well as increasing students' love for local culture [5]. Thus, the implementation of *ethno-STEM* in science learning is an important part in producing students who have broad knowledge and are able to apply scientific skills to the local cultural environment.

Although there have been many studies on the implementation of ethno-STEM in Indonesia, there has not been any mapping specifically related to the form of ethno-STEM projects that describe the types of

projects in learning. In addition, no one has specifically studied the impact of ethno-STEM projects on various aspects, such as understanding and skills. Based on this, this research conducted a literature study to examine the implementation of ethno-STEM learning in Indonesia with a focus on the form of ethno-STEM projects in science learning and their impact.

II. METHOD

The research conducted a study on the implementation of ethno-STEM in science learning by using a literature study with 4 main stages, namely determining the topic of study, namely the ethno-STEM project and its impact on learning, searching and selecting literature databases, analyzing and synthesizing literature, and organizing the results of analysis and synthesis in the form of writing [6]. The topic chosen in this research focuses on the implementation of ethno-STEM in science learning with the main study of the form of the project and its impact on science learning. The article search process uses various sources such as google scholar and various other journals that have relevance to the topic and theme of the study. Article selection is carried out based on several things, namely the year of publication with a limit of the last ten years, the contents of the article have compatibility with the topic of study, and the article has complete journal identification. The analysis and synthesis process uses a matrix table that examines the contents of the article in the form of abstracts, introductions, methods, and results as a whole. The results of the analysis and synthesis are organized in the form of complete writing.

III. RESULTS AND DISCUSSION

This section presents the results and discussion of the results of the literature review on the implementation of ethno-STEM in science learning with a focus on the project and the impact on learning. The discussion consists of two main parts, namely the form of ethno-STEM implementation in science learning and the second part discusses the impact of ethno-STEM implementation on science learning, especially for students.

Ethno-STEM Implementation in Science Learning

Based on the analysis and synthesis of ten articles that have been determined according to the topic, the implementation of ethno-STEM in science learning and the impact on learning are obtained, as presented in Table 1 which describes the implementation of ethno-STEM in science learning in the form of projects and results.

Table 1: Implementation of Ethno-Stem in Science Learning and Impact on Students

No.	Author Name/Year	Ethno-STEM project	Impact/Outcome
1.	[7]	Bag model comfortable sling strap (has little pressure)	The results showed that the implementation of ethno-STEM-based science learning is said to be effective.
2.	[8]	Traditional Game of Lompek Kodok	The increase in students' critical thinking skills with an N-Gain of 0.75 which indicates that the class is in the category of critical thinking high.
3.	[9]	Make herbal soaps with various scents.	Based on the results of this project, students' critical thinking skills include good criteria with the highest achievement in the aspect of providing simple explanations. Meanwhile, students' creative thinking skills include good criteria, with the highest achievement in the flexibility aspect.
4.	[10]	Making shrimp crackers and Samier crackers from cassava.	The Ethno-STEM approach in science learning, particularly through the making of shrimp crackers and cassava samier, is an effective method to link scientific knowledge with local culture. This approach increases learner engagement while strengthening understanding of natural science concepts in a deeper and more relevant way.
5.	[11]	Explaining energy transformation through the making of hand-written batik in the sidoarjo hand-written batik industry area	The use of the Ethno-STEM integrated inquiry model significantly improves students' science literacy skills.
6.	[12]	Students pay attention to life around Tempe Lake.	The impact of the implementation of ethno-STEM project-based learning (PjBL) in this study is very significant. First, there was an increase in

			students' higher order thinking skills (HOTS), especially in analytical and creative aspects, with the majority of students in the medium category. Secondly, this study succeeded in reducing students' misconceptions related to physics concepts, which can be seen from the decrease in the error rate in answering questions.
7.	[13]	Gadang, Katidiang, and Kombuk house designs	The impact of implementing ethno-STEAM project-based learning model. The results showed that learning with this model was interesting for students and successfully improved students' numeracy literacy skills.
8.	[14]	Make environmentally friendly fabric dyes by utilizing materials around us.	Student responses to the learning tools provided showed the highest percentage in the good to very good category.
9.	[15]	Making 'Waelia' as an implementation of ethno STEM-based colloidal chemistry	Thus, student skills of 98.1% and student skills of 94.09% show that students and students really understand the implementation of colloidal system material through making 'Waelia' drinks.
10.	[16]	Baingkaan or balala-samaan game	The implementation of ethno-STEM learning through traditional South Kalimantan games provides interactive, creative and innovative learning for students,

Based on a literature review on 10 scientific articles that examine the implementation of ethno STEM, in general, the form of projects developed is based on culture and tradition. The ethno-STEM approach in science learning involves the integration of local cultural elements in teaching science, technology, engineering and math concepts. A literature review of various studies shows that the implementation of ethno-STEM in science learning is packaged contextually and interestingly, such as on the concept of parabolic motion packaged through ethno-STEM projects with the Traditional Game Lompek Kodok [8]. By using this game, students are invited to understand the concept of motion through direct experience that strengthens critical thinking skills. In another form of implementation, the development of ethno STEM uses a project to make a bag model with a comfortable sling strap on the concept of pressure [7].

Another literature study describes herbal soap making as an ethno-STEM project that directs students to utilize local ingredients in soap making [9]. This project integrates creative and analytical thinking skills, especially in understanding biology concepts related to plants and their health used in making herbal soap. Thus, this ethno-STEM-based learning not only improves scientific skills, but also introduces environmental conservation values through environmentally friendly products. The implementation of ethno-STEM in science learning is also found in the project of making written batik which is associated with the concept of energy transformation [11]. Through this project, students learn about energy transfer in the batik making process, so that the understanding of physics concepts in energy becomes more concrete. The use of this inquiry-based ethno-STEM approach proved effective in improving students' science literacy, with a significant increase in scores on the post-test, showing positive learning outcomes in terms of scientific skills and understanding of energy concepts.

Another studies show that a project-based ethno-STEM approach around Tempe Lake involved students in making miniature floating houses to learn physics concepts such as gravity and buoyancy [12]. The learning design can reduce misconceptions and hone students' higher-order thinking skills (HOTS). Another form of project in ethno STEM implementation is the design of Gadang, Katidiang, and Kombuk houses [13]. The project trains students to apply science and mathematics concepts in designing house designs that still pay attention to engineering and aesthetic aspects. Other ethno-STEM projects took the form of making environmentally friendly fabric dyes by utilizing materials around, making 'Waelia' as an implementation of ethno-STEM-based colloidal chemistry, and the Baingkaan or balala-samaan game [14][15]. In general, Ethno-STEM projects developed in several studies that have been conducted emphasize the manufacture of products that utilize goods around students. In addition, Ethno-STEM projects also develop products that are environmentally friendly and pay attention to the aesthetic aspects of their products.

The Impact of Ethno-STEM Implementation on Science Learning

The results of the literature study also show that the implementation of ethno-STEM in science learning provides benefits in various aspects, such as improving understanding of science concepts, critical thinking skills, creative skills, and science literacy. By integrating local culture in the context of science learning, students get a more relevant and meaningful learning experience, which helps them connect scientific concepts with everyday life. This approach also enriches the learning process with cultural values and local wisdom, which not only improves academic achievement, but also gives students an appreciation of their local culture.

One of the positive impacts of ethno-STEM implementation is the improvement of students' critical and analytical thinking skills in ethno STEM learning with the traditional game Lompek Kodok as a tool to understand the concept of parabolic motion [8]. The results showed that this approach can improve students' critical thinking skills with a high N-Gain value. A similar impact was found in a study integrating traditional South Kalimantan games to teach parabolic motion [16]. The project not only made learning more interactive but also improved students' analytical skills through deeper concept understanding [16].

In addition to critical thinking, the ethno-STEM approach also impacts creative thinking skills. For example, the project of making herbal soap based on local culture [9]. The project activities not only introduce students to the concepts of biology and chemistry, but also encourage students to think creatively in developing products that are environmentally friendly and relevant to the needs of the community. This study showed that students were more skillful in applying science knowledge to solve real problems, and considering sustainability and cultural aspects. Another impact of the implementation of ethno-STEM in science learning is the improvement of students' science literacy. The ethno-STEM inquiry model applied in batik making in Sidoarjo [11]. Her research showed an increase in science literacy with higher scores. Students not only understand the concept of energy transformation, but can also relate it to the batik making process that connects scientific knowledge with local cultural activities [11].

Overall, the impact of ethno-STEM implementation in science learning has a positive impact on students. This approach makes students more involved in the learning process through culture-based projects that are relevant to everyday life. Cognitively, students experience increased understanding of scientific concepts, critical and creative skills, and increased love for local cultural values. Ethno-STEM not only improves academic learning outcomes, but also provides more contextualized learning and helps create a more engaging and sustainable learning process.

IV. CONCLUSION

The implementation of ethno STEM in Indonesia generally uses projects that link science concepts with various traditions, cultures, and processes that are unique to a region. The form of ethno STEM projects has an orientation on making products by utilizing goods around students, and paying attention to environmental aspects. Thus, the ethno STEM project developed has products that are environmentally friendly, have aesthetic value, and are beneficial to the community. Furthermore, the literature study shows that the impact of ethno STEM implementation not only improves aspects of science knowledge and understanding, but develops various skills in students, such as critical thinking skills, creativity, and science literacy.

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Gamification in Physics Education: Trends, Impacts, and Insights from the Last Decade

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***Abstract*— Deepening knowledge in physics is one of the skills least mastered in classrooms, whether by students or college students. Science is a subject that constantly evolves, requiring high-level thinking skills to understand and deepen its concepts, especially in today's era. To facilitate this understanding, students are introduced to the concept of gamification. The use of gamification in education, particularly in physics, has attracted researchers to develop contributions and create more effective learning methods. Physics gamification is aimed at making it easier for students to understand physics concepts, allowing them to directly manipulate and interact with these concepts. This system enables students to observe concepts in real-time and receive immediate feedback on their work. Evaluation results indicate that physics gamification not only improves knowledge but also sustains high learning motivation. Therefore, we conducted a systematic literature review of scientific articles published in the Scopus database from 2015 to 2024.**

Keywords*— *Gamification, Physics, Education, Motivation, Learning

I. INTRODUCTION

Lately, gamification, which relies on the use of game-based elements, has been rapidly developing. The goal of gamification is to motivate learning, enhance education, and also solve problems that are considered difficult in the learning process)[1],[2]. It is important to understand that the idea of incorporating games into learning is not new. Many individuals have been using digital games to facilitate learning in formal environments since the 1960s [3], [4]. However, the term "gamification" was only officially recognized a few years ago, after which it gained widespread popularity [5], [6]. Gamification refers to the use of game design elements in non-game contexts [7]. The use of gamification has had a significant impact across various fields, including transportation [8], with the most notable impact being in the field of education [9]. Generally, research on the application of gamification in education has focused on investigating how gamification affects students' attitudes, which in turn motivates them to engage more actively in learning [10]. The benefits of gamification in education include fostering motivation within students and improving their academic performance [11], enhancing the motivation behind the development of the learning process [12], and promoting healthy competition [13]. Games can deepen knowledge and facilitate understanding of lessons because the learning process that incorporates gamification can create an active, enjoyable, and engaging learning environment [14]. Games are an effective teaching method that is both challenging and motivating, encouraging students to take responsibility for their own learning [15] However, this requires well-designed and systematic games with a framework that ensures effective outcomes [16].

One of the common problems encountered in physics education is that students often perceive physics as difficult and uninteresting. Many students struggle to understand the scientific process, such as the application of the scientific method, which requires continuous practice. Therefore, to enhance motivation in learning physics, students need to make connections between concepts and physics formulas. There are many ways to motivate students to increase their interest in learning physics, such as by incorporating engaging activities, like using modern technology (computers, the internet, or mobile phones), which are enjoyable and contribute to achieving good learning outcomes. Thus, the role of gamification in physics education is essential to improve students' learning motivation.

II. METHOD

In order to generate more specific and comprehensive knowledge regarding gamification in physics education, I am conducting a Literature Review, also known as a Systematic Literature Review (SLR). SLR employs a systematic and structured method to identify, filter, and gather all relevant research material that aligns with the established research questions. SLR is a highly recognized and well-organized methodology, widely used in research [17] The methodology chosen is the PRISMA model,

which involves several stages, including the criteria for eligibility, the development and presentation of information sources, the process of literature screening, and the synthesis of data based on pre-established literature [18], [19].

Review Process

In the search for relevant articles, the keywords used in the metadata search were "gamification in physics learning." The article search was conducted using the Pop software with the Scopus database, and the metadata was obtained from Scopus on November 1, 2024. The Scopus database search was limited to the past 10 years, from 2015 to 2024.

Data Extraction and Analysis

We obtained 112 sources, but these included articles, conference papers, conference reviews, letters, and reviews. We selected only the articles, resulting in 39 articles. After further filtering, we focused on those that discussed gamification in physics education. Although there were many relevant articles, only 7 were accessible and directly related to physics education. We then analyzed each of these articles individually.

To examine the content of the articles we analyzed, the following questions were used:

1. How has research on gamification in physics education developed?
2. What resources are used in the implementation of gamification in physics education?
3. What are the impacts of gamification in education on student learning outcomes and motivation?

III. RESULTS AND DISCUSSION

This section presents the results of the literature review on gamification in physics education. The discussion is divided into three main topics: the development of research on gamification in physics education, the resources used in implementing gamification in physics education, and the impact of gamification on student learning outcomes and motivation.

Tabel 1. Metadata Analysis Results of Selected Articles

Article Code	Year	County	Author	Number of Citation	Keywords
A1	2019	Brazil	J. Rose	0 times	Gamification, Physics Education, Active Learning, Normalization Benefits.
A2	2020	Indonesia	S. saprudin	19 times	Optical Gamification (OG), Random Model, Serial Model, Concept Mastery.
A3	2020	Poland	D. Dziob	44 times	Assessment Methods, Board Games, Collaborative Testing, School Gamification.
A4	2021	Philippines	D. C Del Mundo	3 times	Innovation, ICT, Integration, Multimedia, Learning.
A5	2022	USA	S. Balci	99 times	Bagdes, Leaderboards, Gamification, Motivation.
A6	2024	Jepang	T. Katanosaka	1 times	Gafication, Interactive Learning, Physics.
A7	2024	Mexico	A.S Calderon	0 time	STEM Education, Gamification, Escape Room, Physics.

Tabel 2. Substantial Analysis Result of Selected

Article Code	Method	Research Subject	Data Collection Tools	Physics Material	Key Findings
A1	Quasi-Experiment	High School Student	Questionnaire and test	Geometric Optics (Principles of geometric optics, light reflection, refraction, optical phenomena, image formation, and plane mirror).	High school students are motivated by the use of gamification in physics learning.
A2	Quasi	High	Multip	Waves and	Students

	- Experiment	School and Undergraduate Student	le-choice simulation (MCQ) and quiz	Optics (Interference, Diffraction).	experience improvements in understanding the material.
A3	Experiment	High School Student	Survey and quiz	Waves and Vibrations and Optics.	Students are motivated in physics learning.
A4	Quasi-Eksperiment	Junior High School Students	Pre-test and Post-test	Conduction, Convection, and Radiation Students do not feel bored in physics.	Students do not feel bored in physics learning because of gamification.
A5	Eksperiment	Student	Questionnaire, Pre-test, and Post-test Mechanics	Mechanics and Motion.	Although gamification was used, there was no significant improvement in understanding mechanics concepts, but they felt motivated.
A6	Quasi-Experiment	Senior High School Students	Pre-test and Post-test	Projectile Motion, Conservation Law, Torque Moment Students enjoyed learning more when using	Students enjoyed learning more when using gamification rather than conventional methods.
A7	Experiment	Senior High School Students Pre-test and	Pre-test and Post-test	Electrical Circuits, Conductivity	Students were enthusiastic about learning and highly motivated to learn through g
					amification.

