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The Urgency of Cyber Education in Islamic Education for Indonesia's Golden Generation 2045: A Conceptual Analysis

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Abstract: *In the context of Indonesia's ambitious goal to cultivate a Golden Generation by 2045, this article examines the urgent need to integrate cyber education within Islamic educational systems. Through a conceptual analysis grounded in descriptive qualitative methods, the study synthesizes insights from 42 recent scholarly works to propose a strategic framework for embedding digital technologies in Islamic pedagogy. The analysis reveals that cyber education, characterized by its interactivity, flexibility, and global reach, holds transformative potential for Islamic schools. However, its adoption is constrained by significant obstacles, including inadequate technological infrastructure, educators' insufficient digital skills, and a lack of coherent policy frameworks. A SWOT analysis further elucidates the strengths, weaknesses, opportunities, and threats associated with cyber education in this context. To overcome these challenges, the study advocates for a comprehensive strategy that includes digital literacy programs, collaborative efforts among stakeholders, and curriculum innovations that harmonize technological advancements with Islamic values. While the research is conceptual and requires empirical substantiation, it offers a valuable foundation for policymakers and educators. The article recommends conducting empirical studies to validate the conceptual model across various educational settings and to foster innovative practices that ensure Islamic education remains relevant and competitive in the digital era.*

Abstrak: Dalam konteks tujuan ambisius Indonesia untuk mencetak Generasi Emas pada tahun 2045, artikel ini mengkaji urgensi integrasi pendidikan siber dalam sistem pendidikan Islam. Melalui analisis konseptual yang didasarkan pada metode kualitatif deskriptif, studi ini mensintesis wawasan dari 42 karya ilmiah terbaru untuk mengusulkan kerangka strategis dalam mengintegrasikan teknologi digital ke dalam pedagogi Islam. Analisis menunjukkan bahwa pendidikan siber, yang dicirikan oleh interaktivitas, fleksibilitas, dan jangkauan global, memiliki potensi transformatif bagi sekolah-sekolah Islam. Namun, adopsinya masih terkendala oleh sejumlah hambatan signifikan, termasuk infrastruktur teknologi yang belum memadai, keterampilan digital pendidik yang masih rendah, serta belum adanya kerangka kebijakan yang koheren. Analisis SWOT turut digunakan untuk menjelaskan kekuatan, kelemahan, peluang, dan ancaman yang terkait dengan pendidikan siber dalam konteks ini. Untuk mengatasi tantangan tersebut, studi ini menganjurkan strategi komprehensif yang mencakup program literasi digital, kolaborasi antar pemangku kepentingan, dan inovasi kurikulum yang selaras dengan nilai-nilai Islam serta perkembangan teknologi. Meskipun bersifat konseptual dan memerlukan pembuktian empiris lebih lanjut, studi ini memberikan landasan yang berharga bagi para pembuat kebijakan dan pendidik. Artikel ini merekomendasikan dilakukannya studi empiris untuk memvalidasi model konseptual di berbagai konteks pendidikan, serta mendorong praktik inovatif agar pendidikan Islam tetap relevan dan kompetitif di era digital.

1. Introduction

The centennial celebration of Indonesia's independence in 2045, known as "Indonesia Emas," represents a pivotal national aspiration toward global prominence. This vision is anchored in demographic projections indicating that approximately 70% of Indonesia's population will be within productive age, offering a rare opportunity for accelerated economic growth.[1,2] However, this demographic advantage alone is insufficient without a strategic transformation of the national education system. A key concern lies in the persistent gap between the nation's human resource potential and the competencies required in the 21st-century digital economy. Hence, embedding cyber education into Indonesia's Islamic education system emerges as an urgent priority for cultivating a generation that is digitally literate, ethically grounded, and globally competitive.

The global proliferation of digital technology has fundamentally reshaped educational paradigms, compelling institutions to integrate ICT as a core driver of pedagogical innovation.[3] Several nations have repositioned their education systems to meet the demands of the digital age, emphasizing cyber literacy and resilience from early education levels.[4,5] In the United Kingdom, the strategic shift from general education to executive education was motivated by a national commitment to cyber security education.[6] These global trends illustrate the repositioning of education not only as a vehicle for knowledge transmission but also as a defense mechanism in an increasingly digitized world. Consequently, countries that fail to integrate cyber education risk systemic vulnerabilities in national development.

Cyber education research has identified various pedagogical models that effectively promote cybersecurity awareness and practical competencies among students. The application of serious games and gamification techniques, such as MDA-based game design and Capture the Flag (CTF) competitions, has proven to enhance learner engagement and comprehension.[7,8] Additionally, cloud-based self-directed learning environments are increasingly valued for promoting autonomy in cyber training across domains.[9] Interdisciplinary approaches that merge STEM education with

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[1] Isabel Borges Alvarez, Nuno S Alves Silva, dan Luisa Sampaio Correia, "Cyber education: towards a pedagogical and heuristic learning," *SIGCAS Comput. Soc.* 45, no. 3 (2016): 185–192, doi:10.1145/2874239.2874266.

