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IMPACT OF IOT DURING THE COVID-19 PANDEMIC: PERSPECTIVES FROM ISLAMIC ETHICS AND HIGHER EDUCATION

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ABSTRACT

This study explores the integration of the Internet of Things (IoT) within higher education during the COVID-19 pandemic, analyzing its impacts through the lens of Islamic ethics and societal values. IoT technology has revolutionized communication, education, and social interactions, especially during periods of physical distancing. From an Islamic perspective, technology must align with principles of justice, community benefit (maslahah), and ethical integrity. This paper examines the positive and negative implications of IoT on education and social life for undergraduate students at Universiti Utara Malaysia (UUM), incorporating Islamic teachings to provide a nuanced understanding. A quantitative survey was conducted, involving 200 students from various academic disciplines, to evaluate their knowledge of IoT, experiences with online learning, and its social impacts. The findings highlight the opportunities IoT offers for equitable access to education and information, while addressing ethical concerns such as privacy and responsible use. This study underscores the importance of integrating Islamic ethical frameworks into the adoption of modern technologies to foster holistic societal development.

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INTRODUCTION

The Internet of Things (IoT) represents a transformative force in modern technology, enabling seamless communication among devices and people (Khanna & Kaur, 2020). From an Islamic perspective, technology must align with principles of justice, community benefit (maslahah), and ethical integrity (Abu Bakar et al., 2024). Its applications span diverse sectors, including education, where it has played a crucial role during the COVID-19 pandemic. The pandemic, which began in March 2020, accelerated the adoption of IoT in higher education, allowing students and educators to continue academic activities amidst unprecedented challenges. From an Islamic perspective, technology is viewed as a tool that must serve humanity's collective good while adhering to ethical and moral principles derived from the Qur'an and Sunnah. This worldview emphasizes the responsible use of resources and technological advancements to benefit society, preserve dignity, and ensure equitable access.

The present study investigates the dual impacts of IoT on education and social life, with a focus on Islamic ethics. IoT facilitates accessibility, affordability, and flexibility in education (Muhammad Ayoub Kamal et al., 2023). On the other hand, it raises concerns about ethical integrity, privacy, and the potential for social isolation (Atlam & Wills, 2020). By anchoring the analysis in Islamic values such as justice ('adl), compassion (rahmah), and mutual benefit (maslahah), this study seeks to provide a comprehensive understanding of IoT's implications for undergraduate students at UUM. This paper contributes to the discourse on the intersection of technology and Islamic ethics, offering insights into how IoT can be harnessed to advance educational equity and social cohesion in line with the principles of Islamic civilization.

LITERATURE REVIEW

IoT and Online Education

The transition to online education has been a defining feature of the pandemic, as highlighted by (Bao, 2020)who illustrates how Peking University adapted its instructional design to maintain educational continuity through effective use of technology. This shift underscores the role of IoT in facilitating remote learning, aligning with Islamic values that emphasize knowledge sharing and community support. The necessity for robust digital tools has been critical in ensuring that educational practices do not falter during crises. IoT-enabled platforms and tools allowed educational institutions to continue operations through remote learning solutions, ensuring that education remained accessible despite physical restrictions (Laksmi et al., 2023).

Similarly, research emphasize the importance of IoT applications in enhancing access to educational resources and communication in Nepal(Pratap et al., 2020). Moreover, IoT technologies such as smart classrooms, wearable devices, and learning management systems (LMS) have been pivotal in enhancing student engagement and personalized learning (Al-Fuqaha et al., 2015). The challenges faced, such as the need for clear ICT policies, resonate with the Islamic principle of adaptability in education and continuous improvement. This indicates a broader need for educational institutions to commit to equity and support all learners, reflecting Islamic values of justice.

Technology was employed to maintain the education of medical residents during the pandemic(Chick et al., 2020). The integration of IoT into medical education aligns with Islamic ethics, which advocate for the pursuit of knowledge and healthcare improvement. This suggests that the lessons learned during this period can inform future educational practices, ensuring that they remain ethical and effective. Similarly, in engineering education, IoT applications have allowed for the remote operation of laboratory equipment, fostering innovative ways to deliver technical education (Nelke et al., 2024).

