

**Advancing E-Government, Education, and Healthcare through Strategic Software
Solutions: A Comparative and Solution-Focused Study in Nepal and Nigeria**
(Technical Project)

**Digital Divide and Societal Progress: A Socio-Technical Study of Software Technology
Education, E-Government and Healthcare in Nepal and Nigeria**
(STS Project)

A Thesis Prospectus
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By
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On my honor as a University Student, I have neither given nor received unauthorized aid on this
assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

In the modern world, software systems play a crucial role in various aspects of human life, such as education, healthcare, business, and governance. In developing countries, implementing, and effectively using these technologies in essential sectors like e-government, digital healthcare, and e-education are vital for societal advancement. Unfortunately, there is a gap between developed and developing countries regarding adopting these technologies. As a Nepal-born Computer Science student at the University of Virginia, I have seen many differences in education, government systems, and healthcare in developing and developed worlds. To better understand these differences, I have conducted a comparative analysis of two technologically advancing countries - Nepal and Nigeria. Since Nigeria has made significant progress in this sector in recent years, a country like Nepal could learn so many things from Nigeria. Making this comparison could improve my home country's government, health, and education system advancements by adopting how Nigerians have recently advanced their digitalization.

Nepal is a small country between two giant nations, China, and India, facing unique technological challenges. Despite a population of 30 million with a literacy rate of 71.15%, its progress in sectors like e-government and digital healthcare needs to be improved. Limited infrastructure and educational opportunities lead to many students (approximately 100,000 annually) seeking education abroad. Nigeria, the most populous country in Africa, has made significant progress in the education and healthcare sectors. With a literacy rate of 77.62% among its 213.4 million citizens, Nigeria is a valuable example for other developing countries.

Not addressing these issues could lead to wider socio-economic gaps, hindered national development, and an inability to compete in the global digital economy. This portfolio includes a technical project and a sociotechnical study (STS) to tackle these challenges.

The technical aspect of this study will focus on analyzing the implementation and impact of software systems in the education, e-government, and healthcare sectors in Nepal and Nigeria. This involves identifying current technological practices, challenges, and opportunities for improvement. I aim to improve the use and acceptance of software in these countries. I will research customized strategies that consider each country's unique situation. I plan to use my knowledge to find an easy-to-understand and implement software solution by conducting comparative analysis research.

The STS research will investigate the social and technical factors contributing to adopting software systems in developing countries. The research aims to understand how technological advancements in these sectors impact cultural, social, and political aspects. This study will employ qualitative and quantitative research methods to achieve its goals, including interviews with key stakeholders such as the manager of infoDevelopers Private Limited (Pvt. Ltd) in Nepal and the manager of Tek Experts Nigeria. Additionally, the research will involve in-depth analysis of policy documents, including consultation with a lawyer from Imperial Law Associates in Nepal and a legal expert from Minerva Legal in Nigeria to provide a deeper understanding of the legal and regulatory frameworks that impact technology adoption. The study will also draw upon a wide range of academic literature, including scholarly articles from Google Scholar and materials available through the UVA libraries. This approach aims to provide a balanced perspective that integrates empirical data from fieldwork with theoretical

frameworks from existing literature. Ultimately, the study seeks to uncover the nuanced relationship between technology and society in these developing contexts.

Technical Topic

In the upcoming technical project, my focus is a detailed analysis of the recent technological developments in Nepal and Nigeria. I aim to identify the most effective methods for implementing technological solutions, specifically addressing the challenges unique to e-government, e-education, and the health sector in these countries. Nigeria, known as an emerging powerhouse for software development in Africa and the largest economy on the continent, presents a compelling case for study (Nigeria Bureau of Statistics, 2016). Nigeria's recent significant growth is a source of inspiration, and there is much to be learned from its advancements to aid Nepal's technological progress.