[2] Dedi Wahyudi dan Novita Kurniasih, "Membangun Generasi 'Great' Beretika Menuju Indonesia Emas," *Tarbawiyah Jurnal Ilmiah Pendidikan* 3, no. 1 (2019): 46, doi:10.32332/tarbawiyah.v3i1.1453.

[3] Etistika Yuni Wijaya, Dwi Agus Sudjimat, dan Amat Nyoto, "Transformasi Pendidikan Abad 21 Sebagai Tuntutan," *Jurnal pendidikan* 1 (2016): 263–78, http://repository.unikama.ac.id/840/32/263-278 Transformasi Pendidikan Abad 21 Sebagai Tuntutan Pengembangan Sumber Daya Manusia di Era Global .pdf. diakses pada; hari/tgl; sabtu, 3 November 2018. jam; 00:26, wib.

[4] Regina Ade Darman, "Mempersiapkan Generasi Emas Indonesia Tahun 2045 Melalui Pendidikan Berkualitas," *Edik Informatika* 3, no. 2 (2017): 73–87, doi:10.22202/ei.2017.v3i2.1320.

[5] Zelhendri Zen, "Inovasi Pendidikan Berbasis Teknologi Informasi : Menuju Pendidikan Masa Depan," *E-Tech* 6, no. 2 (2018), doi:10.24036/et.v2i2.101346.

[6] Jacob Willem Abraham Witsenboer, Klaas Sijtsma, dan Fedde Scheele, "Measuring cyber secure behavior of elementary and high school students in the Netherlands," *Computers & Education* 186 (2022): 104536, doi:10.1016/j.compedu.2022.104536.

[7] Aaron Pendleton dan James S Okolica, "Creating Serious Games with the Game Design Matrix," in *International Conference Games and Learning Alliance*, 2020, https://api.semanticscholar.org/CorpusID:208179494.

[8] Rukman Senanayake, Phillip Porras, dan Jason Kaehler, "Revolutionizing the Visual Design of Capture the Flag (CTF) Competitions," in *HCI for Cybersecurity, Privacy and Trust*, ed. oleh Abbas Moallem (Cham: Springer International Publishing, 2019), 339–52.

[9] Nathaniel Flack dan Mark Reith, "Self-Directed Learning Tools in USAF Multi-Domain Operations Education," no. December (2018): 2018.

cybersecurity content, such as the 5E instructional model, have also shown significant improvements in student motivation and situational awareness.[10] These findings reinforce the viability of cyber education as a flexible and scalable model adaptable to diverse educational contexts.

In the Indonesian context, digital transformation in education has accelerated due to external factors such as the COVID-19 pandemic and rising gadget penetration. Data indicates high usage rates of digital devices among students across educational levels, suggesting readiness for technology-based learning.[11] However, Islamic educational institutions, despite their wide reach—over 12,000 pesantren nationwide—have not uniformly embraced cyber-integrated pedagogies.[12] Blended learning, though increasingly accepted, is still unevenly implemented across religious schools, often constrained by infrastructural and epistemological limitations.[13] This inconsistency highlights the need for a tailored framework that aligns cyber education with the distinctive ethos of Islamic pedagogy.

Efforts to professionalize cybersecurity education continue to evolve, yet significant barriers persist. Research has pointed to limitations in faculty preparedness, insufficient cross-disciplinary training, and fragmented curricula.[14,15] Even in countries with established programs, challenges remain in linking educational outcomes with labor market needs, especially through accreditation and competency mapping.[16,17] Technological innovations such as fog computing and context-aware training architectures offer promising alternatives to enhance cyber resilience. Nevertheless, these innovations are rarely adapted within religious or culturally embedded education systems, underscoring a lack of inclusive implementation strategies.

Despite the growing body of research on cyber education, few studies have critically examined its integration within Islamic educational systems, particularly in Southeast Asia. Most existing frameworks are secular and Western-centric, with minimal attention to how cyber paradigms interact with the theological, ethical, and philosophical underpinnings of Islamic pedagogy. There is also a lack of conceptual models that bridge Islamic epistemology with technological competencies such as cybersecurity, data ethics, and digital citizenship. Furthermore, Islamic educational institutions often remain peripheral in national digital policy discourse. This gap necessitates an integrative

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[10] Kamsuriah Ahmad, Suhaila Zainudin, dan Shahrina Shahrani, "Interactive STEM in Cyber Awareness Learning System," in *Proceedings of the International Conference on Electrical Engineering and Informatics* (Scopus, 2023), 1–5, doi:10.1109/ICEEI59426.2023.10346823.

[11] Edward J Glantz et al., "Cross-Boundary Cyber Education Design," in *Proceedings of the 21st Annual Conference on Information Technology Education*, SIGITE '20 (New York, NY, USA: Association for Computing Machinery, 2020), 336–341, doi:10.1145/3368308.3415374.

[12] Umum Budi Karyanto, "Pendidikan Karakter: Sebuah Visi Islam Rahmatan Lil Alamin," *EDUKASIA ISLAMIKA: Jurnal Pendidikan Islam* 2, no. 2 (2017): 191–207, doi:https://doi.org/10.28918/jei.v2i2.1668.