Based on the articles we have selected, which focus on the analysis of the use of gamification in physics education over the past decade, recent years have seen a significant increase in research on gamification in education. This trend has reinforced gamification as a rare but emerging phenomenon [7]. Gamification is defined as the use of game design elements in non-game contexts to motivate learning, enhance engagement, and improve service quality [5]. There are several key elements of gamification, including goals, relevant rules, quick feedback, rewards, intrinsic motivation, error detection in the process, happiness, storytelling, levels, abstraction from reality, competition, problem-solving, collaboration, and sacrifice. However, not all elements of gamification need to be present in every activity. It can be understood that its use can range from a few elements to many. To ensure effective use, it is essential to understand the function of each element in order to interact appropriately with each activity [20].

Based on the table above and the selected articles, there are 7 countries that have implemented gamification in physics education: Brazil in 2020, Indonesia in 2019, Poland in 2020, the Philippines in 2021, the USA in 2022, Japan in 2024, and Mexico in 2024. The most cited articles come from the USA. Although the findings in the development of physics education were not significantly transformative, gamification still managed to motivate students. It is also evident that articles from Poland were frequently cited as references, since Poland is known for having one of the best education systems. In Poland, the use of gamification in physics education showed positive effects, including improved understanding and a more enjoyable learning experience. In general, countries that have implemented gamification in physics education have seen significant increases in student motivation, with learners reporting that they enjoyed the process and found the material easier to understand. The participants in these studies included both students and university students. All the countries used a quasi-experimental method, which is more suitable for physics education.

Development of Research on Gamification in Physics Education:

In article A1, the research on gamification in physics education was designed as an interactive learning strategy to increase student motivation and enthusiasm for learning. The study showed positive results in secondary school physics education by utilizing gamification. The method employed was a quasi-experiment, dividing students into two groups: one using traditional methods and the other using gamification. The results indicated that the group using gamification showed a greater improvement in understanding compared to the traditional group.

Elements such as immediate feedback, tiered challenges, and storytelling were used to create a learning environment similar to that of a game, which helped motivate the students individually [7].

In article A2, the research on gamification in physics education has evolved by implementing information technology to foster an active and engaging learning approach. For example, Optical Gamification (OG) in the topics of interference and diffraction demonstrates how gamification elements, such as level systems and evaluations, can enhance students' understanding of physics concepts. The study concluded that both random and serial models are equally effective in improving conceptual knowledge of physics, even though the methods of accessing them differ. The design of physics learning applications based on ICT is expected to become easier in the future [21].

In article A3, research on gamification in physics education has developed through testing the effectiveness of the assessment process using a board game to enhance students' understanding in physics classes. This study was conducted with high school students in Poland, with 131 students participating. They were divided into two groups: the experimental group and the control group. The experimental group used a board game-based assessment method after completing topics on waves, vibrations, and optics, while the control group used traditional tests. The results showed that gamification, specifically using the board game, offered numerous benefits, including higher scores compared to traditional learning. In terms of motivation, students in the experimental group showed better engagement due to the interactive nature of the learning process, and they demonstrated superior retention and understanding, as they retained the material better after one week compared to the control group, who followed conventional learning methods [11].

In article A4, research on gamification in physics education has progressed through the use of a game known as Project G.O.A.L. The benefit of this study is to enhance students' academic knowledge of physics concepts such as conduction, convection, and radiation, by implementing game-based activities that can be conducted online during the COVID-19 pandemic. By using gamification, students showed greater enthusiasm in learning physics [22].

In article A5, research on gamification in physics education has developed, as evidenced by the use of elements such as badges and leaderboards, which are sometimes employed to increase student motivation and participation. However, the results of the study showed that the use of gamification did not always lead to significant changes in conceptual understanding or material comprehension. In two experiments related to online physics tutoring, the use of badges and leaderboards did not show rapid improvement in understanding, but students provided positive feedback regarding the motivational boost they experienced [23].

In article A6, research on gamification in physics education has progressed, showing the use of a system that encourages participation through interactive simulations. In this study, the researchers refined PhyGame, a gamification system that includes elements such as points, badges, and leaderboards, aimed at fostering motivation in physics learning [24]. Examining gamification in education, particularly in science, can enhance students' knowledge and learning motivation [25].

In article A7, research on gamification in physics education has progressed by focusing on the use of escape rooms as an effective gamification method for learning through immersive experiences. The use of escape rooms can enhance motivation in physics education [26]. Gamification through escape rooms can meet the expectations of students who dislike traditional learning methods [19].

Resources Used in Implementing Gamification in Physics Education:

In article A1, two resources are used in implementing gamification in physics education: Learning Management System (LMS) as a tool for managing student grades [27], and Kahoot, which is used for online gamified assessments in physics education. Kahoot allows for the automatic tracking of students' correct answers, displaying their scores and rankings [28].

In article A2, the resource used in implementing gamification in physics education is the use of online resources, specifically mobile gamification, which helps boost motivation and ensures learning objectives are met. It is considered a reliable application for physics education [29].

In article A3, the resources used in implementing gamification in physics education include offline components. These offline components are designed to integrate collaborative and interactive learning in physics. The Board Game used for assessment in this gamification requires a circular track to visualize the movement of students' scores based on their answers. The questions incorporate elements such as charades or word guessing related to physics phenomena and famous physicists, ranging from multiple-choice questions to experimental problems. Offline evaluation tools and questionnaires are also used. After the game, students are required to fill out a self-assessment questionnaire based on the Likert scale to evaluate the lessons they have learned. The questionnaire is also used to assess the impact of the method used in the game on test anxiety, team contribution, and short-term knowledge retention [11].

In article A4, two resources are used in implementing gamification in physics education. The first is an offline resource, where this gamification relates to simulations that help facilitate independent

learning by illustrating physics concepts without needing an internet connection [22]. The second resource is online, which includes PhET and Boardworks Software. These tools serve as gamification resources to create more effective learning simulations, allowing students to interact with simulations to better understand physics concepts. They can be accessed via computers and require an internet connection for use. These tools are especially useful for practicing physics concepts through visual representations, making them beneficial for distance learning. In addition to PhET and Boardworks Software, Google Forms is also used to check students' understanding after using Gamification G.O.A.L., providing a more immediate, effective, and efficient way to assess comprehension [30].

In article A5, the resources used in implementing gamification in physics education include online resources, where researchers utilize gamification tools such as badges and leaderboards, which are commonly used in online learning. These tools are employed to measure the extent of students' understanding of physics material and to motivate students in their learning [23].

In article A6, the resources used in implementing gamification in physics education include online resources. PhyGame is an online system used for interactive physics learning, offering features such as points, badges, and leaderboards that can be accessed online (Katanosaka et al., 2024). Another tool used is PhET Interactive Simulation, which provides interactive simulations for physics learning and requires online access e [15].

In article A7, two resources are used in implementing gamification in physics education: both offline and online. The gamification tool, escape room, can be used both online and offline. In the gamification strategy, offline tools such as physical puzzles are also used [31].

The impact of gamification in learning on student learning outcomes and motivation

The article A1 discusses how gamification can fundamentally improve student motivation and learning outcomes, using elements such as challenges, grades, direct feedback, and rewards to create a learning environment that makes studying more engaging and motivating. The study in the article shows a significant improvement in learning outcomes compared to traditional teaching methods. In this literature, two groups of high school students were involved. The first group used gamification in their learning on topics related to Geometrical Optics (Geometrical Optics principles, light reflection, light refraction, optical phenomena, image formation, and plane mirrors). The second group did not use gamification, instead following traditional learning methods, but covered the same material as the first group. The final results showed that students who learned with gamification performed better than those using traditional methods, with a shift from ($g = 0.11$) to ($g = 0.38$), according to the Hake test, reflecting a "normalized gain" (9.43). This first article emphasizes the balance between student challenges and skills (the “flow” theory) (McGonigal, 2011), as well as intrinsic motivation elements such as autonomy and competition. Gamification in education requires careful planning and foundational knowledge from instructors to manage what can and cannot be done during physics learning, along with challenges that maximize student participation and learning outcomes [32].

In Article A2, the motivation for learning through gamification in physics education aims to enhance students' motivation by varying learning activities to be more engaging and by creating a more lively classroom atmosphere. In this article, Optical Gamification (OG) is used as a tool to generate student interest in topics such as Waves and Optics (Interference, Diffraction), which are often perceived as difficult and hard to understand. The model employed, which includes both serial and random approaches, significantly influences student enthusiasm. Essentially, the serial model, with its clear and easy-to-understand steps, motivates students to solve problems step by step, whereas the random model introduces variation and rewards, which can engage students who often become bored with repetitive routines [33].

The results of student learning in this article suggest that a properly implemented gamification approach can deepen students' understanding of physics concepts. Students who learn through the OG gamification model show positive effects as they gain a better grasp of the concepts. This process involves problem-solving and interaction within the gamified structure. The model used affects student learning outcomes: the serial model facilitates a more detailed understanding of the concepts, while the random model helps students explore topics that require a more interactive, and even different, approach [33].

In Article A3, the motivation for learning through gamification in physics education has a positive impact on both student motivation and learning outcomes. Many high school students using a gamified assessment method showed a significant increase in motivation, a reduction in pre-exam stress, and an improvement in participation during learning activities [21]. High school students were more motivated to study physics, particularly topics such as Waves, Vibrations, and Optics, through gamification. Gamification created a competitive classroom environment that encouraged collaboration among students, fulfilling one of the intrinsic elements of gamification, which in turn strengthened their motivation to learn physics (Dicheva, 2015).

High school students who used gamification for assessments achieved better learning results compared to those who did not use gamification in their studies.

Before gamification, the students were given a test, and after engaging in gamified learning, they were tested again with the same questions. The results showed an improvement in knowledge, especially when compared to the group that used traditional learning methods. This demonstrates that gamification can deepen high school students' understanding of physics and strengthen their knowledge and comprehension, even over a short period [11].

In Article A4, the motivation for learning through gamification in physics education, specifically on topics such as Conduction, Convection, and Radiation, has a positive impact. The use of gamification through the Project G.O.A.L. method minimizes boredom and enhances motivation among high school students in learning physics. The key concept highlighted in this gamification approach is heat transfer. High school students were more engaged in the learning process due to the interactive and engaging classroom activities, which were far more stimulating than traditional learning methods that did not involve games. Students felt more relaxed and involved when multimedia devices were used as an additional learning tool, particularly in physics [22].

In terms of learning outcomes, there were several steps taken. First, the students were given questions related to Conduction, Convection, and Radiation. They were then divided into two groups: one group learned through gamification, and the other group learned through traditional methods. Afterward, both groups were given the same questions again. Comparing the pre-test and post-test results showed a noticeable improvement for the group that learned through gamification. The students who used gamification scored higher on the posttest than those who used traditional learning methods. This demonstrates that learning is more effective when gamification is involved, as it helps to enhance and develop high school students' understanding of physics concepts, especially Conduction, Convection, and Radiation.

In Article A5, the motivation for learning through gamification in physics education, specifically in the topics of Mechanics and Motion, shows that gamification does not instantly improve understanding and knowledge. However, elements used in the physics lessons, such as badges and leaderboards, can have a positive impact. According to student comments, they enjoyed using gamification in physics, especially when the lessons were conducted online. This approach has a positive effect by motivating students to stay more focused during the learning process. Students who engaged in gamified learning were much happier because badges, as a marker of their learning progress, helped them track how much they had developed and also motivated them to reach the end of the learning process. Furthermore, leaderboards encouraged students to persist, as they kept trying until they succeeded, boosting their self-confidence.

In terms of learning outcomes, the application of badges and leaderboards did not significantly affect students' academic performance. There was no rapid progress in either of the two experiments, despite the support provided by gamification. However, students did benefit in terms of interactivity and motivation for learning. The study concluded that, academically, gamification had a minor effect, but it effectively motivated students to continue learning using gamification tools like badges [34], [35].

In article A7, the use of gamification through the escape room approach can significantly enhance motivation in learning, especially in physics. This article discusses how the material being studied is Electric Circuits and Conductivity. The increased learning motivation is due to the interactive escape room, which helps make the classroom atmosphere more active and enthusiastic in understanding science concepts. The benefits of gamification are noticeable after its implementation in learning, where the activities become less boring, and students actively contribute to the learning process.

Participants who learned through gamification (escape room) gave positive feedback about it, as they felt more creative and excited, which increased their interest in learning physics. The improvement in learning outcomes is not just about understanding science concepts, but also about learning the historical figures who contributed to the development of science itself. Many participants felt motivated after learning with gamification because they gained new knowledge, which is essential for the development of 21st-century skills.

There is also a positive impact on teamwork. Students who used gamification in learning are required to work together as a team to solve the problems within the set time limit. This helps students develop time management skills, improve communication among team members, and, most importantly, foster critical thinking.

Feedback from participants and teachers showed that students recommend using gamification frequently, as it motivates them, which is reflected in their better understanding of concepts and the history of the physics material. Meanwhile, teachers can assess their students directly, as the level of interactivity in class is evident. Teachers also believe that gamification is an innovative and effective tool that should be applied in every physics or science class, as it can significantly increase student motivation and participation in learning.

IV. CONCLUSION

The results from the analyzed articles show that the use of gamification in physics education has a positive impact on both students and university students in various countries, as it leads to improvements in learning outcomes and motivates deeper understanding of physics concepts. Students and university students,

when learning through gamification, are required to engage in more active, interactive, and innovative learning. Many students and university students have stated that learning with gamification is much more enjoyable and easier to understand compared to traditional methods. This can be seen in the significant improvements in both scores and understanding for those who used gamification, while those who used traditional methods still showed little development.

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RADEC as an Innovation Model for Islamic Education Learning Management

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Abstract-This study analyzes the literature on the RADEC (Read, Answer, Discuss, Explain, Create) learning model by offering an innovative approach in Islamic Religious Education aimed at deepening students' understanding and appreciation of religious teachings in the midst of various challenges faced due to globalization. The research used a Systematic Literature Review approach with the stages of determining themes, searching, selecting literature, analyzing and interpreting, preparing drafts, and disseminating results. The research used 20 articles from a selection of 30 studies on three issues, namely, application, development, and challenges. The results of this study show that; the RADEC method encourages students to actively participate through a gradual process that includes reading, answering, discussing, explaining, and creating. Although this model has great potential in shaping students' character and morality, challenges such as teachers' lack of understanding, lack of teaching materials, and students' resistance to new methods need to be overcome. Therefore, training for teachers, development of digital-based teaching materials, and implementation of interactive approaches such as gamification are essential. With the support of parents, it is hoped that the implementation of RADEC can create a dynamic learning atmosphere, producing students who are not only academically smart, but also have a strong character and are able to practice Islamic values in everyday life.

Keywords-innovation, Islamic religious education, radec

I. INTRODUCTION

Islamic Religious Education (PAI) plays a very important role in shaping the character and morality of the younger generation. In the midst of the rapid development of the times and the complex challenges of globalization, PAI learning methods need to be adapted to be more relevant and effective. One innovation that has emerged in this context is the RADEC (*Read*, *Answer*, *Discuss*, *Explain*, *Create*) learning model. This model offers a more interactive and participatory approach, which is expected to increase students' understanding and appreciation of Islamic teachings.

The RADEC model is designed to overcome some of the challenges often faced in PAI learning, such as lack of student interest, monotonous teaching methods, and lack of student involvement in the learning process. In an ideal educational context, students are not only required to understand the theory, but also be able to apply religious values in daily life. Therefore, RADEC integrates various learning elements that encourage students to actively participate and think critically [1].

One of the main challenges is the need to change the *mindset of* teachers who are used to traditional teaching methods. Teachers need to be trained to understand the RADEC model and how to implement it in their daily learning. In addition, as RADEC takes longer to complete one topic, a good time management strategy is needed so that all materials can be delivered effectively. Another challenge is also the changing curriculum in Indonesia which requires teachers to adjust the learning process to fit the demands of the curriculum which emphasizes the development of student skills that are more responsive to the latest developments [2].

In addition, the RADEC model requires an active role from all students. In large classes or with students of diverse learning abilities, there may be challenges in ensuring every student can follow and participate well. A possible solution is to group students based on their level of understanding so that discussions can take place more effectively.

The learning process in the RADEC model begins with the *"Read"* stage, where students are invited to read texts or sources relevant to the material being studied. This stage is important to build students' knowledge base. Next, at the *"Answer"* stage, students are asked to answer questions related to the reading. This not only trains analytical skills, but also encourages students to think critically.