The technical challenges in implementing e-government, e-education, and health systems in Nigeria and Nepal bear striking similarities. These challenges are not confined to individual organizations but are prevalent across various agencies, including issues like unstable electricity supply, Information and Communication Technology (ICT) illiteracy, and poor network infrastructure (Lawan, 2020, p.9). Ajayi (2020) has expressed concerns regarding the power and electricity supply in Africa as a major hindrance to the effective use of e-government. In Nepal, the situation is somewhat similar. Dhital (2018) observed that while electricity supply in Hagam was reliable, it was erratic and unpredictable in Fulpinkot, with frequent power cuts. Moreover, many schools in Nepal lack basic ICT resources due to the country's developing status, making it challenging to connect all regions to the national electricity grid (Dhital, 2018).

The situation in Nigeria is analogous, where online class attendance is low due to poor internet connectivity and the high cost of data (Adeoye, 2020, p.30). The implementation of technologies like Electronic Medical Record Systems (EMRS) in developing countries is often hindered by a lack of infrastructure and computer literacy (Dhital, 2018). In Nepal, approximately 80% of the population resides in rural areas with limited access to educational resources, widening the educational gap (Giri, 2020). Nigeria, despite its progress in certain areas, has historically faced challenges with e-learning due to poor ICT infrastructure (Ajadi, 2008). In 2022, Nepal's e-readiness was still in a developmental phase, with emerging concerns like cybersecurity (Giri, 2020). The UN's E-Readiness Index rankings for 2020 placed Nepal at 132 and Nigeria at 140, reflecting these ongoing challenges.

The software industry in Nepal is grappling with effective project management and implementing suitable software development processes. Many software project failures in Nepal are attributed to unclear requirements, lack of strategic planning, and ineffective project management tools (Shakya, 2020, p.136). In Nigeria, the quality of software engineers and technical workers has been a setback, impacting the performance of the tech industry (Timm, 2017). Challenges in Nepal also include low literacy rates, poor infrastructure, and political instability, which hinder the development and implementation of e-government systems. Despite its potential, Nigeria's tech industry faces internal issues affecting its global image (Casado-Lumbreras et al., 2014). However, improvements in political stability and economic strength

offer hope for a brighter future. According to Filipovikj et al. (2013), success in software development is heavily dependent on the skills and motivation of the people involved.

As a rising software engineer from UVA, I found Nigeria's situation to be less advanced than expected, given its status as Africa's software powerhouse. It's evident that both Nepal and Nigeria require assistance to grow their technical industries. With my knowledge in software development and cybersecurity, I believe I can make a significant contribution to the digital advancement of both countries. By analyzing their strengths and addressing their weaknesses, we can revolutionize various sectors and enhance overall development. One approach is to teach agile methodologies and utilize frameworks like Django and Python, as these are currently in high demand for training new software engineers and IT students, as well as software users in the government and healthcare sectors in both Nepal and Nigeria. Furthermore, both countries need more computer devices and skilled personnel. As a recent graduate, I am compelled to contribute to meeting this need in Nepal and Nigeria. Through collaborations with organizations like Computers with Causes and by partnering with Nepalese software firms like LIS Nepal, as well as Nigerian tech companies such as Flutterwave and MTN, I plan to empower individuals with essential skills in the software industry. I am also planning to conduct software-boosting seminars in major cities like Kathmandu and Pokhara in Nepal, and Abuja and Lagos in Nigeria. These efforts are crucial to overcoming existing barriers and promoting the development of robust digital infrastructures in e-government, e-education, and electronic healthcare systems.

In conclusion, both Nepal and Nigeria are navigating their paths towards technological advancement, each facing unique challenges. Nepal struggles with infrastructural and educational disparities, while Nigeria contends with internal issues that affect its global image. Despite these hurdles, both countries are making strides towards digital advancement. A comprehensive strategy that encompasses education, cybersecurity, social stability, and international perception management is crucial. As Newman (2015) notes, wicked social software engineering problems do not have single or purely technical solutions; a process that explores multiple approaches to address different manifestations of the same problem is necessary. As global leaders in technology, it is our responsibility to promote digital equality worldwide, ensuring that the benefits of technology are accessible to everyone as a fundamental right.