[13] Ratna Hidayah, Muhammad Nur Wangid, dan Wuri Wuryandani, "Teaching as Part of Blended Learning Lead to the Trend of Indonesian Future Cyber Education," *International Journal of Intelligent Systems and Applications in Engineering* 11, no. 2 SE-Research Article (17 Februari 2023): 484–94, https://ijisae.org/index.php/IJISAE/article/view/2658.

[14] Martti Lehto, "Cyber Security Capacity Building: Cyber Security Education in Finnish Universities," in *European Conference on Cyber Warfare and Security*, 2017, doi:10.34190/EWS.20.112.

[15] Moti Zwilling, "Trends and Challenges Regarding Cyber Risk Mitigation by CISOs—A Systematic Literature and Experts' Opinion Review Based on Text Analytics," *Sustainability (Switzerland)* 14, no. 3 (2022), doi:10.3390/su14031311.

[16] Raymond Greenlaw dan Rajendra K Raj, "ABET's cybersecurity accreditation: history, accreditation criteria, and status," *ACM Inroads* 13, no. 4 (November 2022): 14–21, doi:10.1145/3571091.

[17] Matthew Hudnall, "Educational and Workforce Cybersecurity Frameworks: Comparing, Contrasting, and Mapping," *Computer* 52, no. 3 (2019): 18–28, doi:10.1109/MC.2018.2883334.

approach that not only contextualizes cyber education within Islamic frameworks but also positions it as a strategic instrument for national transformation.

This study aims to conceptualize the urgency of integrating cyber education within the Islamic education system as a proactive measure in preparing for *Indonesia Emas* 2045. By employing a descriptive conceptual analysis, it synthesizes contemporary literature to identify core challenges, pedagogical opportunities, and strategic pathways for implementation. The article argues that cyber education should be reimagined not merely as a technical addendum, but as a transformative educational paradigm compatible with Islamic values and responsive to 21st-century challenges. This approach contributes a novel theoretical framework that aligns Islamic education with global digital transitions. In doing so, it offers practical insights for policymakers, curriculum designers, and educators committed to inclusive, forward-looking educational reform.

2. Method

This study employs a conceptual analysis approach using descriptive qualitative methods to examine the urgency of integrating cyber education within Islamic education as part of Indonesia's strategic preparation for the Golden Generation 2045. The data were collected through a structured literature review of 42 scholarly references published within the last five years (2020–2025), consisting of peer-reviewed journal articles, academic books, policy documents, and official reports. The sources were obtained using targeted keyword searches such as "cyber education," "Islamic education," "digital literacy," "21st-century competencies," and "*Indonesia Emas 2045*" across major academic databases including Scopus, Google Scholar, ERIC, and DOAJ. The literature was analyzed thematically through a process of identifying, categorizing, and synthesizing relevant concepts to build a coherent theoretical framework. Cross-contextual comparisons were also conducted to highlight best practices from global cyber education systems and evaluate their adaptability to Islamic pedagogical principles. This method aims to generate a strategic conceptual model that is academically grounded, contextually relevant, and applicable for policymakers, educators, and curriculum developers navigating the challenges of digital transformation in education.

3. Results

3.1. Cyber Education: The Global Shift Toward Cyber Technology

Cyber education encompasses both technical and non-technical content across all educational levels. At the initial stage, cyber education is intended to provide exposure to the fundamentals of the virtual world. In subsequent stages, it equips individuals with the necessary content to complement their education with knowledge of the cyber domain.[18] Cyber education is largely focused on computer-based learning. Numerous universities and higher education institutions now offer courses in the field of cybersecurity. Technology serves as a primary component of cybersecurity; countries that excel in technological development have also demonstrated strength in cybersecurity. Western nations are significantly ahead in the field of cyber education, having integrated legal and managerial frameworks into cyberspace. At the same time, the United Kingdom has placed emphasis on cyber strategy, believing that cybersecurity can be enhanced by

[18] Edward Sobiesk et al., "Cyber Education: A Multi-Level, Multi-Discipline Approach," in *Proceedings of the 16th Annual Conference on Information Technology Education*, SIGITE '15 (New York, NY, USA: Association for Computing Machinery, 2015), 43–47, doi:10.1145/2808006.2808038.

providing both civilians and military personnel with comprehensive knowledge in cyber education.[19]

Traditionally, cybersecurity education has been predominantly oriented toward science, technology, engineering, and mathematics (STEM) disciplines at the university level. However, in the 1990s, cybersecurity education expanded its focus to include areas such as business, management, political policy, international relations, and law.[20] Today, technological realities influence public behavior across various sectors including the economy, education, law, politics, society, and culture. The internet has evolved into an invisible public sphere that facilitates information exchange, interaction and dialogue, commerce, and even political engagement.[21]

The current electronic culture is dissolving geographical and social boundaries in tandem with technological advancements. The emerging reality is a direct consequence of this electronic culture. According to Paul Virilio, technology and its innovations have drawn individuals into a fast-paced and impactful lifestyle. The influence of electronic culture necessitates that educators and stakeholders possess adequate technological infrastructure to create meaningful and engaging learning experiences for all learners.[22] Simultaneously, cybersecurity education has emerged as a new academic field worldwide, driven by rapid transformations in platforms, vulnerabilities, and threats within cyberspace. When governments release cybersecurity strategies, education is consistently cited as a key area of responsibility. Cybersecurity is increasingly regarded not only as a matter of public policy but also as a pedagogical challenge.