Ethical Implications of IoT

While IoT offers immense benefits, it also introduces complex ethical issues, particularly concerning data privacy and surveillance (Allhoff & Henschke, 2018). As IoT collects vast amounts of data, concerns about

consent, data security, and unauthorized usage become paramount, especially from an Islamic ethical perspective that mandates respect for individual privacy and the protection of personal information (Suwondo, 2023).

The pandemic has also highlighted the vital role of IoT in healthcare (Chamola et al., 2020). Their comprehensive review indicates that the use of IoT and other technologies was crucial in managing the pandemic's effects, aligning with Islamic teachings that prioritize the preservation of life and health. The ethical imperative to protect and serve the community is reinforced through enhanced resource management and communication facilitated by technology.

Moreover, the experiences documented in New York City's hospitals underscore the ethical commitment to community well-being through innovative use of IoT (Goh & Sandars, 2024). The planning and interdisciplinary collaboration described reflect the importance of ethical decision-making in healthcare during crises, supporting the Islamic principle of utilizing available resources for the greater good. Furthermore, ethical challenges in IoT extend to educational contexts where students' performance data, behaviors, and interactions are constantly monitored. Hence, embedding Islamic ethical principles in the design and deployment of IoT solutions becomes essential to ensure that technological benefits do not come at the cost of moral values (Khan et al., 2018).

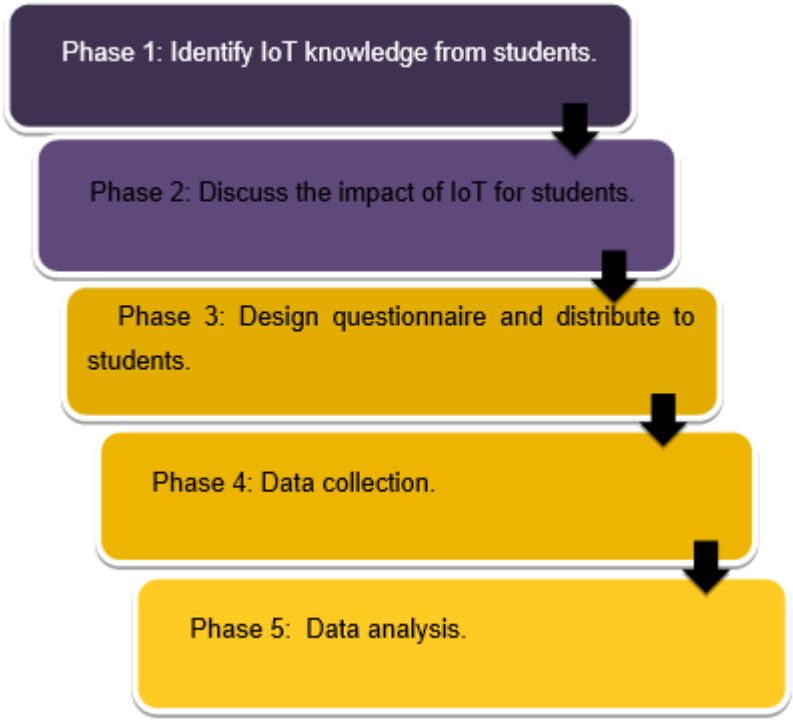
Challenges and Opportunities for Student Engagement

Some research focuses on student engagement during the pandemic, emphasizing the need for adequate training and support in online learning environments (Turnbull et al., 2021). This aligns with the Islamic ethic of empowering individuals through education. The transition to online learning during the pandemic highlighted challenges such as internet connectivity and student engagement (Dhawan, 2020). The findings suggest that improving internet connectivity and providing emotional support are essential for effective online learning, echoing the Islamic value of community support. Research indicates that while IoT can enhance interactive learning, many students experience difficulties such as limited access to reliable internet and insufficient digital literacy.

Additionally, the necessity for hybrid learning approaches Bioscience students, pointing out the challenges faced by students from disadvantaged backgrounds (Kelly M Griffin, et al, 2020). This aligns with the Islamic principles of social justice and equity in education, indicating that future educational strategies should ensure access to quality learning opportunities for all.

Moreover, emotional well-being is increasingly recognized as a key factor in online learning, with (Adnan & Anwar, 2020) emphasizing the need for emotional and psychological support mechanisms in IoT-enabled education. Islamic ethics also underline the importance of emotional care (rahmah) and empathy, underscoring the need for education systems to address not only cognitive but also emotional needs of students.