STS topic

As technology advances in our modern world, ensuring its benefits are available to all societies worldwide is crucial. It is vital to ensure everyone can access essential digital services, regardless of where they live or their financial situation. This study focuses on how software developments influence critical sectors—education, e-government, and healthcare—in Nepal and Nigeria. Both countries have potential but face challenges such as insufficient infrastructure, electricity shortages, and a lack of skilled workers. The poor state of the infrastructure and the need for good talent are also responsible for holding back the industry. Notwithstanding, the tech companies in Nigeria have made significant progress despite the challenges pulling them back. (Muhammad, 2017, p.100).

A pivotal socio-technical aspect that demands attention within the realms of Nepal and Nigeria is the digital divide in the education sector. This divide has become increasingly significant with the rapid expansion of e-learning and digital education platforms. The disparity in access to digital resources and digital literacy is not merely a technological issue but a complex socio-technical challenge with deep-rooted implications for educational equity. In Nepal and Nigeria, this digital divide is not just a matter of infrastructure but also cultural, economic, and policy dimensions. The lack of reliable electricity, affordable digital devices, and internet connectivity, particularly in rural and underserved areas, exacerbates the gap between those who can benefit from digital education and those who are left behind. This divide goes beyond the physical availability of technology; it also encompasses the readiness of educators to integrate technology effectively into the curriculum and the ability of students to engage with digital learning tools.

Budgetary constraints further complicate the situation. For instance, Nigeria's educational budget allocation, being substantially below UNESCO's recommended threshold, hampers the development of digital infrastructure and resources necessary for modernizing education (Adeoye, 2020). Similarly, The Government of Nepal (GON) and the Ministry of Education (MOE) have introduced various interventions to achieve the education goal in Nepal. The use of Information and Communication Technologies (ICT) in education has been considered as one of the strategies to achieve the broader goals of education (Dhital, 2018, p.3217).

Moreover, the digital divide in education is a barrier to individual learning and a broader societal issue. It affects the ability of countries to develop a skilled workforce capable of competing in the global digital economy. This aspect ties directly into the broader theme of the

study, which examines the role of software technology in societal transformation. As such, understanding and addressing the digital divide in education becomes crucial in assessing the overall impact of software developments on societal progress in these countries.

How do limited infrastructure, electricity access, and skilled personnel shortages in Nepal and Nigeria impact software technologies' successful implementation and effectiveness in education, e-government, and healthcare sectors? The study will employ mixed methods, including qualitative interviews with educators and policymakers and quantitative analysis of educational outcomes about technology access. Surveys will be conducted in urban and rural areas to assess the availability and use of digital tools in education. Most rural areas in Nigeria are not even connected to the national electricity grid. The consequence of this is that students residing in such areas may need help to use ICT effectively. Limited expertise has been reported because there are few technical staff to maintain the operations system. (Nwagwu, 2020). Policy documents and budgetary allocations will also be analyzed to understand governmental priorities and interventions. The quality of education, healthcare, and e-government services remains a challenge in modern Nigeria and Nepal.

This research employs the Social Construction of Technology (SCOT) framework to examine the intricate relationship between technology and society. The study uses SCOT to demonstrate how software technology and various social groups influence one another. The research focuses on the digital divide in education, and it compares the experiences of Nepal and Nigeria. This critical global issue underscores the importance of comprehending the interplay between technology, societal structures, and education systems in a nuanced way. Ultimately, the research seeks valuable insights into promoting digital inclusivity and educational equity by

focusing on the field of government and healthcare. By drawing on theories from Science, Technology, and Society (STS), the study contributes to the broader discourse on using technology for societal advancement.

Conclusion

The study delves into the current state of software applications in critical sectors such as education, e-government, and healthcare in Nepal and Nigeria. This report is designed to inform and assist a diverse audience, including policymakers, lawyers, technology company executives, IT professionals such as software engineers and trainers, and educators, particularly in developing nations. By integrating sociotechnical research methodologies, the study examines the intricate relationship between software development and societal implications. The report aims to provide a holistic view of the software landscape, emphasizing its influence on societal structures and dynamics. The insights garnered will be of significant interest and value to a wide range of stakeholders, including academics, researchers in the field of sociotechnical studies, and software developers, contributing to a deeper understanding of the intersection between technology and society. These projects provide practical strategies for implementing software solutions that meet societal needs while offering a theoretical understanding of the relationship between technology and society. They aim to promote a sustainable approach towards digital advancement in Nepal and Nigeria, bridging the gap between technical solutions and societal needs. Our research aims to ensure that technology is used fairly and efficiently in developing countries. To achieve this, both countries must focus on improving their educational systems to produce individuals with software expertise. This will enable the development of e-government and digital infrastructure, as they will be able to create software tailored to their specific needs.