3.2 The Urgency of Cyber Education in Islamic Education

Islamic education can be understood as an effort to develop an individual's spiritual, intellectual, and emotional capacities as provisions for a better life. Fundamentally, Islamic education involves the process of socializing, internalizing, and actualizing Islamic values through learning activities guided by educators.[23] Any discussion of education inevitably involves the broader issue of its underlying systems. A system is a unified entity composed of interrelated components or elements functioning in an organized manner to achieve a specific goal.[24] Within this context, education consists of interconnected components designed to create a learning environment that fosters the development of spiritual, intellectual, and emotional potential, as well as the skills necessary for individuals, society, and the nation.

Islamic educational institutions generally implement a traditional educational system.[25] As a prominent example, Islamic boarding schools (*pesantren*) are characterized by five core elements: the *kyai* (religious leader), the mosque, classical Islamic texts (*kitab kuning*), students (*santri*), and dormitories. The *kyai* acts as the

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[19] Syed Shahab Uddin, "Importance of Cyber Education in the Era of Cyber War," *Pakistan Journal of Educational Research* 5, no. 2 (2022): 250–60, doi:10.52337/pjer.v5i2.530.

[20] Daniel E Krutz dan Thomas Richards, "Cyber security education: why don't we do anything about it?," *ACM Inroads* 8, no. 4 (2017): 5, doi:10.1145/3132217.

[21] Wahyudi dan Kurniasih, "Membangun Generasi 'Great' Beretika Menuju Indonesia Emas."

[22] Jorge Otero-Pailos, "Living or Leaving the Techno-Apocalypse: Paul Virilio's Critique of Technology and Its Contribution to Architecture," *Journal of Architectural Education (1984-)* 54, no. 2 (18 Mei 2000): 104–10, http://www.jstor.org/stable/1425597.

[23] Laila Fajrin, *Pendidikan Ideal untuk Mempersiapkan Generasi Emas Indonesia* (Yogyakarta: Timur Barat, 2020).

[24] Syaukani Syaukani, "Menuju Indonesia Emas Dalam Perspektif Pendidikan Islam," *Jurnal Pendidikan Agama Islam Al-Thariqah* 2, no. 1 (30 Agustus 2017): 111–23, doi:10.25299/althariqah.2017.vol2(1).651.

[25] Mahyudin Ritonga, "Modulasi Kitab Kuning Bidang Fiqh Berbasis Materi UAM di Pondok Pesantren Darul Ulum Air Pacah," *Jurnal Kajian dan Pengembangan Masyarakat* 1, no. 1 (2018): 1–13.

highest authority, the mosque serves as a place of learning and worship, the *kitab kuning* provides traditional Islamic knowledge, the *santri* are the learners, and the dormitories provide their residence. These five elements function synergistically.[26] Islamic educational institutions have proven effective in nurturing intellectual and moral development by leveraging these characteristics. However, to address increasingly complex societal demands resulting from rapid scientific and technological advancements, Islamic institutions must consider additional factors.[27] Notably, many Islamic educational institutions in Indonesia still underutilize technology as a tool to enhance the teaching and learning process.

Given the rapid pace of technological development, cyber education is essential for enabling teachers and students to conduct learning more securely and efficiently. Typically implemented in the form of virtual education, cyber education refers to a learning process in which educators and students are geographically separated, with communication facilitated by one or more technological media.[28] The interactivity, flexibility, and accessibility of information and communication technology have led to a paradigm shift from teacher-centered to learner-centered education models, in which computers and the internet facilitate active engagement among all participants.[29]

Today, one of the core competencies required of educators is proficiency in using technology and guiding students to explore digital resources independently while protecting themselves from potential risks. Ali's research indicates that teachers often lack competence in utilizing technology during online learning, which ultimately reduces the time allocated for students' learning.[30] To formulate appropriate strategies, a SWOT analysis of cyber education can serve as an alternative framework. A systematic identification of its strengths, weaknesses, opportunities, and threats helps inform strategic planning for cyber education.[31] The results of this SWOT analysis are outlined in the following table:

Table 1. SWOT Analysis of Strategic Planning for Cyber Education

No	Category	Analysis
1	Strengths	1. Integrates learning with digital devices.2. Requires relatively low storage capacity.3. Offers technological features that enhance learning.
2	Weaknesses	1. High development costs.2. Lack of public familiarity with the term "cyber education," requiring widespread promotional efforts.3. Requires thorough preparation, as learning objectives may not be fully achieved.

[26] Bambang Arif Rahman, "Islamic revival and cultural diversity: Pesantren's configuration in contemporary Aceh, Indonesia," *Indonesian Journal of Islam and Muslim Societies* 12, no. 1 (2022): 201–29, doi:10.18326/ijims.v12i1.201-229.