METHODOLOGY



Identify IoT Knowledge from Students

This study helps to increase students' understanding about IoT since it has evolved into something important where everyone needs the internet to communicate and work. All devices need to connect with the internet to function. Without being cautious, our private info might be exposed to the public.

Discuss the Impact of IoT for Students

We discussed the pros and cons of IoT about education and students' social life. As mentioned in the literature review, (Chang, 2016) stated that IoT bene-fits students to join class without travelling. However, students will feel less confident in socializing in real life due to lack of face-to-face interaction.

Design Questionnaire & Distribute to students

In this study, quantitative method is implemented for data collection using questionnaire survey where it contains three sections: Demographic, Impact of IoT in Education and Impact of IoT in Social Life. A Google Form was designed and went through a pilot test with 10 respondents to check its validity and reliability before dis-tribute via WhatsApp application platform.

Data Collection

The population of this research is the students of Universiti Utara Malaysia (UUM) Sintok, Kedah. The purpose of this questionnaire survey is to identify students' knowledge regarding Internet of Things (IoT) and to analyse students' experiences about online classes throughout this COVID-19 pandemic since early 2020. Data was gathered using cluster sampling modality, involving undergraduate students from schools of CAS, COB and COLGIS. An amount of 200 instruments were distributed.

Data Analysis

After 3 weeks of collecting data, 200 instruments were received. And about 37% response rate which is quite low because the surveys were distributed through WhatsApp platform only. The questionnaire survey used the five-point scale for the answer choices with 5 points for strongly agree, 4 points for agree, 3 points for undecided, 2 points for disagree and 1 point for strongly disagree. Option agree is frequently chosen.

RESEARCH FINDINGS AND DISCUSSIONS

Demographic Analysis

The analysis of the respondents' demographic characteristics demonstrated that many of the students from UUM are female (56.5%). The majority of the respondents were aged 20 to 25 years old (72.5%). Besides that, most students' responses to this survey are from semester 5 (45.5%) which is their current semester. The college that has the majority of respondents is CAS (40%) and their majority current places right now are at home (66.5%).

Impact Positive and Negative of IoT in Education

Items	Strongly disagree to strongly agree										Mean
	1		2		3		4		5		
	%	n	%	n	%	n	%	n	%	n	
I had an easy access of the internet wherever I go.	0	0	4.5	9	23.5	47	40.5	81	31.5	63	1273.99
I can attend the online learning classes.	0	0	3.5	7	23	46	35.5	71	38	76	12.98
Online learning led me to explore the development of ICT.	0	0	3	6	24.5	49	39.5	79	33	66	13.034
I actively involved in group activities in online classes compared to face-to-face classes.	2	4	11	22	29	58	36	72	22	44	10.984
I would rather get additional information and training lessons through the internet than through the lecturers and textbooks.	1.5	3	7.5	15	31	62	37.5	75	22.5	45	11.73
Students tends to cheat during online assessment.	0.5	1	8	16	29	58	36.5	73	26	52	11.753

Hard to focus and understand during online class.	0	0	4	8	35	70	33.5	67	27.5	55	12.48
Lack of communications between lecturers and students.	0.5	1	7	14	28	56	38	76	26.5	53	12.02
Slow internet connection during quizzes and online exam.	2	4	6.5	13	35	70	36	72	20.5	41	11.96
Lack of practical learning because online learning only focuses on the theoretical learning.	0	0	5.5	11	31.5	63	33	66	30	60	12.05

Table above highlights ten survey items examining the positive and negative impacts of IoT on education from an Islamic perspective. The findings show that 40.5% of respondents agreed they could easily access the internet wherever they went, enabling broader learning opportunities. This aligns with the Islamic value of talabul ilm (seeking knowledge). Similarly, 38% of respondents strongly agreed that IoT facilitated participation in online classes, while 39.5% noted that it encouraged exploring ICT developments. These results reflect the principle of maslahah in creating accessible and innovative educational experiences.

However, challenges emerged, including 36.5% of students acknowledging a tendency to cheat during online assessments, which raises ethical concerns in line with the Islamic principle of amanah (trust). 35% of respondents struggled with focus during online classes, and 38% experienced limited communication with instructors, emphasizing the need for fostering ukhuwwah (brotherhood) in learning environments. Additionally, 36% reported slow internet as a barrier, which highlights the importance of addressing disparities to fulfill the Islamic call for ‘adl (justice) in equitable education access.