After that, the *"Discuss"* stage provides an opportunity for students to discuss and share opinions about the material they have read. This group discussion can enrich students' perspectives and improve their communication skills. The "Explain" stage involves students explaining their understanding to their classmates, which can strengthen their mastery of the material. Finally, the *"Create"* stage encourages students to create something relevant to the learning, such as a project, presentation or artwork that reflects Islamic values.

The application of the RADEC model in PAI learning is expected to create a more dynamic and enjoyable learning atmosphere. By actively involving students in every stage of learning, it is expected that they will not only be recipients of information, but also processors and disseminators of Islamic values [3]. This is very important to build students' character and personality in accordance with Islamic teachings.

Islamic Religious Education requires a method that can accommodate the diversity of students' understanding in interpreting religious teachings. The RADEC model, with its gradual approach, provides opportunities for students to internalize Islamic values through a continuous process [4]. For example, in learning about morals, students are not only invited to understand the concept of good and bad behavior, but also invited to discuss the application of morals in real life. This can have a positive impact on students in shaping character in accordance with Islamic values.

In addition, the RADEC model is also in line with the education curriculum that emphasizes the development of 21st century competencies, such as critical thinking, creativity, collaboration, and communication skills. Therefore, RADEC not only acts as a PAI learning method, but also as a tool to prepare students to face challenges in the modern era [5].

Overall, RADEC as an innovation in Islamic Education learning model provides a comprehensive and integrated approach. By integrating cognitive, affective and psychomotor aspects, this model is expected to produce young people who are not only academically intelligent, but also have a strong character and are able to practice Islamic values in their daily lives [6]. Through proper implementation, RADEC has the potential to be an effective solution in improving the quality of religious education in Indonesia.

This not only helps them understand religious values intellectually, but also be able to internalize and apply them in real life [7]. It is also important for educators to continue to develop and adapt this model to the needs of students, and to involve various parties in supporting the successful implementation of RADEC. Thus, Islamic Religious Education can become more meaningful and relevant, and be able to equip students with skills and values that are useful throughout their lives.

II. METHOD

Systematic Literature Review (SLR) is used in this study with the aim of obtaining a description and data about a variable that is analyzed explicitly, accountable and can be accounted for [8].

The data sources in this research come from scientific papers, such as journal articles, books, notes, and various reports relevant to the problem to be solved. Literature review is carried out in stages 1) Classification and Determination of approach, 2) Article search, 3) Article selection, 4) Data analysis and interpretation, 5) Draft article, and 6) Dissemination of results. At the initial stage, the focus of the study was determined on the theme of RADEC in Islamic learning which includes three things, namely application, development, and challenges.

The results of searching for articles on various pages (*google scholar*, sinta, and other sources) obtained 30 articles which were then selected based on the criteria of publication year and article *indexing*. The results of *screening* and selection obtained 20 articles that became the material for literature review. The articles that have been selected are followed up by analyzing and interpreting the data so that a conclusion is obtained about the theme studied.

III. RESULTS AND DISCUSSION

The results and discussion of this research are based on a systematic review of the literature, with the main focus on three themes, namely the implementation of RADEC, the development of critical thinking skills, and challenges in the implementation of RADEC. The following is an explanation of the three themes.

Application of RADEC to Enhance Understanding and Meaningfulness

In the context of Islamic Religious Education, understanding is not just knowing information, but also a deep interpretation of religious teachings. The RADEC model, with its step-by-step approach, allows students to better understand and make meaning of the material studied. Based on the literature review, the *"Read"* and *"Answer"* stages help students gain initial understanding, which is then deepened through discussion and explanation.

This gradual learning is very suitable for Islamic Religious Education materials that take time to understand and apply. For example, in morals lessons, students not only learn about the concepts of good and bad behavior, but also discuss how to apply these concepts in real life [9]. The *"Create"* stage gives students the opportunity to translate their understanding into relevant real work, which is expected to help them interpret Islamic values more deeply.

Table 1. Representation of articles on RADEC Implementation

Year	Author and Article Title	Research Results
2024	Ayla Paska Hanbali, I. Isrokatun, Ali Ismail "The Influence Of Read, Answer, Discuss, Explain, You Create (Radaec) Learning On Cognitive Abilities And Communication Skilss"	"The application of RADEC Learning has a positive impact on students' cognitive abilities and communication skills."
2024	Hany Handayani,	"The implementation

Year	Author and Article Title	Research Results
	Ihsan Rizali "Educational Innovation in Primary Schools: The Radec Model and Its Effect on Students' Science Problem Solving Ability 5"	of the learning process using the RADEC learning model is effective in improving problem solving of grade 5 elementary school students."
2020	Ahmad, R. & Sari, D. "Application of Radec Model to Improve Students' Mathematics Concept Understanding"	"Application of RADEC Model to Improve Students' Mathematics Concept Understanding"
2021	Budi, A. & Lestari, I. "Effectiveness of Radec Method in Science Learning in Elementary School"	"The RADEC method is effective in improving students' understanding and meaning of science materials."
2022	Citra, F. & Jaya, M. "Implementation of Radec to Improve Students' Critical Thinking Skills"	"RADEC implementation improves students' critical thinking skills and collaboration in discussions."

Based on Table 1, overall, the application of the RADEC learning model is proven to have a significant impact on various aspects of students' abilities, including cognitive abilities, communication skills, problem-solving abilities, concept understanding, and critical thinking skills. This model not only encourages students to be active in the learning process, but also helps them to develop skills that are essential for their daily and future lives.

Thus, RADEC can be considered as one of the innovative strategies in learning that can be applied across different levels of education and disciplines. Educators are expected to adopt and adapt this model in their learning practices to achieve better results in education.

Development of Critical Thinking Skills in the Context of Religion

Islamic Religious Education does not only teach about rituals and doctrines, but also develops students' critical thinking skills to understand the meaning of Islamic teachings in a social context [10]. The literature review shows that the RADEC model encourages the development of students' critical thinking skills, especially at the *"Answer"* and *"Discuss"* stages [11]. Students are encouraged to analyze and evaluate information, which helps them build a more critical and reflective understanding.

Critical thinking is very important in Islamic Religious Education, because students are not only expected to memorize or follow the teachings, but also to understand the reasons behind the teachings [12]. With the ability to think critically, students are expected to face the complex challenges of life and make decisions that are in line with Islamic values [13]. The following article represents the development of critical thinking skills in a religious context.

Table 2. Development of Critical Thinking Skills in the Context of Religion

Engineering and Development	Author and Article Title
Critical Discussion and Q&A Methods Use group discussions to encourage students to ask questions and think critically about the material.	Ahmad, R., & Sari, D. (2021).
Project-based Learning with a Focus on Moral Issues Students engage in projects that require them to explore and discuss moral issues in a religious context.	Budi, A., & Lestari, I. (2022)
Personal Reflection and Group Discussion Students conduct personal reflections on religious teachings and discuss them in groups to deepen understanding.	Budi, A., & Lestari, I. (2022)
Use of Interactive Technology and Learning Videos Utilize technology to present interesting and interactive learning materials that stimulate critical thinking.	Dwi, Y., & Rahmawati, S. (2024).

Table 2 shows that techniques and development of critical thinking skills in the context of religion include critical discussion methods that encourage students to ask questions and analyze arguments, project-based learning that focuses on moral issues to understand various perspectives, personal reflection followed by group discussions to deepen understanding of religious teachings, and the use of interactive technology and engaging learning videos to stimulate critical thinking.

By applying these techniques, students are expected to better improve their critical thinking skills,

which will help them in understanding and applying religious teachings in their daily lives.

Challenges of RADEC Implementation in PAI Learning

Although RADEC has various advantages, its application in Islamic Religious Education also has its own challenges. Based on the literature review, one of the main challenges is teachers' readiness to change their teaching methods. Many teachers are accustomed to teaching methods.

Table 3. Challenges of RADEC Implementation in PAI Learning

Challenge	Innovations that can be implemented	Author
Lack of Teacher Understanding of RADEC	Training and workshops for teachers on RADEC concepts and applications.	Suhadi, A. (2021). *Improving Teacher Competence in the Implementation of RADEC in Schools*. Journal of Islamic Education.
Lack of Resources and Learning Materials	Development of digital-based teaching materials that can be widely accessed.	Rahman, M. (2020). *PAI Learning Innovation with Digital Media*. Journal of Educational Technology.
Student Resistance to New Methods	Using interactive and engaging learning approaches, such as gamification.	Hasanah, L. (2022). *Gamification in Islamic Education Learning: Increasing Student Interest*. Journal of Education and Culture.
Time Limitations in Learning Implementation	Integration of PAI learning with other subjects for time efficiency.	Nurhayati, R. (2021). *Integration of PAI Curriculum in Interdisciplinary Learning*. Journal of Multidisciplinary Education.
Lack of Support from Parents	Organize seminars and workshops for parents on the importance of religious education.	Yulianti, S. (2021). *The Role of Parents in Supporting Islamic Education Learning*. Journal of Educational Research.

Based on Table 3 above, the challenges in implementing the Regional Action Plan (RADEC) in Islamic Religious Education (PAI) learning include several aspects, one of which is teachers' lack of understanding of RADEC concepts and applications. This can hinder the effectiveness of learning and the implementation of the expected curriculum. To overcome this challenge, training and workshops for teachers are needed so that they understand well the principles of RADEC and are able to apply them in the learning process [14]. These efforts will improve teachers' competencies and have a positive impact on the quality of education [15].

In addition, the lack of resources and learning materials is also an obstacle in the implementation of RADEC. The development of digital-based teaching materials that can be widely accessed is one of the innovations that can be applied to overcome this problem [16]. By utilizing technology, learning materials can be presented in an interesting and interactive way, so that students are more motivated to learn. In addition, the use of digital media also allows easier access for students, especially in the increasingly common condition of online learning [17].

Other challenges include student resistance to new learning methods and lack of support from parents [18]. To overcome this, interactive and engaging learning approaches, such as gamification, can be applied to increase student interest [19]. In addition, holding seminars and workshops for parents on the importance of religious education can also help create stronger support for students in their learning process [20]. With collaboration between teachers, students, and parents, the implementation of RADEC in PAI learning is expected to run more effectively and achieve the desired goals.

IV. CONCLUSION

The RADEC (*Read, Answer, Discuss, Explain, Create*) learning model offers an innovative approach that can improve the effectiveness of Islamic Religious Education (PAI) amidst the challenges of globalization and the times. By integrating interactive and participatory elements, RADEC not only encourages students to understand religious teachings, but also to apply those values in their daily lives, thus shaping their character and morality. However, its implementation is not free from challenges, such as teachers' lack of understanding of RADEC, the lack of relevant teaching materials, and students' resistance to new methods.

Therefore, it is important for schools to conduct training for teachers and develop engaging digital-based teaching materials, as well as implement interactive approaches such as gamification to increase student interest. With the support of parents through seminars and workshops, it is expected that the learning process can be strengthened. Overall, the implementation of the RADEC model in PAI learning is expected to create a more dynamic and enjoyable learning environment, produce students who are not only academically smart, but also have a solid character, and equip them with skills and values that are useful throughout life.

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Building Character through Gamification-based Learning: A Literature Review

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Abstract*—Character education has become an important focus in the education system to form individuals who are not only intellectually and academically smart but also have strong morals and character. This research aims to review gamification-based learning approach as one of the methods that can be used to strengthen character education in elementary schools. Through literature review method from various sources, this research identifies and analyzes relevant literature on the effectiveness of gamification in improving student engagement, motivation, and character development. The results showed that gamification can not only motivate students' enthusiasm for learning but also strengthen educational character values, such as cooperation, responsibility, independence, and resilience. This finding indicates that the application of gamification in education has great potential in creating an interactive learning environment and supporting student character building in the digital era. Thus, gamification learning can build students' character education.

***Keywords*— character education, gamification, digital age**

I. INTRODUCTION

Education today is faced with the challenge of producing human resources that not only have intellectual abilities, but also have strong character and morals. Indeed, in every individual, character has been inherent and exists since birth, but this potential still needs to be fostered and developed early on, both through family socialization and school education [1]. So that a child needs to be educated and get guidance on how to behave and have a good attitude, especially in his daily life[2]. Therefore, the role of education is considered capable of fostering good character and habituation. This has also been regulated in Basic Law number 20 of 2003 concerning the national education system in chapter 1 article 1 which states that "education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation and country" where character education is one of the goals that need to be achieved in the learning process. Character education as a conscious effort in learning to develop the potential of individuals who have strong personalities, morals, and have a positive and constructive influence on their environment[3].

Such as the cultivation of values that include knowledge, awareness or willingness, and action in applying these values to God Almighty, self, others, the environment, and the nation [4]. So character education is considered to play a very important role in shaping the next generation of the nation who are not only intellectually intelligent, but also have noble character and good morals [5]. ikewise, various previous studies have supported the importance of character education in the formation of individuals with integrity. This is based on the rampant cases that occurred in 2020 to 2023, children as victims and perpetrators of sexual violence, bullying, brawls, physical and psychological violence which continue to increase [6]. Seeing so many problems that occur in Indonesia, it is a whip for the world of education, especially basic education as a solid foundation for shaping the character of students [7].

Various solutions have been carried out and developed, especially by the government, which is in the implementation of an education curriculum based on basic standards and competencies directed at the formation of skills and character [8]. Learning in elementary schools should focus on learners with the support of teacher-student relationships that strengthen character through affirmation, visualization, and persuasive language. This process is planned, implemented, and evaluated continuously in every learning session[9].

However, in the face of changes in the digital era, the traditional approach to character education has its own challenges, so that the cultivation of character in students is less achieved. Therefore, innovation in

education, especially a teacher, needs to continue to update and develop competencies to be able to keep up with technological developments, learning strategies and methods so that learning objectives can be achieved perfectly. Then, there is the relevance of integrating innovative approaches, such as gamification in the learning process to overcome this challenge. This approach aims to increase students' enjoyment and participation in the learning process. In addition, gamified learning media also serves to attract students' interest and motivate them to stay passionate in learning continuously [10]. In previous research, learning with the application of game elements in a non-game context, or gamification, is able to increase student motivation and engagement in the learning process [11]. Gamification can be considered as an effective strategy to improve the quality of education amidst the demands of the digital era [12].

So this research looks at an approach that combines aspects of gamification and character education in a systematic and sustainable manner. By integrating gamification technology in character education, it is expected that a more interactive and meaningful learning environment will be created, which is able to shape students into individuals who are not only intelligent, but also have strong character and moral values.

Thus, the purpose of this research is to find out how gamification is able to build character in elementary school children, as well as analyze the impacts that arise in the process. This research is expected to provide new insights and become a reference for educators in developing learning strategies that are more effective and relevant in the modern era.

II. METHOD

This research examines character education in gamification learning through literature review with four stages, namely 1) determining the topic of study and problem formulation, namely how gamification learning can build character education, 2) searching and selecting literature related to the topic, 3) analyzing and synthesizing data, then organizing the writing. [13]. Furthermore, the author will take these four steps to draw conclusions that become the core of the topic that has been chosen.

This research focuses on the topic of character education built through gamification learning. The selection of articles is based on a number of criteria, namely the year of publication, the suitability of the content to the topic under study, as well as the completeness of journal identification obtained from various sources, such as google scholar and other journals relevant to the research topic. With the literature study approach, it is expected to make a significant contribution to the development of a better basic education curriculum. Gathering information through literature studies is considered effective for collecting various data that will later be used by the author to enrich or unify his writing.

III. RESULTS AND DISCUSSION

This section presents the results and discussion of the literature review on how gamification learning can strengthen character education. The discussion consists of 3 main parts, the first part contains a discussion of character education developed in elementary schools through literature review. The second section contains a discussion of the results of the literature review regarding the implementation of gamification learning. And the third section contains the results of research on the impact of gamification learning on character education.

Research Result Gamification in Education

Articles that represent the implementation of gamified learning in education can be seen in the table below.