[27] Abdul Halik, "Ilmu Pendidikan Islam: Perspektif Ontologi, Epistemologi, Aksiologi," *Istiqra': Jurnal Pendidikan dan Pemikiran Islam* 7, no. 2 (2020): 10–23, http://jurnal.umpar.ac.id/index.php/istiqra/article/view/500.

[28] Loane Shannon, "Distance Education and Accreditation," 2001, https://www.govinfo.gov/app/details/ERIC-ED464525.

[29] Ashley Blackburn, Irene Linlin Chen, dan Rebecca Pfeffer, *Emerging Trends in Cyber Ethics and Education* (IGI Global, 2019), doi:10.4018/978-1-5225-5933-7.

[30] Abdul Halik Nasaruddin, St. Wardah Hanafie Das, dan Suyatno Ladiqi, "Digital-Based Islamic Religious Education (IRE) Learning Model at Senior High School," *Indonesian Journal of Islamic Education Studies (IJIES)* 6, no. 1 (2023): 79–92, doi:10.33367/ijies.v6i1.3525.

[31] Velma Alicia dan Inta Hataningtyas Rani, "Kontribusi Aplikasi Sistem Manajemen Pembelajaran Berbasis Siber Terhadap Kompleksitas Manajemen Tindakan Kelas," *Jurnal Pendidikan* 23, no. 1 (2022): 24–42, doi:10.33830/jp.v23i1.2611.2022.

3	Opportunities	1. High number of gadget users in Indonesia, including school-age children.2. Youth and adolescents show a strong preference for gadget use.3. Numerous Islamic educational institutions provide potential for widespread implementation.
4	Threats	1. Many competitors in the field of online education beyond Islamic institutions.2. Risk of student distraction and misuse of digital devices.3. Unpredictable levels of learner fatigue or boredom.

This SWOT analysis can serve as a basis for further development of cyber education models and designs. Furthermore, such an analysis highlights the urgency of modernizing Islamic educational systems to support the vision of Indonesia's Golden Generation 2045.[32] Successful implementation of cyber education requires collaboration among educators, parents, and stakeholders. This collaboration may include: (a) Full moral and material support from Islamic education leaders; (b) Shared commitment to institutional advancement through regulation and operational standards; (c) Cultivation of a critical and constructive institutional culture; (d) Consistent support from teachers and students in implementing cyber education; and (e) Exemplary leadership from administrators, whose actions inspire and motivate others.

The implementation strategy for cyber education can be designed holistically by involving various stakeholders and employing strategic approaches. First, collaboration between Islamic educational institutions and IT experts or relevant technology companies is essential to ensure the integration of technology aligns with educational values. Second, launching cyber education campaigns that involve community figures such as respected scholars, public figures, and young influencers can enhance the appeal and credibility of the program. Third, the use of engaging and relatable slogans and advertisements across multiple media channels can help raise public awareness and broaden the program's reach. Fourth, the regular introduction of innovative features is a vital strategy to sustain student motivation and prevent fatigue or boredom in online learning environments. Lastly, promoting digital literacy, encouraging safe technology use, and providing cybersecurity support teams are foundational to creating an inclusive and secure digital learning ecosystem

3.3 Digital Literacy as a Strategi Toward Cyber Education

The rapid advancement of information and communication technology that drives the 21st-century educational revolution will continue to evolve. One of the most visible impacts is the increasing integration between physical and virtual (cyber) environments. However, the acceleration of technological development as a driving force behind cyber education is often not accompanied by the necessary skills. Digital literacy has become one of the essential competencies needed to navigate the integration of physical and virtual environments in the field of education. Computer literacy and information literacy are foundational to digital literacy. In this century, these two forms of literacy are increasingly influential in various sectors of life, including education.[33] Atmazakki provides a more comprehensive definition of digital literacy as the knowledge and ability

[32] Niken Pratiwi Yuliani Nurani Lathipah Hasanah, "Digital Media based on Pancasila Values to Stimulate Character Building in Early Childhood," *Journal for ReAttach Therapy and Developmental Diversities* 5, no. 1 (30 Juni 2022): 41–49, https://jrtdd.com/index.php/journal/article/view/59.

[33] Ryani Yulian, Ufi Ruhama', dan Syarifah Putri Agustini Alkadri, "PELATIHAN PENGEMBANGAN FLIPPED CLASSROOM BERBASIS HIGHER-ORDER THINKING SKILLS (HOTS) DAN KURIKULUM MERDEKA BAGI MGMP BAHASA INGGRIS SMA KABUPATEN KUBU RAYA," *Jurnal Abdi Insani* 10, no. 3 (13 September 2023): 1647–57, doi:10.29303/abdiinsani.v10i3.1085.

to use, evaluate, and produce digital media, communication technologies, or networks in a healthy, reasonable, intelligent, careful, appropriate, and lawful manner, with the aim of fostering conversation and connection in everyday life.