Overall, the responses confirm that while IoT offers significant opportunities for enhancing education, it also necessitates ethical awareness and practical solutions rooted in Islamic teachings to mitigate its challenges effectively.

Impact Positive and Negative of IoT in Social Life

Items	Strongly	disagree	to	strongly	agree	Mean
	1	2	3	4	5	
	% n	% n	% n	% n	% n	
I can learn adaptability in the university and college life.	1.5 3	5 10	26 52	38 76	29.5 59	12.07
I can easily pay my monthly	0 0	5 10	24 48	40 80	31 62	12.70

bills using online transaction.											
I have a very effective communication and instant messaging services.	0.5	1	7	14	30	60	35	70	27.5	55	11.82
I can expand my network of acquaintance.	0.5	1	7	14	30	60	37	74	25.5	51	11.97
I can access the latest news from anywhere in the world.	0	0	4.5	9	22.5	45	42	84	31	62	13.01
I lack of social interacting in online class which leads to feeling loneliness and isolation.	0.5	1	4.5	9	31.5	63	38	76	25.5	51	12.53
Private information will be easily expose to other people.	0.5	1	6.5	13	25.5	51	42.5	85	25	50	12.60
Increase misleading information in social life.	0	0	4	8	24.5	49	45.5	91	26	52	13.45
Overall											100.1

Table above shows the responses for the impact of IoT on social life, highlighting its alignment with Islamic values. Most respondents (38%, 76 respondents) agreed that IoT improved adaptability in university and college life, fostering resilience and flexibility. These qualities reflect the Islamic principle of sabr (patience) and the importance of adapting to challenges. Additionally, 40% of respondents agreed that IoT made it easier to pay bills using online transactions, showcasing the benefits of technological efficiency and time management in accordance with the principle of ihsan (excellence). IoT was also praised for facilitating effective communication tools (30%) and enabling access to global news (42%), demonstrating its role in maintaining silaturrahim (family ties) and enhancing awareness of the wider community.

However, IoT also presented challenges that contradict Islamic ethical principles. For instance, 38% of respondents felt a lack of social interaction during online classes, leading to feelings of loneliness and isolation. This undermines the Islamic emphasis on ukhuwwah (brotherhood) and community bonds. Privacy concerns were another issue, with 42.5% fearing exposure of private information, which goes against the Islamic value of sitr (protection of privacy). Furthermore, 45.5% noted an increase in misinformation, highlighting the need for critical evaluation of information, as emphasized in Surah Al-Hujurat (49:6).

Sentiment Analysis

This study also employed open-ended questions to gather qualitative data to complement the quantitative data. We used both thematic and sentiment analyses to analyze the qualitative responses. The combination of the quan-qual methods should provide a more comprehensive understanding of the perspectives from islamic ethics and higher education on the impact of Iot during pandemic.

Figure 1: Conceptual framework for the application of creativity skills in learning and facilitation for SEN students with learning disabilities

Comment	Sentiment	Magnitude	Sentiment Score
"IoT has been a blessing for education, allowing us to continue learning."	Neutral	0.187	0.251
"Online classes are convenient, but I miss the social interaction."	Neutral	0.161	0.357
"Slow internet makes online exams very frustrating and unfair."	Positive	0.635	0.788
"Using IoT tools has made group projects easier and more efficient."	Positive	-0.59	0.751
"I worry about how much data these platforms collect about us."	Neutral	-0.107	0.573
"IoT helps me stay in touch with family, fulfilling the Islamic principle of silaturrahim."	Positive	0.88	0.59
"False information on IoT platforms can mislead, which is warned against in the Qur'an."	Negative	1.05	-0.50
"IoT makes life easier, but it can feel overwhelming at times."	Neutral	0.138	0.45
"The ability to access global resources is a major advantage of IoT."	Negative	-0.548	0.666
"Privacy concerns make me hesitant to fully trust IoT technologies."	Neutral	-0.2	0.8

The sentiment analysis in this study examines user perceptions of the impact of IoT during the COVID-19 pandemic, particularly in the context of higher education and Islamic ethics. By analyzing comments for their sentiment, magnitude, and sentiment scores, the study reveals diverse perspectives on IoT technologies, ranging from positive to negative, with a significant focus on ethical implications.