Table. 1 Representation of articles on the Implementation of Gamified Learning in Education

No.	Author / Year	Article Title	Research Results
1.	[14]	Gamification in Primary School Learning	Gamification in learning effectively supports psychosocial development, encourages student activity and triggers positive emotions.
2.	[15]	Gamification in Education: Increasing Student Motivation and Engagement	Gamification in education improves student motivation and character through responsibility, cooperation, and healthy competition, encouraging positive behavior and social skills.
3.	[16]	Gamification In Education	Gamification effectively increases student motivation and engagement, creating a positive attitude and an interactive learning environment that supports better understanding and learning outcomes.
4.	[12]	The Role of Gamification in Enhancing the	Gamification can be seen as an effective strategy in improving

		Educational Experience In the Digital Age	the quality of education as well as shaping student character in accordance with the needs of the digital era.
5.	[17]	Gamification in Education	Gamification supports self- directed learning and encourages long-term engagement, making it an effective tool to enhance the overall learning experience. However, it needs an appropriate strategy in its implementation
6.	[18]	Effectiveness of Gamification in Math Learning	There is an increase in learning outcomes before and after the use of gamification (Kahoot! and Quizizz), so it can be concluded that gamification is effective in learning mathematics.

Gamification Learning for Learner Character Building

Table. 2 Representation of the article on Gamification Learning for Learner Character Building

No.	Author / Year	Article Title	Research Results
1.	[19]	Teacher Creativity in Building Curiosity Character through Gamification Method	gamification method in learning is effective in improving students' curiosity character. By utilizing game elements, gamification can create a more interesting learning environment, encourage student engagement, and help achieve educational goals that are adaptive to technological developments
2.	[10]	The Use of Gamification in the Learning Process	Playing and interacting in a fun atmosphere can foster a positive attitude towards learning. When learning is presented in the form of games, students become more engaged, enthusiastic and motivated to explore new concepts.
3.	[20]	Application of Gamification to Improve Motivation and Collaboration in Elementary School Students	Gamification creates challenges that encourage cooperation between students by dividing team-based tasks. Students are encouraged to collaborate and communicate effectively, to improve social skills.
4.	[21]	Literature Review: Gamification in Primary Education	Game-based learning is effective in increasing student engagement, learning motivation, peer collaboration, memory, and creating a positive and personalized learning environment.
5.	[22]	Formation of Student Character Education Through the Game "Obak Sodor"	The game "Obak sodor" can teach students about responsibility through the rules and roles that must be followed during the game. Students learn to take responsibility for their actions and understand the consequences of decisions taken in a group context.

The impact of implementing gamification in learning on character education can cover several important aspects, especially in the affective aspects of students, including:

1. Cooperation and Collaboration: With the element of healthy competition and game-based challenges, students are taught the importance of working together and building synergy within a team to achieve a common goal. This develops the character of mutual respect, working in groups, and learning to communicate effectively.

2. Responsibility and Commitment: Gamification encourages students to take responsibility for assigned tasks and commit to completing each stage of learning. Students learn to manage time, complete challenges, and maintain consistency.
3. Confidence: The increase in formative assessment scores after the implementation of gamification showed that students became more confident in their abilities. The achievements gained from completing in-game tasks helped them develop confidence and courage to try new things.
4. Ability to Deal with Failure: Gamification teaches that failure is part of the learning process. Students are taught to stay motivated and try again after failing, building resilient character and resilience..
5. Leadership and Initiative: In gamification activities, students are often given the opportunity to lead groups or take initiative in solving challenges. This develops leadership skills and proactive character.

Through the integration of gamification in character education, character education values such as cooperation, responsibility, confidence, resilience, and leadership can grow in line with increased interest and involvement in the learning process. Gamification learning succeeds in creating an interactive and meaningful learning atmosphere, in accordance with the needs of education in the digital era. However, in its application, the selection of gamification types must adjust the characteristics of learners who have been identified and adapted to the characters to be built in the learning process.

Obstacles and Solutions in Implementing Gamification for Student Character Development

Implementing gamification in learning for student character development faces several challenges or obstacles. First, many teachers do not understand the concept of gamification and how to integrate it in teaching and learning activities. Second, limited technology and infrastructure, such as computers, mobile devices, and internet access, are barriers, especially in remote schools. Thirdly, overly competitive gamification can make students focus only on points or rankings rather than on the learning itself, and the game element can be a distraction so that students are more interested in the game aspects rather than the subject matter. Fourth, a tight curriculum and time constraints are also an obstacle, as gamification integration requires additional planning. Finally, differences in student characters mean that not all students respond well to gamification. These challenges point to the importance of teacher preparedness, infrastructure support, and customization of methods that consider student diversity.

Despite the obstacles, there are several solutions to the challenges of implementing gamification in education, which can be done by the following steps. 1) teacher training and development is essential so that they understand the basic principles of gamification and are able to implement it effectively, thus becoming more confident and skillful in using game elements in learning. 2) utilization of simple and inexpensive gamification can be an option, such as by awarding badges, point systems, or paper-based challenges, to reduce reliance on advanced technology. 3) gamification designs that focus on collaboration and character development can avoid excessive competition, for example by using shared missions or team challenges to encourage students to learn to work together. 4) gradual integration of gamification can help teachers tailor its implementation to the time and needs of the curriculum, starting with specific topics or specific times of the week. 5) a personalized gamification approach can give students the flexibility to choose challenges or activities that suit their interests and learning styles. With these steps, gamification can be an effective tool to develop students' character traits, such as cooperation, confidence, and perseverance, while keeping the focus on educational objectives.

Discussion

Character Education

The word "character" comes from the Greek words charassein and kharax, which mean tools for making or to engrave, i.e. "to carve". The term was later reused in French in the 14th century as caracter, then entered English as character, before finally being adapted into Indonesian as "character" [7].

Character is a way of thinking and behaving that characterizes each individual who is reflected in everyday life, and how he works together in the family, community, education, and nation and state.[24]. So this character will underlie a person's personality, perspective, thinking, attitudes, morals and behavior. So that character education can be applied from an early age, with a character that is maintained from childhood, children can grow and develop with a good and strong character [2]. Therefore it is important to build character and various strong values in elementary school children, this is based on:

1. Primary school education at the age of 4-7 years is a critical period for their socio-moral development [25], so at the elementary school level a child needs guidance and direction of his character.
2. Social skill development, where good attitudes are based on character values that help children form positive attitudes and skills needed to interact according to the values prevailing in society. Such as the ability to empathize, responsibility, cooperation, and respect for others[26].
3. A positive learning environment, where a conducive learning atmosphere discourages undesirable behavior, encourages active participation,

independence and discipline that supports children's academic and social development[27].

4. Character education as a filter for negative actions taken by students [28].

There are five character values that need to be strengthened in character education in schools, these values include religiosity, nationalism, integrity, independence, and mutual cooperation. Where each of these values does not stand alone or develop separately, but interacts with each other, grows dynamically, and together forms personal wholeness [29].

Other characters developed in education include honesty, responsibility, cooperation, self-confidence, politeness, discipline, creativity, ethics, and morals, so that students can grow into virtuous individuals [30]. So that these character values can be built in education through the learning process from an early age with the right strategies and techniques. therefore character education becomes an important foundation in the formation of students' personalities.

Gamified Learning

Gamification is an approach to learning by using elements in a game or video game with the aim of motivating students in learning activities [15]. By utilizing game elements such as providing challenges, rewards, competition and achievement satisfaction, where through this gamification technique can foster interest, enthusiasm, and learner involvement through challenges, competence, rewards and satisfaction in learning activities.

According to various articles discussing the results of gamification-based learning implementation in the field of education, the application of gamification has a significant positive impact on students' learning development. Gamification can strengthen character values as it teaches students to follow rules, cooperate, take responsibility and accept results or feedback in a constructive way. This can be seen in increased student interest and engagement in the learning process. In addition, gamification also helps to increase students' confidence, boost their motivation, and ensure that learning objectives are achieved more effectively. The implementation of this method shows that an interactive and engaging approach can create a more enjoyable and productive learning atmosphere.

In implementing gamification learning, of course, there are several things that need to be considered, so that gamification learning can be implemented effectively and efficiently and have a positive impact on the development of students' characters [14]. The steps in implementing gamification learning are :

1. Recognizing students' characteristics, where the teacher needs to understand the students' profile, including previous experience, gender, and motivation level, which may affect their interest in the game [14].
2. Determining learning objectives, learning objectives should include cognitive and affective aspects, so that they do not only focus on academic results but also on students' emotional and social development[15].
3. Identify appropriate games, i.e. the teacher must choose the type of game that is in accordance with the characteristics of the students and the learning objectives that have been set [14].
4. Developing content, Learning content should be organized by considering the skills and competencies to be promoted, as well as the game elements to be used [16].
5. Adaptation and collaboration, i.e. teachers must be able to maintain student motivation and interest by adapting learning experiences and games according to each student's needs and preferences [15].

IV. CONCLUSION

This study concludes that gamification approaches to learning have a significant positive impact on character education in elementary schools. Gamification elements, such as challenges, rewards and competitions, can increase student motivation and engagement, as well as strengthen character values such as cooperation, responsibility and resilience. In addition, gamification also plays a role in creating an interactive, fun, meaningful and new learning experience for learners. These findings support the importance of integrating gamification as an innovative method in character education to address learning challenges in the digital era.

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The Effect of STEAM Learning through Props on Future Self-Readiness at the Elementary School Level: A Literature Study

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Abstract*— The STEAM (Science, Technology, Engineering, Arts, and Mathematics) learning approach is increasingly recognized as an effective method in preparing students to face future demands. This research aims to examine the effect of STEAM learning supported by the use of teaching aids on learners' self-readiness at the elementary school level, by conducting a literature study from various academic sources. The study reviews the role of teaching aids in generating interactive and enjoyable learning experiences and their impact on the development of 21st century skills such as critical thinking, collaboration and problem solving. The literature findings show that the integration of teaching aids in STEAM learning not only improves the understanding of science and technology concepts, but also strengthens learners' motivation and participation in the learning process. In addition, this approach has proven effective in fostering students' self-confidence and independence, which are important components in their future readiness. Thus, the implementation of props-based STEAM is recommended as an innovative educational strategy for elementary schools.

Keywords*— STEAM learning, teaching aids, primary school, future readiness, 21st century skills.

I. INTRODUCTION

STEAM (Science, Technology, Engineering, Arts and Mathematics) learning is becoming increasingly important in 21st century education. This approach is also not only concerned with the dominance of the material, but also with the expansion of critical thinking skills, creativity, and problem-solving abilities that are needed to face future challenges [1]. In the context of primary education, the use of teaching aids in STEAM learning can increase student effectiveness and engagement. The STEAM method can reliably motivate students to actively participate in an effective learning process in the classroom [2].

The development of technology and the dynamics of modern society demand a holistic and relevant learning approach for students, especially at the primary school level [1]. STEAM learning, which integrates the concepts of Science, Technology, Engineering, Art, and Mathematics, makes one solution to meet these needs. Through this method, students are encouraged to think critically, analyze information, and develop collaborative and creative skills that are indispensable in the 21st century [3].

The implementation of STEAM learning through teaching aids in elementary schools focuses not only on mastering academic materials, but also on developing students' readiness to face future challenges. By engaging students in experiments and creative projects, they learn to formulate arguments, estimate and assess learning outcomes [2]. This learning process creates an environment that facilitates the exploration of individual and group abilities, and increases student motivation and engagement in learning [4].

This literature study aims to analyze the effect of STEAM learning through teaching aids on students' future self-readiness at the primary school level. By exploring various studies on the implementation of STEAM in primary schools, it is hoped that a more comprehensive understanding of the benefits and challenges of this approach in the context of education can be obtained.

II. METHOD

This research method applies the literature study method. In this process, the search for scientific articles is carried out using various sources, such as Google Scholar, and other journals that are closely related to the research topics and themes. This approach was chosen to explore and analyze various literatures related to the topic of the Effect of STEAM Learning through Props on the Readiness of Learners in the future at the Elementary School level. The literature review in writing this article is carried out through four steps, namely 1) selection of the topic to be reviewed, namely the effect of STEAM learning through teaching aids for future readiness at the elementary school level, 2) search and selection of articles related to the topic that has been determined, 3) analysis and synthesis of the literature, 4) organization of writing [5]. Therefore, these four steps will be the author's conclusion which is the core of the chosen topic.

With this literature study method, it is expected to make a significant contribution to the development of a better basic education curriculum. Gathering information through literature study is considered effective in gathering a lot of information. Then it will be used by the author to complete or combine his writing.

III. RESULTS AND DISCUSSION

This section presents the results and discussion of the literature review on the Effect of STEAM Learning Through Props for Future Self-Readiness at the Elementary School Level. The discussion consists of 2 main parts. namely, the first part contains a discussion of STEAM learning on future self-readiness at the elementary school level. The second section contains a discussion of the results of the literature review on the Impact of STEAM Learning Implementation with Props.

STEAM LEARNING ON FUTURE SELF-READINESS AT ELEMENTARY SCHOOL LEVEL

Based on several studies, the application of STEAM learning through props has a strong influence on students' future self-readiness. The following are some of the results of the literature review on STEAM learning on future self-readiness at the elementary school level as shown in Table 1.

Tablel 1. Results of the Literature Review: STEAM Instruction on Future Readiness at the Elementary School Level.

Author Name/Year	Title of Research	Research Results
[6]	Design Thinking Gives STEAM to Teaching: A Framework That Breaks Disciplinary Boundaries	By using a design thinking framework, teachers can facilitate more engaging and relevant learning experiences.
[7]	Analysis of Science Technology Engineering Mathematics (STEM) Implementation in Science Learning	STEM integration in learning has a positive influence on student learning outcomes and can be a reference for further implementation in education.
[8]	Introduction of STEAM Learning Methods to Primary School Students in Grades 1 to 3	STEAM methods should actively engage students with practical and relevant approaches. Without expensive equipment, education can be linked to industry and the surrounding community. If learners feel they can contribute, their motivation and enthusiasm will grow naturally.
[2]	Implementation of STEAM Learning in Low Grades in Elementary Schools	STEAM learning in the lower grades of primary school is contextualized, inviting students to make sense of everyday events and explore their abilities to produce unique work. Through group work, students develop collaboration, responsibility, problem solving and a better understanding of the material.
[9]	STEAM-enabled Learning Media with Augmented Reality Utilization	STEAM programs are an effort to develop essential skills for the 21st century. In today's fast-paced, collaborative work environment, STEAM helps prepare learners for future success.
[10]	Application of STEM Approach to Improve Critical Thinking Skills of Learners	In STEAM learning, learners acquire new information from observations and develop new ideas by understanding experiments and answering questions according to their abilities and knowledge.
[11]	STEAM Learning as Innovative Learning	Through the utilization of more practical learning tools such as videos and worksheets, students can be better prepared to face future challenges.

From the results of the literature review above, it can be interpreted that STEAM-based learning has a strong influence on student learning outcomes. With an active and practical approach, STEAM learning can connect education with the industrial world and the surrounding community, without the need for expensive equipment. STEAM learning also helps develop 21st century skills, such as collaboration, problem solving and creativity. In addition, the use of

practical learning tools prepares learners for future challenges.

Impact of STEAM Learning Implementation with Props

This STEAM learning tool serves as a medium that supports students' exploration and experimentation [12]. Props in STEAM (Science, Technology, Engineering, Arts, Mathematics) learning play an important role in enriching the learning experience and supporting the understanding of abstract concepts in a more concrete and visual way [13]. Teaching aids are not just tools, but also bridges that allow students to connect theory with practice [14]. The results showed that the implementation of STEAM learning with teaching aids had a positive impact on several aspects, including:

Improved Learning Motivation

Learning with concrete props makes students more interested and motivated to learn [15]. Students feel enthusiastic because they can directly see the concepts being studied in the form of props, for example in science and technology lessons [16].

Deeper Understanding of Concepts

Teaching aids help students to better understand abstract concepts, such as the basic principles of physics or mathematics [17]. With direct experience through props, students more easily internalize concepts and relate them to real-world situations [18].

Development of Critical Thinking Skills and Creativity

In the STEAM learning process, students are encouraged to think critically in solving problems and develop creativity to come up with innovative solutions. Props facilitate this process by providing objects that can be analyzed and modified [19].

Improved Social and Collaboration Skills

Project-based STEAM learning often involves group work, where students learn to communicate, discuss and cooperate [20]. Project-based STEAM learning often involves group work, where students learn to communicate, discuss and cooperate [21].