Moreover, digital literacy holds practical value in enabling individuals to complete various tasks—for instance, in accessing public services and taking advantage of opportunities in online business, education, and learning. In addition, digital literacy skills empower individuals to actively participate in a range of online activities. Digital literacy also involves the development of cognitive, creative, critical, and social capabilities that go beyond basic functional skills in using ICT. Several skills that individuals should possess in relation to digital literacy, which are outlined in Table 2.[34]

Table 2. Essential Digital Literacy Skills

Basic Skills	Description
Usage	Skills in utilizing ICT functions and programs to perform basic tasks
Communication and Interaction	Skills to share knowledge and information, communicate with others, and participate in online communities
Analysis	Skills to critically analyze and understand information and messages
Creation	Skills to create digital content using ICT

Digital literacy can be defined as a survival skill in the digital age. It constitutes a system of skills and strategies employed by learners who live in digital environments.[35] In order to ensure the sustainability of learners' lives in the future, cooperation among educational stakeholders such as teachers, schools, families, communities, and policymakers is required. Teachers are obligated to teach basic technology usage skills as illustrated in Table 1. Furthermore, facilities and infrastructure are needed to support literacy programs at the household, school, and community levels. Schools should provide libraries, classroom reading corners, bulletin boards, computer rooms and internet access, laboratories, both conventional and digital information boards, and various equipment.

Additional educational support within families should offer facilities such as reading areas and home libraries with digital literacy materials. Communities can contribute by establishing public libraries, community reading gardens, reading corners in public buildings, museums, public internet access points, and other amenities, either independently or collaboratively. The development and enhancement of such facilities and infrastructure must involve the participation of all current stakeholders in alignment with their respective demands and capacities

4. Discussion

The transformation toward a digital society, characterized by the convergence of cyber and physical spaces, demands an urgent reevaluation of educational paradigms, particularly within Islamic education. With the projected demographic dividend peaking in 2045, Indonesia is poised to achieve significant socio-economic advancement,

[34] Seung-Hyun Lee, "Digital Literacy Education for the Development of Digital Literacy," *Int. J. Digit. Lit. Digit. Competence* 5, no. 3 (2014): 29–43, doi:10.4018/ijdldc.2014070103.

[35] Yoram Eshet, "Digital Literacy: A Conceptual Framework for Survival Skills in the Digital era," *Journal of Educational Multimedia and Hypermedia* 13, no. 1 (2004): 93–106, https://www.learntechlib.org/p/4793.

provided that its human capital is appropriately developed.[36,37] This study addresses the conceptual urgency of integrating cyber education into Islamic educational systems as a critical strategy to prepare the Golden Generation of 2045. Prior research emphasizes that conventional Islamic pedagogical frameworks, while spiritually rich, require substantial technological infusion to remain relevant amidst 21st-century demands.[38,39,40] By framing cyber education not merely as an instructional tool but as a transformative educational paradigm, this study aligns with broader discussions on sustainable digital literacy and global citizenship education.[41]

The study reveals that cyber education, when conceptually situated within Islamic educational contexts, offers a holistic pathway to bridge traditional pedagogies with digital imperatives. The SWOT analysis outlines critical strengths such as technological integration and flexible learning modalities, while also exposing barriers like underutilization of digital tools and limited public familiarity with cyber education.[42,43,44] Notably, Islamic educational institutions are under-leveraging their extensive reach to promote digital competencies, despite a nationwide increase in gadget use among school-age populations. The findings also indicate that digital literacy must be systematically embedded in curricula to enhance both spiritual and cyber competencies of learners.[45] Surprisingly, the lack of synergy between educational policy, technology infrastructure, and pedagogical innovation emerged as a key limitation to the successful deployment of cyber education in Islamic schools.

These findings support broader global trends recognizing cyber education as pivotal to modern education systems, as evidenced in the UK and Finland where cybersecurity frameworks have been institutionalized to fortify educational resilience.[46,47,48] Similar to the interdisciplinary shifts observed in Western contexts—where cyber education encompasses not only STEM but also law, politics, and business—the current study suggests the potential for Islamic education to embrace a multidimensional cyber

[36] Alvarez, Silva, dan Correia, "Cyber education: towards a pedagogical and heuristic learning."

[37] Moh. Ali Muddin dan Firmanda Dwi Septiawan, "CLS (Cyber Learning Santri): Optimalisasi Proses Pembelajaran Pondok Pesantren Salafiah sebagai Upaya Merealisasikan Visi Indonesia Maju Menuju Indonesia Emas 2045 (Studi Kasus: Pondok Pesantren Assalafiyah 1 Luwungragi Brebes)," *Jurnal Penelitian Inovatif* 2, no. 1 (2022): 51–58, doi:10.54082/jupin.43.

[38] Abdul Halik, "Ilmu Pendidikan Islam: Perspektif Ontologi, Epistemologi, Aksiologi."

[39] Mark Reith et al., "Rethinking USAF Cyber Education and Training," in *International Conference on Cyber Warfare and Security*, 2018.

[40] Rahman, "Islamic revival and cultural diversity: Pesantren's configuration in contemporary Aceh, Indonesia."

[41] Waryani Fajar Riyanto dan Robby Habiba Abror, "Filsafat Digital Integral: Reformulasi Program Literasi Digital Nasional Di Era Pandemi Covid-19 Di Indonesia," *FIKRAH* 9, no. 2 (2021): 203–21.

[42] Alicia dan Rani, "Kontribusi Aplikasi Sistem Manajemen Pembelajaran Berbasis Siber Terhadap Kompleksitas Manajemen Tindakan Kelas."

