

Re-Evaluating the University Library in the 4th Industrial Revolution: A Case Study of Undergraduate Engineering Students at UMaT

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Abstract

Background: The university library is traditionally considered the central hub for academic excellence and knowledge transfer. However, conventional engineering library frameworks frequently lack the specialized digital resources and flexible operational models required to meet the demands of modern higher education systems.

Purpose: This study evaluates the utilization patterns, infrastructure needs, and alternative digital learning platform preferences of contemporary undergraduate engineering students to guide institutional adaptation.

Methodology: A quantitative research approach was employed using a cross-sectional questionnaire administered to 317 undergraduate engineering students within the oil and gas and chemical engineering programs at the School of Petroleum Studies, University of Mines and Technology (UMaT), Tarkwa, Ghana. Open-ended qualitative responses regarding improvements and external platforms were systematically coded and categorized using thematic analysis.

Results: The findings indicate that while 97.5% of students utilize the physical library space, their primary activities are limited to personal studying (89.5%) and collaborative group discussions (65.8%). Conversely, traditional operations have dramatically declined, with only 2.7% of students utilizing the library for book lending. A thematic analysis of student recommendations identified Digital Infrastructure & Connectivity (34.0%) and Library Access & Opening Hours (23.0%) as the primary areas of concern, with strong demands for high-speed Wi-Fi, localized charging outlets, and a permanent 24/7 operating model. Additionally, when studying outside the classroom, students display an overwhelming preference for visual, asynchronous networks, with Video-Based Learning Platforms (predominantly YouTube) accounting for 72.7% of all alternative platform references, followed by institutional/academic repositories like Uhall (14.6%), open-access tutorial websites (4.7%), and AI-powered assistants (4.1%).

Conclusion: The study demonstrates that engineering students' academic habits have evolved away from static print media toward decentralized, technology-driven, and visual learning ecosystems. To maintain institutional relevance, university libraries must adapt by systematically upgrading high-speed digital networks, extending access hours, and integrating curriculum-aligned virtual and video-based learning resources into their core services.

Keywords: Engineering Education; Higher Education; Library Utilization; Asynchronous Education.

1. Introduction

The heart of any university is the library. It serves as a center for academic excellence in University¹. Libraries are established by universities for student use and support for academic knowledge transfer. Hence, the use of library services in the university by students is very important to evaluate the relevance of the library². Typically, in the past, the fundamental or primary use of the library by university students was to loan/access digital resources and conduct peer academic and research consultancy³. This level of service changes over time; however, the current services by most engineering university libraries lack the relevant services to meet the needs of students within the 4th revolution higher educational systems⁴. This has led to student apathy in core library activities, poor library usage, and consequence affect the academic performance and quality of students produced by the universities. It is therefore necessary for universities to evaluate the usage of the library facilities by their engineering students. This would provide useful guides on meeting students' academic needs and fulfilling the library's core mandate.

Traditionally, loans of books, use of digital resources, and appointments with peers are the primary uses of libraries⁵. Recent studies in literature also suggest that the use of libraries among engineering students reflects a strong preference for digital access and on-demand information, documenting that engineering students tend to access resources remotely^{6,7}. Although the physical presence of students in libraries is still relevant for other uses. In another study, Chinnadurai and Balamurugan⁸ argued that 30.84 % of engineering students use textbooks in the libraries. While 40.83 % prefer the use of electronic resources. Most of the studies in literature demonstrate the adaptiveness of libraries to present-day applications and student interest. Therefore, understanding the present-day needs for engineering students in libraries would provide useful knowledge on how to make university libraries relevant to student excellence.

In this study, a well-structured questionnaire on engineering students' views or opinions on the use of library services is administered and analysed to show the state-of-the-art use of libraries by undergraduates in universities. Also, students' opinions on ways to improve library services and students' motivation to use libraries are discussed. The study is based on questionnaires administered to over 300 undergraduate engineering students at the School of Petroleum Studies, University of Mines and Technology.

2. Methodology

This study employed a quantitative research approach to collect data from undergraduate engineering students within the oil and gas and chemical engineering programs. This approach allows the generalization of findings for effective use. This was done through a cross-sectional questionnaire administered to all participants of the survey. The Engineering group selected for the study were 317 undergraduate students from the School of Petroleum Studies at the University of Mines and Technology, Tarkwa. Specifically, the students study several oil and gas-related disciplines such as Chemical Engineering, Petroleum Engineering, Petroleum Refining and Petrochemical Engineering, Petroleum Geoscience Engineering, and Natural Gas Engineering.