References

- Adeoye, I. A., Adanikin, A. F., & Adanikin, A. (2020). COVID-19 and E-Learning: Nigeria Tertiary Education System Experience. *International Journal of Research and Innovation in Applied Science (IJRIAS)*, *V(V)*.
https://www.researchgate.net/publication/341574880_COVID-19_and_E-Learning_Nigeria_Tertiary_Education_System_Experience
- Ajadi, T. O., Salawu, I. O., & Adeoye, F. A. (2008). E-learning and Distance Education in Nigeria. *The Turkish Online Journal of Educational Technology – TOJET*, *7(4)*.
<https://files.eric.ed.gov/fulltext/ED503472.pdf>
- Ardo, A. A., Bass, J. M., & Gaber, T. (2023). Implications of Regulatory Policy for Building Secure Agile Software in Nigeria: A Grounded Theory. *The Electronic Journal of Information Systems in Developing Countries*, e12285. DOI: 10.1002/isd2.12285
<https://onlinelibrary.wiley.com/doi/pdf/10.1002/isd2.12285>
- Casado-Lumbreras, C., Colomo-Palacios, R., Ogwueleka, F. N., & Misra, S. (2014). Software development outsourcing: Challenges and opportunities in Nigeria. *Journal of Global Information Technology Management*, *17(4)*, 267-282.
<http://www.rcolomo.com/papers/245.pdf>
- Dhital, H. (2018). Opportunities and challenges to use ICT in government school education of Nepal. *International Journal of Innovative Research in Computer and Communication Engineering*, *6(4)*, 3215-3220. DOI:[10.15680/IJIRCCE.2018.0604004](https://doi.org/10.15680/IJIRCCE.2018.0604004)
https://www.researchgate.net/publication/324860589_Opportunities_and_Challenges_to_Use_ICT_in_Government_School_Education_of_Nepal

- Filipovikj, P., Feljan, J., & Crnković, I. (2013, May). Ten Tips to Succeed in Global Software Engineering Education: What do the Students Say?" *2013 3rd International Workshop on Collaborative Teaching of Globally Distributed Software Development (CTGDSD)*, San Francisco, CA, USA, 2013, pp. 20-24, DOI: 10.1109/CTGDSD.2013.6635241.
http://www.es.mdh.se/pdf_publications/2770.pdf
- Giri, S., & Giri, R. (2022). E-Readiness for E-Learning: A Nepal Case. *International Journal of Computer Science and Mobile Computing*, 11(1), 173-81.
DOI: 10.47760/ijcsmc.2022.v11i01.023
<https://ijcsmc.com/docs/papers/January2022/V11I1202208.pdf>
- Kharel, P., & Shakya, S. (2012). e-Government implementation in Nepal: a challenges. *International Journal of Advanced Research in Computer Science and Software Engineering*, 2(1).
<https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence>
- Lawan, B. M., Ajadi, I. A., Kayode, A. A., & Yaru, A. U. (2020). E-Government and Public Service Delivery in Nigeria. *e-BANGI Journal*, 17(5).
<https://core.ac.uk/download/pdf/333872115.pdf>
- Lempp, H., Abayneh, S., Gurung, D., Kola, L., Abdulmalik, J., Evans-Lacko, S., ... & Hanlon, C. (2018). Service user and caregiver involvement in mental health system strengthening in low-and middle-income countries: a cross-country qualitative study. *Epidemiology and Psychiatric Sciences*, 27(1), 29-39. DOI:10.1017/S2045796017000634
<https://www.cambridge.org/core/services/aop-cambridge-core/content/view/CED117AE287ABCA330661DB5EE747FB1/S2045796017000634a.pdf/div-class-title-service-user-and-caregiver-involvement-in-mental-health-system->