[43] Blackburn, Chen, dan Pfeffer, *Emerging Trends in Cyber Ethics and Education*.

[44] Nasaruddin, Das, dan Ladiqi, "Digital-Based Islamic Religious Education (IRE) Learning Model at Senior High School."

[45] Eshet, "Digital Literacy: A Conceptual Framework for Survival Skills in the Digital era."

[46] Lehto, "Cyber Security Capacity Building: Cyber Security Education in Finnish Universities."

[47] Muddin dan Septiawan, "CLS (Cyber Learning Santri): Optimalisasi Proses Pembelajaran Pondok Pesantren Salafiah sebagai Upaya Merealisasikan Visi Indonesia Maju Menuju Indonesia Emas 2045 (Studi Kasus: Pondok Pesantren Assalafiyah 1 Luwungragi Brebes)."

[48] Witsenboer, Sijtsma, dan Scheele, "Measuring cyber secure behavior of elementary and high school students in the Netherlands."

curriculum.[49,50,51] The findings also corroborate insights from studies emphasizing the importance of institutional support, gamified learning environments, and robust digital infrastructures in successful cyber education deployment.[52,53] However, unlike models in more digitally mature nations, Islamic institutions in Indonesia lack cohesive strategies for digital transformation despite existing demographic and technological advantages.[54,55,56]

Contrary to optimistic projections in digital pedagogy literature, this study found that awareness and implementation of cyber education within Islamic institutions remain nascent, echoing findings from contexts like Vietnam and Iraq where digital competency among students and educators is insufficient.[57,58] Furthermore, while literature supports the use of serious games and immersive environments to enhance engagement, such innovations are rarely applied in Islamic schooling systems.[59,60] This lag undermines the potential effectiveness of learner-centered pedagogies, which have been central to the success of cyber education in both military and civilian contexts.[61,62] Additionally, while other studies highlight the efficacy of teacher training and digital content creation, Islamic institutions appear underprepared in these domains.[63,64,65] These contrasts suggest that while the theoretical alignment exists, practical application remains a significant hurdle in integrating cyber education into Islamic pedagogy.

One plausible explanation for the limited integration of cyber education in Islamic institutions is the persistence of traditional educational values that prioritize

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[49] Hudnall, "Educational and Workforce Cybersecurity Frameworks: Comparing, Contrasting, and Mapping."

[50] Johanna Jacob, Michelle Peters, dan T Andrew Yang, *Interdisciplinary Cybersecurity : Rethinking the Approach and the Process* (Springer International Publishing, 2020), doi:10.1007/978-3-030-31239-8.

[51] Krutz dan Richards, "Cyber security education: why don't we do anything about it?"

[52] Kendra Graham et al., "Cyberspace Odyssey: A Competitive Team-Oriented Serious Game in Computer Networking," *IEEE Transactions on Learning Technologies* 13, no. 3 (2020): 502–15, doi:10.1109/TLT.2020.3008607.

[53] Marcus Knüpfer et al., "Cyber Taxi: A Taxonomy of Interactive Cyber Training and Education Systems," in *Model-Driven Simulation and Training Environments for Cybersecurity: Second International Workshop, MSTEC 2020, Guildford, UK, September 14–18, 2020, Revised Selected Papers* (Berlin, Heidelberg: Springer-Verlag, 2020), 3–21, doi:10.1007/978-3-030-62433-0_1.

[54] Darman, "Mempersiapkan Generasi Emas Indonesia Tahun 2045 Melalui Pendidikan Berkualitas."

[55] Etistika Yuni Wijaya, Dwi Agus Sudjimat, dan Amat Nyoto, "Transformasi Pendidikan Abad 21 Sebagai Tuntutan."

[56] Zen, "Inovasi Pendidikan Berbasis Teknologi Informasi : Menuju Pendidikan Masa Depan."

[57] Khalid Mukhlif Tarrad et al., "Cybercrime Challenges in Iraqi Academia: Creating Digital Awareness for Preventing Cybercrimes," *International Journal of Cyber Criminology* 16, no. 2 (2022): 15–31, doi:10.5281/zenodo.4766564.

[58] Andrea Tick dan Phuong Thao Mai, "Cyber Security Awareness and the Behaviors of Higher Education Students , using Smartphones in Vietnam" 21, no. 12 (2024): 111–31.

[59] Pendleton dan Okolica, "Creating Serious Games with the Game Design Matrix."

[60] Senanayake, Porras, dan Kaehler, "Revolutionizing the Visual Design of Capture the Flag (CTF) Competitions."

[61] Flack dan Reith, "Self-Directed Learning Tools in USAF Multi-Domain Operations Education."

[62] Reith et al., "Rethinking USAF Cyber Education and Training."

[63] Joshua Maddy, Eric M Dillon, dan Husnu S Narman, "Adapting Cybersecurity Teacher Training Camp to Virtual Learning," in *2023 IEEE Integrated STEM Education Conference (ISEC)*, 2023, 301–8, doi:10.1109/ISEC57711.2023.10402194.

[64] Alan Stines, "Faculty perceptions of open educational resources in cyber curriculums," *Issues in Information Systems* 25, no. 2 (2024): 418–37, doi:10.48009/2_iis_2024_133.