3. Results and Discussion

The students that were involved in this survey were students in the School of Petroleum Students studying varying oil and gas related engineering courses, varying from Petroleum Engineering to Chemical Engineering, as shown in Figure 1 48% of the students were in year 1, 44% were in year 2, while the

remaining 12% comprise of third and final year students (See Figure 1). This was done to get the opinion of year groups in the university. The 68.4% of the respondents were males, while 31.6% of were female. This reflects the dominance of males within the engineering setting. Most engineering universities has more males to female ratio, directly reflecting the historical gender imbalance within modern engineering settings. Globally, engineering faculties exhibit highly skewed male-to-female enrollment ratios. This gender disparity aligns with the study by Acheampong and Gyasi⁹, who claimed that the female registration in mechanical, chemical, and petroleum engineering-related programmes in Ghana rarely crosses the 35% threshold due to long-standing systemic and socio-cultural barriers. However, compared to the claims by Bello and Mohammed¹⁰ for West African engineering departments, where historical baseline female enrollment hovered between 15% and 22%. The 31.6% female respondents in this study show a positive increasing involvement of females in engineering education and the sector in Ghana.

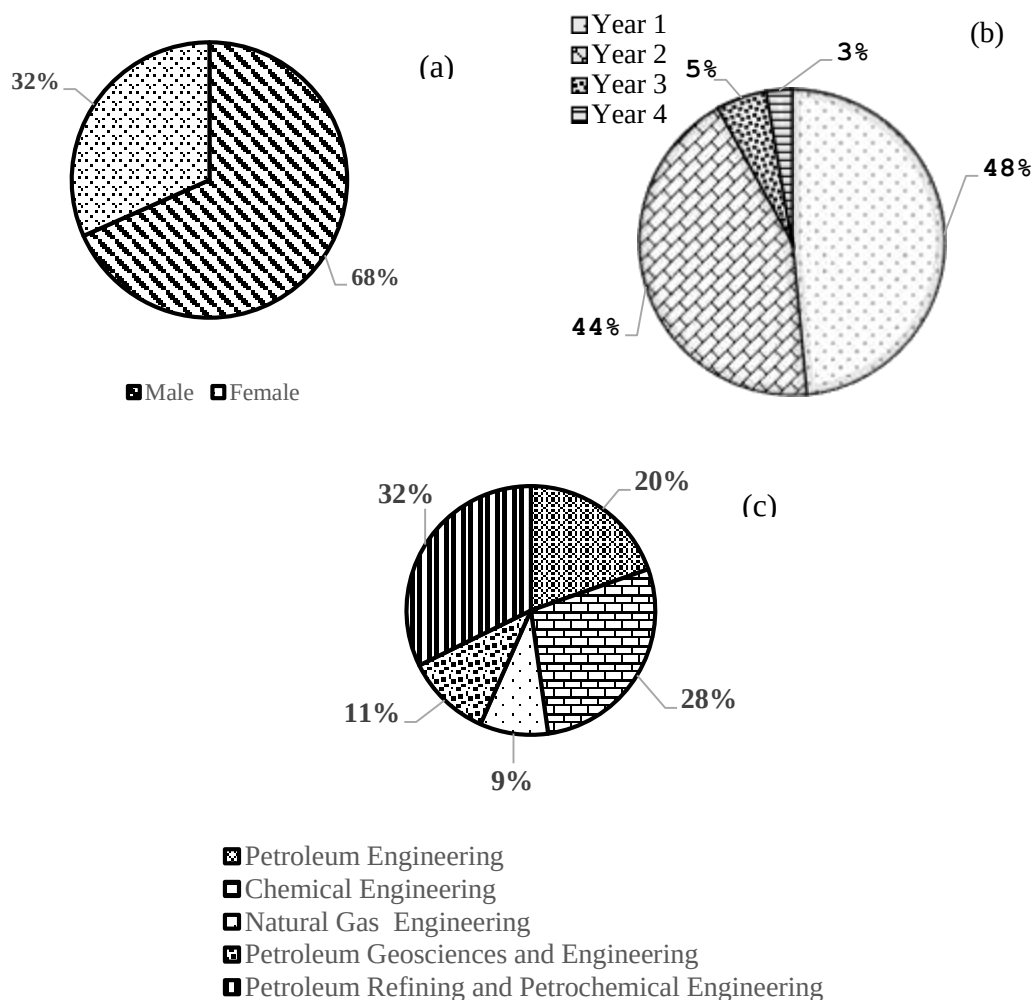


Figure 1. Study demographic data; (a) gender of respondents ;(b) year of study of respondents; (c) programme of study of respondents