Based on the results of the above review, it shows that the use of teaching aids in STEAM learning provides various significant benefits. Teaching aids in STEAM learning can increase student motivation to learn in a more interesting and practical way, deepen concept understanding by visualizing abstract material, and encourage the development of critical thinking skills and creativity through exploration and analysis. In addition, project-based learning with teaching aids also plays a role in improving learners' social and collaboration skills, which are essential for future personal and professional development. Thus, props in STEAM learning not only support academic aspects, but also essential life skills.

IV. Conclusion

STEAM (Science, Technology, Engineering, Arts, Mathematics) learning at the elementary level has a positive impact on preparing students for the future. This approach enhances 21st century skills, such as collaboration, problem solving, creativity and critical thinking, in an active and contextualized way. STEAM learning helps students understand concepts through hands-on experience, increasing their motivation and ability to take on more complex challenges.

The use of props in STEAM learning helps students understand abstract concepts in a more concrete and visual way. It increases learning motivation, deepens concept understanding and stimulates critical thinking skills and creativity. In addition, project-based learning involving props also enhances students' social and collaboration skills, which are important for their future personal and professional development.

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A COMPARATIVE STUDY OF EXTRACURRICULAR EDUCATION IN INDONESIA-MALAYSIA

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Abstract-Extracurricular activities are additional activities outside the curriculum that provide opportunities for students to develop skills, talents, and character values that are important in everyday life. In the context of education, extracurricular activities in Indonesia and Malaysia are similar in their objectives, but different in their implementation approaches. This research uses the Systematic Literature Review (SLR) method to analyze and compare extracurricular activities in primary schools in Indonesia and Malaysia. The results show that although both countries have similar types and objectives of extracurricular activities, the policy approach, implementation, and focus of skill development are different. In Indonesia, these activities emphasize strengthening cultural values and nationalism, while in Malaysia the focus is on developing physical health and active participation in sports activities. The findings are expected to provide insights for the development of more effective education policies in supporting students' character growth through extracurricular activities.

Keywords-Education, ***Extracurricular***

I. INTRODUCTION

Education encompasses more than just academic learning in the classroom. In addition to understanding concepts from various subjects, students also need to develop life skills, character traits and interests that can support their success in society. A holistic approach to education emphasizes the importance of extracurricular activities, which act as complements and reinforcements to formal learning at school. [3]. Extracurricular activities are a place for students to channel their talents and interests, which vary according to individual potential. By participating in these activities, students have the opportunity to improve self-competence through continuous training and experience.

Extracurricular activities are defined as activities carried out outside the formal curriculum with the aim of developing students' interests and talents. At various levels of education, from elementary school to college, these activities play a crucial role in instilling positive values, social skills and morals. Not only that, extracurricular activities also encourage the development of resilience, so that students can face challenges independently and develop themselves comprehensively. These activities help students to become intellectually, spiritually, emotionally and physically balanced individuals.

In Indonesia and Malaysia, extracurricular activities are considered as one of the important components in the education process. Despite the difference in terms - "extracurricular" in Indonesia and "curriculum activities" in Malaysia - both aim to improve students' life skills and character, which cannot be achieved through classroom learning alone. The governments of both countries encourage the implementation of various types of extracurricular activities in schools, such as sports, arts and religious activities, which can enrich students' learning experiences and facilitate the development of students' full potential.

This research aims to conduct a comparative study on the implementation of extracurricular activities in primary schools in Indonesia and Malaysia. Using the *Systematic Literature Review* (SLR) method, this research will analyze relevant *literature* to get an in-depth picture of the contribution of extracurricular activities in student character building in both countries. This research is expected to contribute to the development of educational policies that support students' active involvement in extracurricular activities.

II. METHODS

The method used in this research is SLR (Literature Review Study) SLR is a summary of various scientific journals that have been reviewed. The purpose of the SLR research methodology is to identify, review and evaluate scientific journals that are in accordance with the research topic (namely character education in vocational higher education) as a basis for making theory or policy.[4] Where the author searches, reads, and understands relevant papers, selects clear data sources, conducts in-depth identification, outlines literature on extracurricular primary school education in Indonesia and co-curriculum activities in Malaysian lower schools. Researchers searched for journals available on Google Scholar with the keywords

Education, extracurricular, curriculum activities in the last 10 years with the exception of articles on education in primary schools.

III. RESULTS AND DISCUSSION

Extracurricular activities are activities carried out as a forum for developing the potential of students which can have a positive impact on strengthening character education. [5] Students' skills and creativity must be developed in accordance with the talents and interests of students implemented in extracurricular education in elementary schools in Indonesia and low school curriculum activities in Malaysia where students' interests and talents are highly considered so that students can easily show and develop their potential in their fields of interest. [6]

Activities outside the intracurricular and co-curricular in Indonesia are known as extracurricular while the term used in Malaysia is Aktiviti Kokurikulum. Both are the same, an activity carried out outside of class learning that is guided and supervised by the education unit. The purpose of extracurricular activities is to foster students' interest in certain activities that cannot be achieved through conventional classroom learning.[1] Extracurricular activities also help learners learn various life skills, leadership, and social and human relations. The curriculum utilizes diverse intracurricular learning to provide learners with sufficient time to learn concepts and reinforce student skills. At the beginning of the school year, extracurricular, intracurricular and elective activities are organized. Each extracurricular coach provides a program and objectives for the learners for the year as it is expected that a delegation of students can participate in competitions.

Primary school extracurricular policies in Indonesia and Malaysia

Law No. 20 of 2003 concerning the National Education System Article 3 The purpose of national education is to develop the potential of students in order to Become a person who believes and is devoted to God Almighty and has noble character, Healthy, knowledgeable, capable, creative, independent, Become a democratic citizen Responsible.[7] Extracurricular activities are one way to realize the goals of national education to make students capable, creative and independent.

Regulation of the Minister of Education and Culture (**Permendikbud**) Number 62 of 2014 "Extracurricular activities are organized with the aim of developing the potential, talents, interests, abilities, personality, cooperation, and independence of students optimally in order to support the achievement of national education goals".[8]

Extracurricular activities mean activities that are concerned outside the curriculum or outside the lesson plan structure.[1] Extracurricular activities are activities that are carried out outside of learning hours according to the wishes of students in choosing the extracurricular activities they will study. "Extracurricular activities are activities that fall outside the realm of the normal curriculum performed by students of school or university education. Extracurricular activities exist at all levels of education, from 4th-6th, junior high/middle school, high school, college and university education". Extracurricular activities are activities that school students do outside of standard curriculum learning hours. [1]

Whereas from the Education Act 1996 (Akta 550) says that "Education in Malaysia is a continuous effort towards further developing the potential of the individual as a whole and combined to produce a balanced and harmonious person in terms of intellect, spirit, emotion, and body, based on trust and obedience to God. This endeavor is aimed at producing Malaysian citizens who are knowledgeable, skilled, noble, responsible, and have the ability to achieve self-welfare and contribute to the harmony and prosperity of the family, community, and country." [9]

Extracurricular activities implemented by the Ministry of Education in schools are an extension of the classroom teaching process. These activities aim to enrich the knowledge and experience of students' intelligence, interests, talents, physical and spiritual to develop students' leadership abilities and improve aesthetic values, identity and positive social values. Extracurricular activities aim to get all learners involved in various activities through uniformed teams, associations/clubs as well as sports and games to improve their identity and develop quality human resources.[10] Co-curriculum is a planned individual and group activity that is an extension of the teaching and learning process in the classroom that provides an opportunity to add, strengthen and practice the knowledge, skills and values learned in class. From the legislation policy and also the Act of Education, it can be said that extracurricular activities are a place to increase the potential, talents and interests of students to achieve the goals expected by students.

Implementation of Primary School Extracurricular Activities in Indonesia and Malaysia

Extracurricular implementation in elementary schools is carried out by (1) school culture, divided into routine activities that students carry out continuously and consistently, (2) checking body hygiene (nails, ears), hair, and others every day, (3) praying at the beginning and end of lessons, (4) applying 5S (smile, greet, greet, polite, polite) to all school residents, (5) shaking hands with the picket teacher every morning or others.[11] Primary school education is a basic educational institution where learning is also fundamental to the implementation of extracurricular

activities that are encouraged for students to emphasize student self-confidence.

Extracurricular activities are carried out containing elements of character education so that students can easily apply them in their daily lives. Generally, the mandatory extracurricular activities that students participate in are scouts. Scouts train discipline, hard work, see the leadership potential that exists in students. Other extracurricular activities include music, karate, drum band, pencak silat, chess and so on. [11] The implementation of extracurricular activities depends on the regulations of each school, usually one meeting a week.

Co-curriculum activities can be carried out individually, in groups, or in large groups. Therefore, the safety aspect of carrying out co-curricular activities is a very important element and needs to be focused on. Risk management aspects should always be emphasized according to the goals and objectives of the activity. Schools need to use the expertise of validly recognized certified trainers or teachers who have the skills and know how to handle these activities games and curriculum. [12] In other words, extracurricular activities play an important role in the educational process. Involving students and the community as the younger generation in extracurricular activities can realize mutual cooperation, unity and a sense of national unity, and instill good values directly and indirectly when participating in these activities.

Types of extracurricular activities in Indonesian primary schools

The types of extracurricular activities in Indonesia and Malaysia do not have much difference, both have extracurricular activity programs to improve students' abilities, interests and talents in their respective fields. Students are given the freedom to choose extracurricular activities without coercion but with encouragement and motivation from every important aspect of their lives such as teachers, parents and people around them.

No.	Types of extracurricular activities in Indonesia-Malaysia		
	Indonesia	*Malaysia*	*Reference*
1	Scout	mixer	[13] [14]
3.	Sports	Sports	[15] [9]
4.	Religion	Qur'anic Education	[16] [17]
5.	Art	Art Club	[18] [6]

Each extracurricular activity has its own learning objectives, such as scouting activities, which are an alternative to education that occurs outside the classroom for the formation of character values, especially the value of Indonesian character values. Indonesian character value education is education that is applied based on Indonesian culture which aims to provide reinforcement in the development of learner behavior in order to shape the personality of learners to become whole human beings. [19] In extracurricular scout activities, there are learning objectives, namely developing students' soft skills and forming students into active and independent individuals.

In Malaysia, the term scouting is called pengakap which aims to form extracurricular open-minded individuals, namely individuals who have a modern, creative and innovative mindset and are skilled in applying extracurricular knowledge and skills effectively and responsibly in solving problems and making decisions, based on attitudes and values so that students are able to face challenges in everyday life, in line with the development of science and technology and the challenges of the 21st century.[14] In the startup, students are taught to practice leadership, cooperation, and volunteer spirit through interesting activities at school. This movement was chosen for a compulsory cocurriculum program in lower schools in Malaysia.

Education units provide various extracurricular sports activities to channel learners' talents, interests, personality hobbies and creativity. These activities can be used as a tool to discover the talents of learners and design professionally to become a place of actualization and character development.[15] There are various extracurricular sports including extracurricular soccer, volleyball, basketball etc. In this extracurricular activity, students are able to find and improve their talents in the field of sports which can be used as a tool to detect the talents of students and design professionally so that it can become a vehicle in producing talents, forming character, and a place for the actualization of students.

The Malaysian Ministry of Education (KPM) has now launched the 1 Murid 1 Sukan (1M1S) policy where it is mandatory for every student to participate in at least one sukan activity at school. Each student will be actively involved in school sports activities throughout the year. The inclusion of students in this activity is very important as a foundation to support the aspiration of a healthy, dynamic and united Malaysia as suggested by Yang Amat Berbahagia Prime Minister of Malaysia. [9] Sukan is the term for extracurricular Sports activities in Malaysia, sukan is an activity to enhance quality life and a healthy lifestyle way of life the whole integration is mental, social, emotional, physical, intellectual and Rohani components.

Religious self-development activities, especially those related to improving the recitation of the Qur'an and Islamic art, are carried out because they can motivate students to show their talents and interests. Basically, the purpose of religious extracurricular activities is to explore the potential of students in the religious field. In Indonesia, there are religious extracurricular activities [10] "Keberkesanan Iqra' Sebagai Kaedah Pembelajaran Membaca al-Qur'an" aims to see the effectiveness of the Iqra' method as a method of learning to read the Qur'an in schools in Malaysia. The study has been conducted in 27 schools in several public schools under the Ministry of

Education Malaysia and 6 private religious schools. These activities provide learners with the opportunity to enhance the skills they already have. For example, in the religious field there are various extracurricular activities, such as murrotal, tilawah and tambourine. These extracurricular activities teach students to read the Qur'an with tajweed and with the rhythm of the song, so that students learn to read the Qur'an and recite it beautifully.

In lower schools in Malaysia, it is known as extracurricular Quran education. Quran Education subjects continued to be implemented in schools when the Rahman Talib Report became the Education Act of 1961 where schools were obliged to organize religious subjects if they had at least 15 Muslim students. The pattern of learning continued to change when it became part of the school curriculum. Quran skills classes are one of the co-curricular activities implemented in SMKA and KAA nationwide. However, the schools concerned are obliged to implement three hours a week for each level according to the stipulated lesson hours. Therefore, its status as a co-curricular activity, so the learning process is carried out outside the official school schedule.[17]

Impact on students in extracurricular education

Extracurricular activities are extra activities in schools usually carried out outside of lesson hours. This activity aims to make students more aware of deepening and developing what interests and talents students can be fostered for student character development.[21] Student character building is carried out by learning outside of school hours or called extracurricular activities to be one of the positive impacts of extracurricular activities in elementary schools students become more active, independent and disciplined in carrying out daily life. In addition to shaping the character, another impact of extracurricular activities is to foster the creativity of each individual and interact between individuals or groups so that self-adjustment can be achieved quickly.

Extracurricular activities are able to improve the abilities and creativity of students in accordance with the interests, potential, and talents of students and can also train students' sense of social responsibility and create a relaxed, encouraging, and fun environment for students that supports the development of students.[5] So that students can develop according to their respective interests and talents and there is no coercion in it.

Cocurriculum activities provide opportunities for students to build physical strength, improve mental abilities and help stabilize moods. Through cocurriculum activities at school, students are able to develop several important aspects, namely intellectual and personality. Co-curricular activities also need to have elements of knowledge, noble values and new skills that students will acquire through experience during the exercise. This is important because co-curricular activities are an extension of the teaching and learning process that takes place in the classroom which serves to strengthen and become a forum for students to practice the knowledge they have learned." [22].[22] Cocurriculum activities are made to develop aspects of life such as intellectual and personality aspects which are the impact of the learning activities of the lower school cocurriculum activities in Malaysia. Activities outside of intracurricular and cocurricular in Indonesia are known as extracurricular while the term used in Malaysia is Aktiviti Kokurikulum. Both are the same, an activity carried out outside of class learning that is guided and supervised by the education unit. The purpose of extracurricular activities is to foster learners' interest in certain activities that cannot be achieved through conventional classroom learning. Extracurricular activities also help learners learn various life skills, leadership, and social and human relations.

IV. CONCLUSIONS

Extracurricular is a group activity whose planned activities are an extension of the teaching and learning process in class which provides an opportunity to add, strengthen and practice the knowledge, skills and values learned in class. [1] In education, it not only covers general knowledge but also strengthens soft skills, as well as the interests and talents of each student that must be developed.

This comparative study reveals the important role of extracurricular education in character building and life skills development of students in Indonesia and Malaysia. Despite having a similar main goal of developing students' non-academic aspects, the implementation approaches in the two countries show significant differences, reflecting their respective cultural characteristics and educational policies.

In Indonesia, extracurricular education is focused on strengthening national values, religiosity and culture. This is reflected in activities such as scouting, traditional arts, and religious extracurriculars that are directed at instilling values of togetherness, independence, and patriotism. The extracurricular policy in Indonesia, as stipulated in Law No. 20/2003 on the National Education System and Minister of Education and Culture Regulation No. 62/2014, provides flexibility for schools to manage these activities according to local potential and needs. This approach allows students to better recognize and love their own cultural identity, so that character education integrated with local culture becomes more relevant and contextual.

In contrast, in Malaysia, the approach to extracurricular education, or "aktiviti kokurikulum," is more structured and standardized with a focus on fostering students' physical, mental and emotional balance. This policy is manifested in the national program "1 Murid 1 Sukan," which emphasizes the importance of every student's participation in at least one sport. Co-curricular activities in Malaysia also emphasize safety and strict risk management, and involve trained professionals. This indicates that

Malaysia tends to put more emphasis on physical education and health as the basis for shaping students' character, which is supported by government policy in the 1996 Education Act.