[65] Zwilling, "Trends and Challenges Regarding Cyber Risk Mitigation by CISOs—A Systematic Literature and Experts' Opinion Review Based on Text Analytics."

textual fidelity over technological adaptability.[66,67] While these values are critical for spiritual formation, they inadvertently constrain pedagogical innovation necessary for digital fluency.[68] The underutilization of technology might also stem from resource constraints and insufficient professional development opportunities for educators, a problem widely acknowledged in cybersecurity education literature.[69,70,71] These findings are significant as they underscore the necessity of a dual commitment to tradition and innovation to fully realize the objectives of Indonesia Emas 2045. However, interpretations must be cautiously made, as the conceptual nature of this study does not empirically measure implementation levels or learner outcomes.

Moreover, the challenge of aligning pedagogical values with digital advancements may also reflect broader institutional inertia and lack of policy direction within Islamic education governance.[72] The gap between technological potential and pedagogical practice points to a critical need for leadership-driven strategies and stakeholder collaboration.[73] The significance of these findings lies in their capacity to inform targeted interventions that foster a culture of innovation without compromising Islamic educational identity. Nonetheless, the absence of empirical data limits generalizability and necessitates further research involving field-based assessments and longitudinal analyses of cyber education models. Thus, while the findings offer a compelling conceptual framework, their practical efficacy remains subject to contextual variables and implementation fidelity.

The integration of cyber education into Islamic education holds profound implications for national educational policy, institutional reform, and curriculum development aimed at preparing Indonesia's future generations. By adopting a comprehensive and inclusive cyber education strategy, Islamic schools can significantly enhance their relevance, competitiveness, and contribution to national development goals.[74,75,76] Importantly, this requires an ecosystemic approach involving collaboration among policymakers, religious leaders, educators, and technology providers to ensure sustainability and scalability. Digital literacy initiatives, cybersecurity awareness programs, and stakeholder training must be systematically institutionalized to realize this vision. In conclusion, advancing cyber education within Islamic contexts is not merely

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[66] Fajrin, *Pendidikan Ideal untuk Mempersiapkan Generasi Emas Indonesia*.

[67] Syaukani, "Menuju Indonesia Emas Dalam Perspektif Pendidikan Islam."

[68] Evi Muafiah et al., "Trends of Educational Technology (EdTech): Students ' Perceptions of Technology to Improve the Quality of Islamic Higher Education in Indonesia," *International Journal of Learning, Teaching and Educational Research* 21, no. 6 (2022): 226–46, doi:doi.org/10.26803/ijlter.21.6.14.

[69] Michael Hills, Chris Gamrat, dan Carson Brown, *Classroom Engagement Activities with the Raspberry Pi*, 2019, doi:10.1145/3349266.3351358.

[70] Matúš Madleňák dan Katarína Kampová, "Phishing as a Cyber Security Threat," in *2022 20th International Conference on Emerging eLearning Technologies and Applications (ICETA)*, 2022, 392–96, doi:10.1109/ICETA57911.2022.9974817.

[71] Ibid.

[72] Wahyudi dan Kurniasih, "Membangun Generasi 'Great' Beretika Menuju Indonesia Emas."

[73] Alicia dan Rani, "Kontribusi Aplikasi Sistem Manajemen Pembelajaran Berbasis Siber Terhadap Kompleksitas Manajemen Tindakan Kelas."

[74] Ahmad, Zainudin, dan Shahrani, "Interactive STEM in Cyber Awareness Learning System."

[75] Sobia Arshad et al., "Attack Specification Language: Domain Specific Language for Dynamic Training in Cyber Range," in *2021 IEEE Global Engineering Education Conference (EDUCON)*, 2021, 873–79, doi:10.1109/EDUCON46332.2021.9454094.

[76] Sonal Shukla dan Anand Sharma, "Cyber security using Machine Learning in Digital Education industry," in *2021 International Conference on Innovative Computing, Intelligent Communication and Smart Electrical Systems (ICSES)*, 2021, 1–6, doi:10.1109/ICSES52305.2021.9633786.

an educational imperative but a strategic necessity for achieving Indonesia's aspirations as a technologically empowered and spiritually grounded nation in in 2045.

5. Conclusion

This study aimed to conceptually examine the urgency of integrating cyber education within Islamic education as a strategic response to the challenges and opportunities posed by the digital era in achieving Indonesia Emas 2045. The findings emphasize that cyber education, with its emphasis on flexibility, interactivity, and access to global knowledge networks, offers a transformative potential for Islamic educational institutions to enhance their relevance and responsiveness in the 21st century. However, limitations such as infrastructural inadequacy, insufficient digital competence among educators, and the absence of systemic policies indicate the need for comprehensive reform. These findings imply that a holistic integration of cyber education—supported by digital literacy programs, intersectoral collaboration, and value-based curriculum design—is essential for preparing spiritually grounded and technologically capable future generations. Therefore, further empirical research is recommended to test conceptual models in real educational settings, explore localized innovations, and ensure that Islamic education remains adaptive, competitive, and aligned with national development goals.

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