Positive sentiments highlight the advantages of IoT during the pandemic. For instance, one user noted that IoT helps maintain family connections, fulfilling the Islamic principle of silaturrahim. Others appreciated how IoT

tools simplified group projects and enabled access to global resources, emphasizing its role in fostering collaboration and learning. These comments reflect the practical and ethical benefits of IoT in enhancing connectivity and ensuring continuity in education and personal relationships during challenging times.

Neutral sentiments, on the other hand, convey a balanced perspective on IoT's advantages and limitations. Comments such as "IoT has been a blessing for education, allowing us to continue learning" and "Online classes are convenient, but I miss the social interaction" acknowledge IoT's role in maintaining educational activities while also recognizing its inability to fully replicate in-person interactions. These insights suggest that while IoT has been instrumental, it is not without its drawbacks.

Negative sentiments reveal ethical concerns and frustrations associated with IoT use. Some users expressed worries about privacy, mistrusting the platforms due to the amount of personal data they collect. Others highlighted the issue of false information spreading on IoT platforms, aligning this concern with Islamic teachings that warn against misinformation. These negative views underscore the challenges of ensuring ethical use and trust in IoT technologies, particularly during a time when reliance on them increased significantly.

Overall, the sentiment analysis demonstrates a nuanced view of IoT's role during the pandemic. While its contributions to education, connectivity, and efficiency are appreciated, ethical concerns regarding privacy, misinformation, and social interaction remain prevalent. This dual perspective underscores the importance of addressing these issues to ensure that IoT continues to serve society in ways that align with educational goals and ethical principles.

Thematic Analysis

Theme	n	%
Facilitation of Education	4	40
Islamic Ethical and Social Values	2	20
Privacy and Data Concerns	3	30
Challenges with Misinformation and Accessibility	1	10

The thematic analysis reveals four key themes regarding the impact of IoT during the COVID-19 pandemic, with a focus on Islamic ethics and higher education. The most prominent theme, Facilitation of Education (40%), highlights the significant role IoT played in enabling remote learning, ensuring academic continuity, and providing access to global educational resources. These align with the Islamic principle of seeking knowledge (talabul 'ilm), which is considered a lifelong obligation. The second theme, Islamic Ethical and Social Values (20%), underscores how IoT supported the maintenance of silaturrahim (family ties) and fostered collaboration during the pandemic. Many participants noted that IoT allowed them to fulfill Islamic social obligations, even during periods of physical isolation, emphasizing the importance of relationships and community values in Islam.

Privacy and Data Concerns (30%) emerged as the third theme, reflecting apprehension about the ethical implications of personal data collection by IoT platforms. These concerns resonate with Islamic principles of protecting individual rights (haq al-adami) and ensuring the responsible use of technology. Participants expressed hesitancy in fully trusting IoT technologies due to these privacy issues. The final theme, Challenges with Misinformation and Accessibility (10%), highlights frustrations with false information on IoT platforms, which goes against the Qur'anic emphasis on truthfulness and accountability. Additionally, issues such as unequal access to IoT tools and slow internet were identified, raising questions of equity and justice core

principles in Islam. These findings suggest the need for ethical practices and inclusive policies to maximize IoT's positive impact while addressing its challenges.

CONCLUSION AND RECOMMENDATION

In conclusion, this paper has reviewed both the positive and negative impacts of IoT on education and social life, particularly among undergraduate students in UUM, through the lens of Islamic ethics. The analysis demonstrates that each impact carries its own significance, reflecting both the benefits and challenges of IoT integration. Based on the data collected, the majority of students agree that IoT has had a profound influence on their academic and social experiences. From an Islamic perspective, the positive impacts of IoT in education align with the principle of talabul 'ilm (the pursuit of knowledge), as it provides students with easy access to educational resources and the internet, supporting their academic growth.

In social life, the ability to access the latest global news reflects the Qur'anic value of staying informed and aware of the world, fostering a sense of connection and responsibility. However, the challenges of IoT, such as misinformation and privacy concerns, emphasize the need to uphold Islamic values of truthfulness (sidq), trust (amanah), and justice (adl). These findings highlight the transformative potential of IoT while underscoring the importance of integrating ethical principles to ensure its responsible and balanced use in alignment with Islamic teachings.

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