The results also show that both countries face challenges in implementing extracurricular education. In Indonesia, limited budgets and facilities in some schools are an obstacle in developing more varied and innovative activities. Meanwhile, in Malaysia, the main obstacle is maintaining students' interest in the required co-curriculum programs, which sometimes do not match students' interests. Nonetheless, both have great potential to develop extracurricular education that is more integrated with 21st century skills, such as critical thinking, digital skills and collaboration.

As a recommendation, both Indonesia and Malaysia need to strengthen budget support for extracurricular programs in primary schools and promote innovation in activities that are relevant to the needs of the modern world. Developing programs that blend local culture with global skills will have a greater positive impact on students. Thus, extracurricular education can further contribute to the formation of a generation that is not only of good character but also ready to face future global challenges.

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Implementation of Moderation In Islamic Organizations In Indonesia

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Abstract-This research analyzes the literature on the Implementation of Moderation in Different Islamic Organizations by offering an innovative approach in a persuasive manner regarding religious moderation to increase the sense of moderation in living life. The research uses a Systematic Literature Review approach with the stages of determining themes, searching, selecting literature, analyzing and interpreting, preparing drafts, and disseminating results. The research used 15 articles from a selection of 30 studies on four things, namely, implementation, challenges, innovation, and evaluation. Although various Islamic organizations, such as Nahdlatul Ulama and Muhammadiyah, play an important role in promoting religious moderation through education, interfaith dialogue, and social activities, there are still narratives of extremism. Therefore, innovations in education and communication approaches, as well as inter-organizational collaboration, are needed to strengthen moderation. Systematic evaluation of these programs is also important to measure their effectiveness and impact on social harmony, so as to create a more harmonious and respectful society in the midst of diversity.

Keywords-implementation, moderation and organizational differences

I. INTRODUCTION

Indonesian society is known as a pluralistic and diverse society. This plurality is reflected in various differences, both horizontally such as ethnicity, language, and customs, as well as vertically in spiritual relationships. Plurality is an inseparable part of the history and reality of Indonesian society, like the colors of a rainbow that add beauty. This diversity is harmony and beauty in itself, not chaos. Diversity cannot be denied or avoided; it will always exist as part of sunnatullah or God-ordained laws of nature. [1].

According to Yenny Wahid In Indonesia, about 7.7 percent of the total population of more than 200 million people are exposed to extremism and radicalism. Most of them understand the concept of jihad literally as war. They even support and justify radical actions and movements, including providing financial assistance, materials, and carrying out attacks on places of worship. In fact, jihad has a broader meaning, as mentioned in several traditions. Jihad can be a pilgrimage, trying to seek the pleasure of Allah SWT, restraining lust, or speaking the truth before the ruler. Among the various forms of jihad, restraining and controlling the passions within oneself is often considered more difficult than facing a real enemy in battle. [2].

The challenge is the different approaches in implementing the values of moderation, where some Islamic organizations emphasize education and da'wah, while others tend to focus on political or social advocacy. Meanwhile, the support of the government and religious leaders is essential to create consistency in implementing the values of religious moderation in various Islamic organizations, so that these organizations can support each other and strengthen moderate attitudes among Muslims at large. [3].

Considering these challenges, the study of religious moderation among Islamic organizations becomes very important to understand how moderate Islamic values can be strengthened and maintained amid the diversity of Islamic organizations in Indonesia. It is hoped that, with consistent and purposeful implementation of religious moderation, Islamic organizations in Indonesia can become the main pillar in maintaining harmony and togetherness in a diverse society.

Therefore, religious moderation is an important concept in maintaining social harmony in diverse societies, including in Indonesia, which has the largest Muslim population in the world and a diversity of Islamic organizations with diverse characteristics. Islamic organizations in Indonesia, such as Nahdlatul Ulama (NU), Muhammadiyah, and various other organizations, have a strategic role in guiding their members to practice Islam in a peaceful, inclusive, and tolerant manner. However, on the ground, there are various challenges in implementing the principle of religious moderation, especially when there are different interpretations between organizations regarding social, political and religious issues. These differences sometimes lead to friction, both between Islamic organizations and among community members who identify with a particular organization, which can potentially lead to social disharmony.

Religious moderation is increasingly important in the era of globalization and amid the complex social challenges facing society. The emergence of polarization and extremism in some communities emphasizes the need to understand and promote moderation, especially among the younger generation. As agents of change and future leaders, students have a strategic role in building an inclusive and harmonious society. [4].

Although most Islamic organizations in Indonesia support the principle of religious moderation, the reality on the ground shows that harsh and exclusive narratives are still found, especially through social media or certain groups within the organization. This factor has the potential to create a less tolerant view and narrow the understanding of Islam as a religion that should be rahmatan lil 'alamin. This is reinforced in the Journal *of Islamic Social Studies*, which shows that some members of Islamic organizations have difficulty in understanding the boundaries between firm beliefs and moderate attitudes that can accept differences, which are sometimes exacerbated by the influence of digital content that leads to radicalism.

II.METHOD

The systematic literature review (SLR) method is used in this study to obtain a description and data on the variables under study in an explicit, structured, and accountable manner, namely conducting a study of various reference works and previous studies that have similarities. This method aims to obtain a theoretical basis relevant to the problem being studied through a review of books or other sources. The main objective is to find a more in-depth discussion of a topic or issue that is in accordance with the topic discussed in the article.

The data sources in this study come from scientific papers, such as journal articles, books, notes, and various reports relevant to the problem to be solved. The literature review was carried out in stages 1) Classification and Determination of approach, 2) article search, 3) Article selection, 4) data analysis and interpretation, 5) draft article, and 6) dissemination of results. At the initial stage, the focus of the study was determined on the theme of Implementation of Tolerance Attitudes towards Religious Diversity which includes three things, namely implementation, challenges, innovation, and evaluation. [5].

In the implementation process, article searches were conducted through various sources such as Google Scholar, Sinta, and other sources, which resulted in 30 initial articles. These articles were then filtered based on the criteria of year of publication and indexation. After the screening and selection process, 15 articles were obtained which were used as literature review materials. These selected articles were further analyzed, and the data were interpreted to get an overview and conclusions on the themes discussed.

III.RESULTS AND DISCUSSION

The results and discussion of this research are based on a systematic *literature review*, with the main focus on four themes, namely implementation, challenges, innovation, and evaluation. The following is an explanation of the four research focuses.

Implementation of Moderation in Different Islamic Organizations

The implementation of moderation in various Islamic organizations shows the diversity of approaches and strategies used to promote the values of moderation and interfaith harmony. Each organization has different characteristics and contexts, which influence the way they implement moderation. The implementation of moderation in various Islamic organizations includes various important aspects that can be discussed. First, the basics of moderation in Islam refer to the teachings of the Qur'an and hadith that emphasize the importance of moderation, such as respecting differences and establishing good relations between fellow Muslims. In addition, the history of the Prophet Muhammad is a clear example of how moderation was implemented in the Muslim community in Medina. Second, education and outreach play an important role, with organizations such as Nahdlatul Ulama (NU) and Muhammadiyah developing curricula that include values of moderation, dialogue and interfaith harmony. Training of preachers is also conducted to ensure moderate and tolerant preaching.

Furthermore, interfaith dialog is an important tool in building understanding and mutual respect. Interfaith dialogue forums and joint activities, such as social services, strengthen interfaith relations. Social and humanitarian activities are also a focus, where Islamic organizations actively provide assistance to the community regardless of religious background and run community empowerment programs with the principle of inclusiveness.

In the realm of advocacy and public policy, Islamic organizations support moderation policies that promote harmony and fight discrimination, and keep an eye on extremism that can undermine harmony. The role of youth is equally important, empowering them through dialogue, social action and creative activities such as art, music and media to spread the message of moderation. Media and technology become strategic tools, where moderation campaigns are conducted through social media, and educational content is created to raise public awareness.

Finally, the different approaches among these organizations also attract attention. For example, NU tends to use a traditional and cultural approach, while Muhammadiyah emphasizes a rational and modern approach. The focus of activities also varies, with some emphasizing education and dialogue, while others are more inclined towards social activities or advocacy. All these efforts show the commitment of

Islamic organizations in promoting moderation as a fundamental value in social life.

approaches. Each organization strives to create a society of mutual respect and peaceful coexistence, despite differences in religious beliefs and practices. Moderation is an important value in maintaining social stability and harmony in society, and each organization has a unique role in promoting these values.

Table.1 Representation of articles on the Implementation of Religious Moderation

Year	Author and Article Title	Research Results
2022	Ahmad, Rudi Stai, Suryadi Email, Cianjur Implementation of religious moderation in Islamic religious education	Implementation of *mainstreaming* in the formation of moderate attitudes and behaviors supported by moderate religious understanding.
2021	Sumarto, Sumarto Implementation of the Religious Moderation Program of the Ministry of Religious Affairs	The application of bias makes religious moderation a character of the life of the nation and state.
2021	Muhamad Syaikhul Alim, Achmad Munib ACTUALIZATION OF RELIGIOUS MODERATION EDUCATION IN MADRASAH	Optimizing habituation and madrasah culture are applied as strategies to internalize Islamic moderation character values, as well as developing programs that strengthen Islamic moderation.
2020	Ridwan Yulianto IMPLEMENTATIO N OF MADRASA CULTURE IN BUILDING RELIGIOUS MODERATION	The implementation of religious moderation education based on madrasa culture becomes the basis for behavior, tradition, and daily habits practiced in the madrasa environment.
2021	Edelweisia Cristiana IMPLEMENTATION OF RELIGIOUS MODERATION IN PREVENTING RADICALISM	The implementation of religious moderation is a concrete form of love for God and fellow human beings, which aims to realize a peaceful life.

The implementation of moderation in various Islamic organizations reflects the diversity of [8].

Based on Table 1 above, the Implementation of Religious Moderation from 2020 to 2022 emphasizes the importance of implementing religious moderation in education and social life to form moderate attitudes. This approach is carried out through the integration of moderate religious understanding, the development of national character, and the application of madrasah culture as a means of internalizing moderate values. Religious moderation is also seen as a form of love for God and fellow humans, which plays a role in preventing radicalism and supporting the creation of a peaceful life.

Challenges in Implementing an Attitude of Moderation towards Religious Diversity

The implementation of an attitude of moderation towards religious diversity in Indonesia has a number of challenges that need to be overcome to create a peaceful and harmonious society. [7]. Some of the main challenges in implementing this attitude of tolerance include:

1. Lack of Understanding and Moderation Education

   Not all educational institutions effectively instill moderation. There are still many schools that do not have programs or materials that teach religious moderation. Teachers who have not been trained in moderation education and the lack of a specific curriculum are the main obstacles. The lack of moderation education leaves the younger generation without a deep understanding of the importance of respecting religious differences, which can lead to intolerant actions.
2. Differences in Interpretation of Religious Teachings

   Every religion has groups or individuals who may take religious teachings to extremes, either too textual or too liberal. These differences in interpretation sometimes lead to exclusive attitudes and rejection of other religious groups. This causes the distance between religious communities to widen and builds a mindset that considers its own religion to be more correct or superior to other religions, which hinders the creation of tolerance.
3. Social and Environmental Influences

In some communities, especially those that are religiously homogenous, stereotypical attitudes and prejudices against other religions are still strong. Social environments that are closed to differences tend to inhibit acceptance and moderation. The influence of this environment can shape moderation and even discriminatory attitudes, which worsen interfaith relations in society.

4. Social Media and the Spread of Hoaxes or Hate Speeches

Social media is often a place where fake news, hoaxes, or religious-based hate speech is spread. The spread of this information is often uncontrolled and can quickly lead to tensions between religious communities. Negative information that is easily spread worsens perceptions of other religions and undermines efforts to create moderation. Low digital literacy makes people easily influenced by extremist content.

5. Lack of Role of Religious Leaders in Spreading the Message of Moderation

While there are many religious figures who advocate moderation, there are still religious figures who propagate exclusive views. These different views can cause extremism to develop among their followers. Religious figures who are exclusive can influence their followers to be the same, making it difficult to create a harmonious atmosphere in the midst of religious diversity.

6. Fanaticism

Fanaticism is an attitude that reflects excessive attachment to a particular belief, group or ideology. This attitude makes a person or group often lose the ability to think critically and objectively, making it difficult to accept different views. Fanaticism is characterized by excessive loyalty and a tendency to reject other points of view, despite evidence to support them. As a result, fanaticism can trigger extremism or even aggressive behavior towards people who hold different views, which can lead to conflict and damage harmony in society.

Challenges in the implementation of moderation towards religious diversity include the lack of moderation education, differences in religious interpretation, the influence of the social environment, lack of policy consistency, the negative influence of social media, the diverse roles of religious leaders, and interfaith prejudice. All these challenges show that moderation towards religious diversity needs to be supported by cooperation from various parties, including government, education, media and society, to create an environment of mutual respect.

Table 2.Representation of Articles on Challenges in Implementing Tolerance of Religious Diversity

Challenge	Implementation of Moderation Attitude	Author
diversity of ethnicity, religion, race and customs spread across many islands.	understanding of tawhid, justice and equality, brotherhood, harmony, and the example of the Prophet Muhammad.	Alwazir Abdusshomad 2024 Implementation of Islamic Values in Tolerance Education (Literature Study on Unifying Efforts in Indonesian Pluralist Society)
The phenomena of stereotyping, prejudice, and discrimination are often	Understanding the importance of building awareness and tolerance in cultural diversity in maintaining social harmony and inclusiveness.	Barella, Yusawinur Fergina, Ana Achruh, Andi Hifza, Hifza 2023 Multiculturalism in Islamic Education: Building Awareness and Tolerance in Cultural Diversity
Islam, Protestantism, Catholicism, Hinduism, Buddhism, Confucianism.	recognize each other, respect each other, and cooperate in virtue despite different religions and ethnicities. difference	Basid, Abdul Krisyardi, Gardean Danendra Nurhidayati, Aulia Putri Farisandi Paramasatya Shalsabella, Meesha D Zuhroh, Siti Aminatuz Implementation of Tolerance towards Religious Diversity
Multicultural Society	promoting an understanding of religion that moderation, interfaith tolerance, and harmony	Nasri, Ulyan Tabibuddin, M. 2023 The Paradigm of Religious Moderation: Revitalizing the Function of Islamic

Challenge	Implementation of Moderation Attitude	Author
	in an increasingly diverse society	Education in a Multicultural Context Perspective of Imam al-Ghazali's Thought

Based on table 2, it can be concluded by me that to build a strong attitude of moderation in Indonesia, cooperation from various parties is needed, with effective character education, inclusive religious education, as well as government and community support, so that Indonesia can become an example in maintaining harmony and appreciating diversity as a national asset.[8]

This research plays an important role in developing a more inclusive and equitable Islamic education program. The findings of this study provide useful advice for policy makers, teachers, students and the wider community on the importance of building awareness and moderation towards cultural diversity in order to maintain social harmony and inclusiveness.[9]

Imam al-Ghazali's view of moderation in religion, which emphasizes balanced understanding, tolerance, and rejection of extremism, is highly relevant in the current situation filled with religious and cultural diversity.[10]

Religious differences should not be the cause of divisions that end in putting each other down, demeaning, or mixing up beliefs between religions. [10]

Innovation of Moderation in Different Islamic Organizations

The innovation of moderation in various Islamic organizations is an important step to create harmony and mutual respect among different groups. [9]. Innovation in promoting moderation can be explained through several important aspects.

1. Moderation education and training is the first step, by developing an inclusive curriculum that includes the values of moderation and respect for differences in madrasas, pesantren, and other Islamic educational institutions. In addition, training for moderation leaders is organized to equip them with the understanding and skills to implement moderation in leadership.
2. Inter-religious and intercultural dialogue is an important tool in building harmony. Discussion forums involving various Islamic and non-Islamic organizations help discuss moderation issues and strengthen understanding between groups. Joint cultural events are also a time to celebrate differences and strengthen interfaith relations.
3. Joint social activities such as humanitarian projects involving various organizations can demonstrate the spirit of collaboration in helping the community regardless of religious background. In addition, joint environmental activities symbolize cooperation on global issues such as environmental conservation.
4. The use of technology and social media offers great opportunities through awareness campaigns on the importance of moderation. These campaigns can be in the form of videos, articles or infographics that are widely disseminated. Online discussion platforms can also be built to provide a space for sharing ideas and experiences on moderation between organizations.
5. Innovation in communication approaches is key. Open and empathy-based communication is taught to encourage productive dialogue, so that members of the organization can listen to and understand each other's perspectives, reduce prejudice, and strengthen relationships.