[strengthening-in-low-and-middle-income-countries-a-cross-country-qualitative-study-div.pdf](#)

Matthew, U. O., & Kazaure, J. S. (2020) Multimedia E-learning Education in Nigeria and Developing Countries of Africa for Achieving SDG4. *International Journal of Information Communication Technologies and Human Development (IJICTHD)*, 12(1), 40-62. DOI: 10.4018/IJICTHD.2020010103

<https://www.igi-global.com/article/multimedia-e-learning-education-in-nigeria-and-developing-countries-of-africa-for-achieving-sdg4/259380>

Muhammad, B. M. B., & Ahmad, I. A. I. A. I. (2017). A Survey of Skills and Practice A Survey of Skills and Practices Among Software Professionals Among Software Professionals s Among Software Professionals in the Nigerian Tech he Nigerian Tech Industry. development, 5(4).DOI: 10.22624

https://www.researchgate.net/profile/Aliyu-Muhammad-4/publication/322343331_A_Survey_of_Skills_and_Practices_Among_Software_Professionals_in_the_Nigerian_Tech_Industry/links/5a552a000f7e9bf2a5350976/A-Survey-of-Skills-and-Practices-Among-Software-Professionals-in-the-Nigerian-Tech-Industry.pdf

Newman, P., Ferrario, M. A., Simm, W., Forshaw, S., Friday, A., & Whittle, J. (2015, May). The role of design thinking and physical prototyping in social software engineering. In 2015 IEEE/ACM 37th IEEE International Conference on Software Engineering (Vol. 2, pp. 487-496). IEEE. DOI: 10.1109/ICSE.2015.181

https://www.researchgate.net/profile/Adrian-Friday/publication/308854365_The_Role_of_Design_Thinking_and_Physical_Prototypin

[g_in_Social_Software_Engineering/links/5817c9c508aeb720f689b311/The-Role-of-Design-Thinking-and-Physical-Prototyping-in-Social-Software-Engineering.pdf](https://www.researchgate.net/publication/343234197_Critical_Success_Factor_of_Agile_Methodology_in_Software_Industry_of_Nepal/links/5f3e59b0458515b729315e15/Critical-Success-Factor-of-Agile-Methodology-in-Software-Industry-of-Nepal.pdf)

Nwagwu, W. E. (2020). E-learning readiness of universities in Nigeria-what are the opinions of the academic staff of Nigeria's premier university? *Education and Information Technologies*, 25(2), 1343-1370. <https://link-springer-com.proxy1.library.virginia.edu/article/10.1007/s10639-019-10026-0>

Oke, A. E., Kineber, A. F., Albukhari, I., Othman, I., & Kingsley, C. (2021). Assessment of Cloud Computing Success Factors for Sustainable Construction Industry: The Case of Nigeria. *Buildings*, 11(2), 36. <https://www.mdpi.com/2075-5309/11/2/36>

Osman, R. (2012, July). Teaching Software Engineering in Developing Countries: A Position Paper, 2012 IEEE 36th International Conference on Computer Software and Applications DOI: 10.1109/COMPSAC.2012.91. <https://ieeexplore-ieee-org.proxy1.library.virginia.edu/document/6340223>

Shakya, P., & Shakya, S. (2020). "Critical Success Factor of Agile Methodology in Software Industry of Nepal." *Journal of Information Technology and Digital World*, 02(03), 135-143. DOI: 10.36548/jitdw.2020.3.001 https://www.researchgate.net/profile/Subarna-Shakya/publication/343234197_Critical_Success_Factor_of_Agile_Methodology_in_Software_Industry_of_Nepal/links/5f3e59b0458515b729315e15/Critical-Success-Factor-of-Agile-Methodology-in-Software-Industry-of-Nepal.pdf

Winner, L. (2017). Do artifacts have politics? In *Computer ethics* (pp. 177-192). Routledge. https://web.media.mit.edu/~ascii/papers/winner_1980.pdf