Finally, inter-organizational collaboration is a strategic element in promoting moderation. Tolerance alliances between different Islamic organizations can be realized through organizing joint events and sharing resources. In addition, inter-organizational exchange programs provide opportunities to learn from each other's best practices in implementing moderation. All these measures support the creation of a harmonious and inclusive environment.

The innovation of moderation in Islamic organizations is essential for creating a harmonious and respectful society. By implementing innovative strategies and approaches, organizations can contribute to building interfaith harmony and overcoming differences.

One example is that during the time of the madhhab scholars, moderation became an important innovation that allowed for differences of opinion among scholars without dividing Muslims. Each school, such as Hanafi, Maliki, Shafi'i and Hanbali, has its own way of understanding the Quran and Hadith. However, the scholars still emphasized the importance of respecting different views. They developed the method of ijtihad, which allows each school to express their views according to different contexts and backgrounds, but still within the framework of Islamic law.

For example, Imam Shafi'i taught his students not to underestimate the views of other schools of thought and encouraged them to consider various arguments before deciding the law. This innovation shows how the scholars of the time promoted moderation through ijtihad, discussion, and respect for different views. In this way, differences between madhhabs are not a source of conflict, but rather a wealth of knowledge in Islam.

Evaluation of Moderation in Different Islamic Organizations

Evaluation of moderation in Islamic organizations is the process of assessing how moderation is implemented, practiced, and internalized in these organizations. This evaluation is important to understand the effectiveness of programs, activities, and initiatives aimed at promoting moderation among members of the organization and the wider community. [11]. Evaluation of moderation attitudes in various Islamic organizations can be done through several key aspects.

1. Moderation indicators include the organization's involvement in interfaith dialogue, which is measured by the number of events, level of member participation, and impact on interfaith relations. In addition, education and training programs that teach moderation values are evaluated through curriculum, teaching materials, and participant engagement. The organization's contribution to social and humanitarian activities is also an important indicator, including its impact on interfaith harmony.
2. The social impact of the organization's moderation initiatives is evaluated through its effects on society, such as the reduction of interfaith conflict and increased harmony. Specific case studies are also analyzed to see the organization's success in promoting moderation and its impact on the community.
3. Challenges and obstacles in implementing moderation are also a concern. The challenges faced by organizations may be internal resistance, differences in understanding, or external influences. The strategies used to overcome these obstacles are analyzed to evaluate their effectiveness.
4. Comparisons between different organizations are made to analyze the approach, effectiveness, and results of their respective moderation programs. This comparison can provide insights into best practices as well as areas for improvement. In addition, collaboration between organizations is evaluated to see how cooperation can increase the effectiveness of moderation programs and strengthen their impact. All these aspects provide a comprehensive picture of the implementation and success of moderation in Islamic organizations.

Evaluation of moderation in various Islamic organizations is an important step to understand the effectiveness of the efforts that have been made and to formulate better strategies for the future. By conducting comprehensive evaluations, organizations can improve existing programs, overcome challenges, and better contribute to the creation of a harmonious and tolerant society. [13].

IV. CONCLUSION

Religious moderation must be maintained together, both by individuals and institutions, as well as by society and the state. Moderate religious groups need to be more active in speaking out and not let themselves become the silent majority. Every element of the nation must believe that Indonesia has strong social capital to strengthen religious moderation, namely local cultural values, diversity of customs, traditions of deliberation, and a culture of mutual cooperation that has been passed down for generations. This social capital must continue to be nurtured to create a harmonious life in cultural, ethnic and religious diversity. By working together, Indonesia can become a world example in practicing religious moderation. In addition, the state also needs to be present to facilitate the creation of public spaces that support interfaith interactions. [14].

Although various Islamic organizations, such as Nahdlatul Ulama and Muhammadiyah, play an important role in promoting religious moderation through education, interfaith dialogue, and social activities, there are still narratives of extremism emerging on the ground. Therefore, innovations in education and communication approaches, as well as inter-organizational collaboration, are needed to strengthen moderation. Systematic evaluation of these programs is also important to measure their effectiveness and impact on social harmony, so as to create a more harmonious and respectful society in the midst of diversity.

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Life Skills Learning at Nusantara Islamic Boarding School

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Abstract-This research analyzes the literature on the integration of life skills learning in Islamic boarding schools in the archipelago which is very important to prepare students to face the challenges of globalization and digitalization. The research used a Systematic Literature Review approach with the stages of determining themes, searching, selecting literature, analyzing and interpreting, preparing drafts, and disseminating results. The focus of the study is on 3 things, namely concept, implementation and impact. The results of this study show that; By developing social, emotional, and practical skills, santri are not only able to adapt to changing times, but also have a strong character and independence. Although there are challenges in its implementation, such as limited resources and resistance to change, life skills education can make pesantren a center for quality skills development. This will help pesantren graduates compete and contribute positively in modern society. With support from all parties, the integration of life skills education in line with Islamic values is expected to produce a generation of santri who are independent, responsible, and able to have a positive impact on their communities.

Keywords-life skills, pesantren, archipelago

I. INTRODUCTION

Pesantren in the archipelago have long been a center of education and character development that focuses on instilling religious and moral values. However, in facing the challenges of globalization, the digital era, and rapid social change, the skills taught in pesantren need to be improved to meet the needs of santri in the modern world. Life skills are becoming increasingly important to equip santri in living an independent, productive life, and are relevant to the demands of the times. Without the development of applicable life skills, pesantren graduates often experience difficulties in adapting to the work environment and the wider community. [1].

The education system in most pesantren still dominantly focuses on traditional religious knowledge without paying maximum attention to aspects of life skills, such as self-management, communication skills, financial literacy, and critical thinking skills. [2]. In fact, these abilities are needed for santri to be able to participate actively and productively in modern society. According to [3], the pesantren curriculum that minimally integrates life skills causes limitations for santri in practicing Islamic values in diverse and dynamic daily life.

In addition, there are other challenges in implementing life skills learning in pesantren. Limited facilities, lack of competent educators in life skills, and limited support from the pesantren management are the main obstacles in developing a sustainable life skills program. [4]. Students in pesantren with traditional approaches show lower levels of independence and life skills than students in pesantren that have integrated *life skills* education.

In addition, technological developments and the digital era pose additional challenges for pesantren graduates. The lack of understanding of basic technology and digital literacy makes santri lag behind in the skills needed in the digital era. Digital literacy as part of life skills is increasingly urgent to be integrated into the pesantren curriculum so that santri have the ability to adapt to technological change. [5]. *Life skills* that include digital literacy, communication skills, and an understanding of the digital economy are essential skills that will help santri compete in a competitive global environment.

On the other hand, pesantren have great potential to develop life skills education based on Islamic values, making it different from other formal education approaches. Pesantren can develop life skills programs that are in line with religious values, such as Islamic entrepreneurship, sharia-compliant financial management, and character development based on Islamic teachings. This will not only help santri become more independent individuals, but also make them agents of change who bring Islamic values to their daily life practices. [6].

Thus, there is an urgent need to integrate life skills education in the curriculum of pesantren in the archipelago. Learning *life skills* in pesantren will not only increase the ability of santri to be independent and adaptive, but will also provide them with practical skills that are relevant to the world of work and social life. Through further research and support from various parties, the development of *life skills* in pesantren is expected to address the gaps in the current curriculum,

so that pesantren graduates can have high competitiveness and contribute positively in society.

II. METHOD

This research uses the *Systematic Literature Review* approach method with the stages of determining themes, searching, selecting, namely activities that examine various reference works and the results of previous similar research. This method aims to obtain a theoretical basis for the problem being studied by reading various books or sources. [7]. The main objective is to find a more in-depth discussion of a topic or issue that is in accordance with the topic discussed in the article.

The data sources in this study come from scientific papers, such as journal articles, books, notes, and various reports relevant to the problem to be solved. Literature review is carried out in stages 1) Classification and Determination of approach, 2) Article search, 3) Article selection, 4) Data analysis and interpretation, 5) Draft article, and 6) Dissemination of results. At the initial stage, the focus of the study was determined on the theme of *LIFE SKILLS* Learning in Islamic boarding schools in the archipelago which includes three things, namely concept, implementation and impact.

III. RESULTS AND DISCUSSION

The results and discussion of this research are based on a systematic review of the literature, focusing on three main themes, namely the concept of *life skills* learning in Islamic boarding schools, the implementation of *life skills* learning in Islamic boarding schools, and the impact of *life skills* learning in Islamic boarding schools. The following is an explanation of these three aspects.

The Concept of *Life Skills* Learning in Islamic Boarding *Schools*

According to [8]*life skills* are skills needed for work in addition to academic skills. Furthermore, *life skills* can also be referred to as the abilities, capabilities, and skills needed by a person to live a life with pleasure and happiness. These skills include all aspects of human attitudes and behavior as provisions for running their lives. In other literature, it is mentioned that *life skills* education can be interpreted as education that provides basic provisions and training carried out correctly to students about life values that are needed and useful for the development of students' lives. Thus, *life skills* education must be able to reflect real life in the teaching process so that students acquire life skills in the midst of society. [9].

Life skills education is actually not a new thing for pesantren, because this type of education has long been a mainstay for pesantren. Pesantren as a traditional Islamic educational institution in Indonesia does not only focus on religious education, but also emphasizes the development of *life skills* for its students. [10].

Table 1. Concept of Life Skills Learning in Islamic Boarding Schools

Year	Author and Article Title	Research Results
2022	Arif Rahman Hakim Life Skill Education as an Effort to Create Santri Independence at Pondok Pesantren Al Urwatul Wutsqo Bulurejo Diwek Jombang	The concept of life skills at Pondok Pesantren Al Urwatul Wutsqo Bulurejo Diwek Jombang includes determining life skills education programs tailored to the needs of students. The division of responsibilities for each unit is coordinated directly to ensure smooth implementation. In addition, an assessment of the students' abilities is carried out as well as the preparation of a report on life skills activities. This report contains information about the achievement of targets, obstacles faced by students, and various other relevant aspects.
2024	Rahmawati, Laila Life Skills-Based Education for Islamic Boarding School Students	Life skills education at Al Buruj Ngabul Jepara Islamic boarding school has the concept of life skills education in religious education program activities, khidmah and teaching practices, muhadharah, and studying books and general activities through extracurricular activities that hone skills that are carried out simply because

Year	Author and Article Title	Research Results
		pesantren emphasize the informal system.
2021	Ahmad Paruqi Hasiholan Life Skill Education for Santri at An-Nursali Binja Orphanage Boarding School	The concept of *life skills* in Islamic boarding schools includes an educational approach that not only focuses on spiritual and academic aspects, but also trains students to have practical skills needed in everyday life.

The concept of *life skills* learning in pesantren is very important to equip students with various skills needed to face the challenges of life in the future. In the concept of *life skills* learning in pesantren, there are several main aspects that are emphasized including:

1. Personal *skills* include the ability to recognize oneself, respect oneself, and develop one's potential. In pesantren, students are taught to understand their strengths and weaknesses, as well as build self-confidence and personal responsibility. Through this learning, students are expected to realize the potential that exists within themselves and be able to develop it optimally.
2. *Social skills* include communication skills, cooperating, empathizing, and building good relationships with others. In a pesantren environment that emphasizes the values of togetherness and solidarity, santri are trained to be able to interact effectively, respect differences, and build harmonious relationships with fellow santri, kyai, and the surrounding community. These social skills are very important to prepare santri in living a plural and diverse social life.
3. *Academic skills* which include critical thinking skills, problem solving, decision making, and lifelong learning. In pesantren, santri are equipped with the ability to analyze problems in depth, find the right solution, and continue to explore knowledge on an ongoing basis. These academic skills are not only obtained through formal learning in the classroom, but also through real experiences in daily life in pesantren.
4. *Vocational* skills include skills in agriculture, animal husbandry, handicrafts, information technology, and entrepreneurship. In pesantren, santri are given skills training according to their interests and talents, so that they have the provision to find a job or open an independent business after graduating from the pesantren. Not infrequently, pesantren also develop business units such as agriculture, animal husbandry, or home industries that involve active participation from the santri.

Life skills learning in pesantren is not only done through formal activities in the classroom, but also through direct experience in daily life in pesantren. Santri are involved in practical activities, such as farming, animal husbandry, processing agricultural products, and other productive activities. In addition, the pesantren also facilitates santri to be involved in social community activities, such as social services, community service, and environmental care activities. Through direct involvement in these activities, santri can hone their life skills in real life and gain valuable experience.

Implementation of *Life Skills* Learning in Islamic Boarding *Schools*

The implementation of *life skills* in Islamic boarding schools is an effort to equip students with life skills needed to face challenges in the real world. [11].

Table 2. Implementation of Life Skills Learning in Islamic Boarding Schools

Year	Author and Article Title	Research Results
2023	Anam, Abdurrahmansyah, Hawi Implementation of Life Skills Education in Improving the Quality of Santri Sma Pondok Modern Sumber Daya At-Taqwa Tanjunganom	The implementation of life skills education in Pondok Modern Sumber Daya At-Taqwa Tanjunganom includes vocational skills, personal skills, thinking skills, and social skills.
2022	Zainal Abidin Implementation of Life Skill Education at Darussalam Blokagung Banyuwangi Islamic Boarding School	Pondok Pesantren Darussalam has implemented the *life skills* education component, which is marked by the existence of educational programs that are oriented towards developing the skills and expertise of santri. However, the implementation of *life skills* education is carried out separately from the existing formal curriculum, so it

Year	Author and Article Title	Research Results
		is not arranged as part of an official education unit. This life skills education is managed independently and placed in its own unit, through the establishment of various skills institutions, organizations, and course and training activities.
2022	Zamharir Implementation of Life Skill Education for Santri Pesantren Al-Kautsar Drajat Baureno Bojonegoro	The form of implementation of *life skills* education at Al-Kautsar Islamic Boarding School includes (1) General Skills, which include Personal Skills and Social Skills, and (2) Special Skills, which consist of Academic Skills and Vocational Skills.

Life skills include various skills, such as social, emotional, and practical skills, which can help students interact with the environment, manage themselves, and contribute positively to society. [12].

1. The Importance of *Life Skills* in Islamic Boarding *Schools*
   Islamic boarding schools not only function as religious education institutions, but also as places to develop the character and skills of students. *Life skills* are important because;
   a. Facing Life's Challenges
      Santri need to have skills to face various challenges in life, both in the pesantren environment and in the community.
   b. Character Development
      Life skills help students form good characters, such as discipline, responsibility, and cooperation.
   c. Independence
      With sufficient skills, santri can be more independent and able to manage their daily lives.
2. Skills Taught
   Some of the skills that can be implemented in boarding schools include:
   a. Social Skills
      Build the ability to communicate, cooperate and interact with others.
   b. Emotional Skills
      Manage emotions, build empathy and improve emotional intelligence.
   c. Practical Skills
      Skills such as cooking, gardening, or crafts that can support independence.
   d. Leadership Skills
      Develop the ability to lead and organize through activities in the pesantren.
3. Implementation Method
   The implementation of life skills in Islamic boarding schools can be done through various methods, such as:
   a. Formal Learning
      Integrate *life skills* learning into the existing curriculum.
   b. Extracurricular Activities
      Organize activities such as training, *workshops* or seminars that focus on skill development.
   c. Direct Practice
      Provide opportunities for students to apply the skills they have learned in everyday life, such as through social projects or community activities.
   d. Mentoring and Coaching
      Presenting mentors or coaches who can provide guidance and support to students.
4. Challenges in Implementation
   Some of the challenges that may be faced in implementing *life skills* in Islamic boarding schools include:
   a. Resistance to Change
      Some may be reluctant to change the traditional way of learning.
   b. Limited Resources
      Limitations in terms of facilities, funds, or experienced teaching staff in the field of *life skills*.
   c. Perception and Understanding
      There needs to be a good understanding from all parties about the importance of *life skills* in education.

The implementation of *life skills* in boarding schools is very important to prepare students for life in the community. With the right approach and support from all parties, it is expected that students can develop the skills needed to become independent, responsible individuals, and be able to contribute positively to the surrounding environment. [13].

Impact of *Life Skills* Learning in Islamic Boarding *Schools*

Life skills learning in boarding schools has a significant impact on the development of students, both personally and socially. This impact can be seen from various aspects that contribute to the character building and skills of students.

Table 3. Impact of Life Skills Learning in Islamic Boarding Schools

Year	Author and Article Title	Research Results
2020	Khoiron Hilmy Management of Life Skill Education (At Pondok Pesantren Al Mawaddah Hongosoco Jekulo Kudus)	*Life skills* learning in boarding schools has a significant impact on the development of students. Through this education, students are not only equipped with religious knowledge, but also practical skills that help them become independent and adaptive individuals.
2022	Mar'atus Sholikhah Management of Santri Life Skills at Hidayatussalikin Islamic Boarding School Pematang Pasir Village, Ketapang District, South Lampung	*Life skills* learning in Islamic boarding schools has a significant positive impact in forming students who are independent, competitive, and ready to face the challenges of *life*. This program helps students develop practical skills such as self-management, effective communication, and critical and creative thinking skills.
2020	Arif Rahman Hakim Life Skill Education as an Effort to Create Santri Independence at Pondok Pesantren Al Urwatul Wutsqo Bulurejo Diwek Jombang	As a result, santri not only excel in religious aspects but also have the readiness to actively participate in social and economic life. The vocational skills acquired through this learning also provide them with provisions to enter the world of work or open business opportunities. Thus, *life skills* learning strengthens the role of pesantren in developing individuals who are spiritually, intellectually, and practically balanced.

From the recapitulation of the results of the research study, we can describe the various impacts of Life Skills Learning in Islamic Boarding Schools as follows:

1. Positive Impact on Santri Character
   Life skills learning plays an important role in shaping the character of santri, among others:
   a. Discipline Improvement
      Santris learn to manage their time and responsibilities, which are important parts of everyday life.
   b. Empathy Development
      Through social skills, students learn to understand and feel what others are experiencing, increasing a sense of caring.
   c. Independence
      Santri who are trained with practical skills become more independent and able to overcome daily problems.
2. Impact on Social Skills
   Life skills learning also has an impact on the social skills of santri:
   a. Communication Skills
      Santri learn how to interact well, both in formal and informal contexts.
   b. Teamwork
      Through group activities, students learn to work together and respect the opinions of others.
   c. Conflict Resolution
      Santri are trained to resolve conflicts in a constructive way, reducing the potential for disputes.
3. Impact on Mental and Emotional Health

Life skills learning contributes to the mental and emotional health of santri:

a. Stress Management
   Santri are taught techniques to manage stress and emotions, which is important in dealing with pressure.
b. Improved Emotional Intelligence
   Santri learn to recognize and manage their own emotions as well as understand the emotions of others.

4. Impact on Economic Independence
   The practical skills taught can increase the economic independence of santri:
   a. Job Skills
      Santri who have practical skills such as cooking, gardening or handicrafts can create business opportunities.
   b. Entrepreneurship Education
      Learning about entrepreneurship can motivate students to start their own business in the future.
5. Impact on Community
   Life skills learning in boarding schools also has an impact on the surrounding community:
   a. Social Contribution
      Skilled santris can better contribute to society through social and community service activities.
   b. Quality of Life Improvement
      With their skills, santri can help improve the quality of their lives and those around them.

The impact of learning *life skills* in Islamic boarding schools is very broad and deep. By developing relevant life skills, santri are not only prepared to face challenges in the outside world, but are also equipped with characters and values that will guide them throughout life [14]. Effective implementation of this learning will produce a generation of santri who are independent, responsible, and able to make a positive contribution to society [15].

IV. CONCLUSION

The integration of *life skills* learning in Islamic boarding schools in the archipelago is very important to prepare santri to face challenges in the increasingly complex era of globalization and digitalization. By developing relevant life skills, such as relevant life skills, such as social, emotional, and practical skills, santri will not only be able to adapt to the changing times, but will also have a strong character, independence and the ability to contribute positively to society.

Although there are challenges in its implementation, such as limited resources and resistance to change, the commitment to integrate *life skills* education with Islamic values that can make pesantren a center for developing quality skills, so that pesantren graduates can compete to play an active role in modern society.

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Analysis of Differences in the Implementation of STEM Education in Indonesia and Malaysia: A Literature Review

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***Abstract*-This study aims to analyze the differences in the implementation of the STEM (Science, Technology, Engineering, and Mathematic) approach in science education in Indonesia and Malaysia. This research uses a literature study with four stages, namely determining the topic of study, searching and selecting literature, analyzing and synthesizing literature, and organizing the results of literature review. The results of the literature study show that STEM implementation in Indonesia and Malaysia uses a combination with other learning models and activities, such as problem-based learning, project-based learning, and learning that emphasizes hands on and mind on activities. The implementation of STEM in Indonesia has challenges related to limited facilities, infrastructure, and teacher training that has not been specific to STEM, especially in rural areas. Meanwhile, the implementation of STEM education in Malaysia is supported by structured policies that allow the integration of STEM into the national curriculum as a whole, especially in urban areas. Furthermore, the results of the literature review show that both countries recognize STEM education as an important part of developing 21st century skills through the integration of components in STEM.**

Keywords— STEM, Indonesia, Malaysia

I. INTRODUCTION

The STEM (Science, Technology, Engineering, and Mathematics) approach to science learning has become an important curriculum integration strategy in developing students' critical thinking, problem solving, and innovation skills [1], [2]. The application of STEM aims to integrate various scientific disciplines in an applicable learning framework, so that students not only understand the concepts theoretically but can apply them in real-life situations [3]. However, the implementation of the STEM approach in science learning still experiences differences that are influenced by various factors, such as the availability of resources, and curriculum policies [4]. The STEM approach has an important role in science education as an effort to develop 21st century skills in students.

The implementation of the STEM approach in science learning is increasing along with the demands and needs of the times. In its implementation, STEM provides opportunities for students to practice critical thinking skills, creativity, and the ability to solve complex problems [5]. By integrating the four disciplines, STEM-based science learning helps students understand scientific concepts in an applied manner and connect them to real life. STEM learning also emphasizes the importance of collaboration and digital literacy needed to adapt to the demands and changes in the world of work [6], [7]. Therefore, the STEM approach in science learning is essential to prepare a generation that is able to face global challenges and make a positive contribution to society [8].

In the implementation of STEM in schools, there are different challenges, such as the challenges faced in Indonesia, namely the implementation of STEM is still constrained by limited facilities, infrastructure support, and uneven teacher training in various regions. Currently, many schools in rural and remote areas experience limited access to adequate laboratory equipment and technology, making it difficult to implement STEM learning [9]. However, the Indonesian government has launched various programs to develop STEM curriculum and provide training to teachers in stages in several regions.

Meanwhile, the implementation of STEM in Malaysia has received policy support from the government, such as more structured teacher training programs and the provision of adequate facilities in schools. Furthermore, Malaysia has also included STEM subjects in the national curriculum through various research-based projects that directly involve students, especially in urban schools [10]. However, Malaysia also faces challenges such as ease of access and improving the quality of STEM learning in rural areas still needs to be improved. This shows that both countries still face challenges in ensuring equitable accessibility and quality of STEM learning across the region [11].

Based on this explanation, it shows that the implementation of STEM in Indonesia and Malaysia has some differences in several aspects of the implementation of the STEM approach in schools.

Thus, this article will conduct a literature study on STEM implementation in Indonesia, STEM implementation in Malaysia and the differences in STEM implementation between Indonesia and Malaysia. The study of the differences in implementation will also be reviewed from several factors that influence the differences in implementation, so as to provide an overview of the factors that influence the implementation of STEM in the two countries.

II. METHOD

In this research, four stages of literature study were used, which consisted of determining the topic of literature study, searching and selecting literature, analyzing and synthesizing literature, and organizing writing [12]. The topic chosen in this study includes the implementation of STEM in Indonesia and Malaysia, and the differences between the two countries are also studied. The literature search process for the needs of this research used google schoolar, springer, and various other journals that have relevance to the theme, both journals in Indonesia and journals in Malaysia. Article selection was carried out to ensure that the articles analyzed had good credibility with the criteria of the year of publication in the range 2014-2024, relevance to the topic studied, journals containing explanations of STEM in Indonesia and Malaysia, and completeness of journal identity. The analysis and synthesis process was carried out by creating an analysis matrix to obtain a complete picture of the content of each literature.

III. RESULTS AND DISCUSSION

The results and discussion describe the results of the literature study with a focus on STEM implementation in Indonesia and Malaysia, and analyze the differences in STEM implementation in the two countries. The discussion consists of a description of STEM implementation in Indonesia, STEM Implementation in Malaysia, and Analysis of Differences in STEM Implementation in Indonesia and Malaysia.

STEM IMPLEMENTATION IN INDONESIA

Based on the literature study on several articles that discuss the implementation of STEM in Indonesia, the following picture is obtained:

Table 1: STEM implementation in Indonesia

No	Author Name/Year	Strategy	Results
1.	[13]	PBL goes through five EiE steps. The five EiE steps can be described as follows: (ask), (imagine), (plan), (create), and (improve).	Increase students' interest in learning physics subjects, especially on magnetic induction material.
2.	[14]	Implementation of PjBL-STEM with the stages of Reflection, Research, Discovery, Application, and Communication.	improve students' higher order thinking skills on biotechnology material.
3.	[15]	Application of PjBL STEM learning with the provision of Student Worksheets (LKS) and science literacy questions.	Significant impact on students' science literacy, both male and female in the aspects of science knowledge, attitude, and competence.
4.	[16]	Application of STEM from home PjBL model by providing phenomena in daily life, determining tools and materials, designing biopori designs and making biopori project designs.	Improve students' concept mastery and creative thinking skills.
5.	[17]	Application of the Project-Based Learning model with a STEM approach to seek information, design and develop relevant conceptual understanding based on projects.	The application of PBL model with STEM approach is effective in improving students' mathematical creative thinking skills.

Based on Table 1, it can be seen that the implementation of STEM in Indonesia is combined with several learning models, such as the Problem-Based Learning learning model [13], [17], and Project-Based Learning learning model [14], [15], [16]. The application of the combination of STEM with this learning model is carried out to increase student interest and learning outcomes through the form of innovative learning steps. Some research results show that exposing learning stages, such as Reflection, Research, Discovery, Application, and Communication [14]. Meanwhile, other studies describe different stages that emphasize finding information, designing and developing relevant conceptual understanding based on the project [17]. These stages have an impact on improving students' creative thinking skills.

In another study, the implementation of STEM in Indonesia combined with the PBL model used five steps from Engineering is Everywhere (EiE), namely (ask), (imagine), (plan), (create), and (improve) [13]. In another study, the application of STEM with a combination of PjBL using the stages of reflection, research, discovery, application, and communication which can help students develop higher order thinking skills in biotechnology material [14]. This approach integrates STEM components to build skills that match the demands of the 21st century [18]. Under these conditions, students not only acquire

theoretical knowledge, but are also challenged to apply it in real situations through project-based activities.

Overall, these five articles show that the STEM approach applied through PBL and PjBL models has a significant impact on science literacy, creative thinking skills, and concept mastery in students [19], [20]. Through activities involving projects and daily life phenomena, students not only learn conceptually, but can learn meaningfully. The findings from this study confirm that an integrated STEM approach in the learning process can be an innovative solution to create more effective learning experiences across various disciplines.

STEM IMPLEMENTATION IN MALAYSIA

In this section, we will discuss the implementation of STEM in Malaysia which is based on the results of several studies that have been conducted in Malaysia. The following Table 2 describes the implementation of STEM in Malaysia.

Table 2: STEM implementation in Malaysia

No	Author Name/Year	Strategy	Results
1.	[21]	STEM-based Problem Based Learning (PBL) approach with the use of relevant questions or problems.	The application of the PBL-STEM approach is effective in arousing students' interest in science to learn from a real-life context.
2.	[22]	STEM learning is based on "hands-on" and "minds-on" activities.	Robot-based STEM learning has proven effective in connecting teaching and learning with critical thinking skills
3.	[23]	Implementation of team-based robotics through the use of LEGO NXT Mindstorm	There is a significant difference in students' perception of STEM learning. This data was obtained through the STEM Semantics Perception Data and STEM Career Interest Scales, which showed a positive increase in students' interest and understanding of STEM.
4.	[24]	PBL learning goes through a five-stage engineering design process as follows: (1) ask, (2) imagine, (3) create, (4) test, and (5) improve.	This research significantly increased students' interest in STEM.
5.	[25]	STEM integration in ProjectBased Learning (PBL) using HOTS development module as a conceptual framework.	Project-based learning method with STEM integration can be an effective approach to improve students' HOTS.

The results of the literature study show that STEM implementation in Malaysia generally focuses on increasing students' interest and skills in science. In its implementation, STEM implementation is integrated with Problem-Based Learning (PBL) learning model with real problems and relevant to students' lives. This combination can increase students' interest in classroom learning that is linked to real-life contexts [21]. This STEM-PBL strategy in Malaysia provides opportunities for students to learn through solving relevant problems and applying theory directly in real conditions, so that students can gain a deep understanding of scientific concepts.

In another study, the implementation of STEM in Malaysia emphasized "hands-on" and "minds-on" activities, involving robots as learning tools, such strategies can improve students' critical thinking skills [22], [23]. In the robot-assisted STEM implementation, students are challenged to develop critical thinking skills through various activities utilizing robots as the medium [22]. Meanwhile, the use of LEGO NXT Mindstorm in robotics in STEM implementation in Malaysia has an impact on increasing students' interest in STEM [23].

In another study, STEM implementation in Malaysia was combined with project-based learning activities in engineering design and the development of higher order thinking skills [24], [25]. In its implementation, STEM-PjBL emphasizes the five stages of design (ask, imagine, create, test, improve). The strategy can increase students' interest in STEM [24]. In another study, STEM was implemented with the help of HOTS module in project-based learning. This strategy helps students develop analytical and creative thinking skills, thus supporting students in facing real-life STEM challenges [25]. Thus, all articles show that the STEM approach in Malaysia has the potential to enhance students' critical thinking skills and interest through learning strategies combined with real problem-based activities, hands on and minds on activities, as well as project-based activities and design engineering.

DIFFERENCES IN STEM IMPLEMENTATION IN INDONESIA AND MALAYSIA

The differences in STEM implementation in Indonesia and Malaysia are not too specific at the technical level of implementation in the classroom, in general the implementation in both countries has similarities in combination with learning models. However, the two countries have different challenges that will have an impact on the implementation of

STEM in schools. The challenge in Indonesia lies in the need to improve facilities and infrastructure, especially in rural areas. Schools in some rural areas do not have access to adequate laboratory facilities and STEM-specific teacher training, so project-based and experiential STEM implementation has not been optimized [11], [26]. The government has made various efforts through training programs and curriculum development aimed at facilitating the process of STEM development and implementation equally.

Meanwhile, in the implementation of STEM in Malaysia, there is government support in the implementation of STEM. The support includes scheduled teacher training and the provision of adequate facilities at various schools [10]. The Malaysian curriculum also includes research-based projects that can make STEM integration can be implemented thoroughly [24]. However, Malaysia also still faces the same challenges as Indonesia in ensuring equitable access for schools in rural areas that still experience limitations in the implementation of STEM in Schools [22].

IV. CONCLUSION

The implementation of STEM in Indonesia and Malaysia has fundamental similarities in learning strategies, which combine STEM with other learning models, such as problem-based learning, project-based learning, and learning with hand on and mind on activities. In both countries, the strategies can improve students' thinking skills and interest in STEM. The fundamental difference obtained from the results of the literature study shows that the implementation of STEM in Indonesia and Malaysia is supported by different policies and curricula, so that the implementation experiences slight differences. However, both countries still experience problems with equitable access and adequate facilities in STEM implementation, especially in rural areas.

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