The results show that about 97.5% of the students use the library in capacities, while 2.5% do not use the library (Figure 2). This means that the current library's current services are useful to the majority of the students, with much infrastructure baseline relevance. Students mainly visit the library to study, use the

internet, get information, borrow/renew books, meet up with friends, have group discussions, read lecturer notes, print documents and wait for lectures. In Figure 3, about 89.5% of the students visit the library to study. This is a reflection that most students use the library space to study and focus on their books. Probably because the library is quiet and serene for studying, most students prefer to use the place.

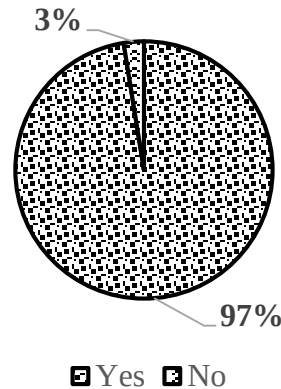


Figure 2. Usage of the library by engineering students

Aside from personal studies, students also use the library for group discussions. 65.8% of students use the library for group discussions for several forms of team collaborative skill development (Figure 4). About 28.6% of the students claimed they use the library as a place to study their lecture notes. The use of the library by students to seek information is 27.3%. This shows poor usage of the library's existing database for knowledge seeking. Students either find it difficult to get the books needed for studying or do not know how to search for nooks and access the eBooks in the library. On a total basis, only 16% of students who seek information from the library use the eBooks in the library. On the other hand, 38.1% use the reference materials, while 5.2% and 4.8% use the journal resources and Thesis reports in the library, respectively.

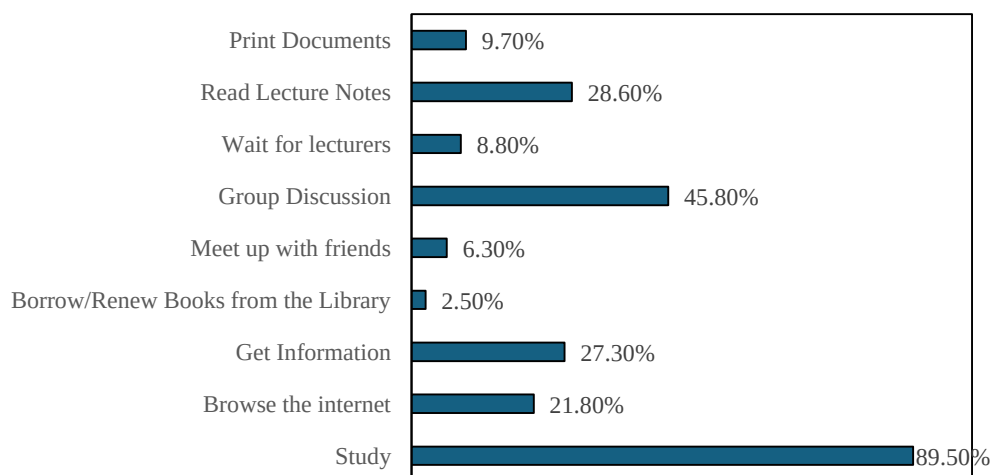


Figure 3. The purpose of using the library by respondents.

21.8% of students confirmed they use the library for browsing the internet. The internet in the library is fairly fast and good for studying, hence most students prefer to use the internet to support academic learning. On the other hand, 2.5% of students borrow books from the library. This reflects the dormant or poor use of library books amongst students. Lending books used to be one of the main activities of university libraries. The sharp decline in book lending could be due to the use of eBooks, online study platforms and AI tools and techniques. This finding agrees with the study by Thornton¹¹, who claimed that

physical textbook check-outs have dropped significantly since the mass-digitization of curricula. Some other emerging uses of the library were to temporarily wait for the next lecture (8.8%), meet with friends (6.3%), secretariat and printing services (9.7%).

It is interesting to note that aside from the use of the library for studies and group discussions, students poorly use all the services provided by the library. This implies that the utilization of the library by students has evolved over the years, and the traditional methods no longer apply, thus requiring an upgrade. This is critical, especially due to the emerging use of online learning platforms and AI-assisted tools for fast information and easy understanding.

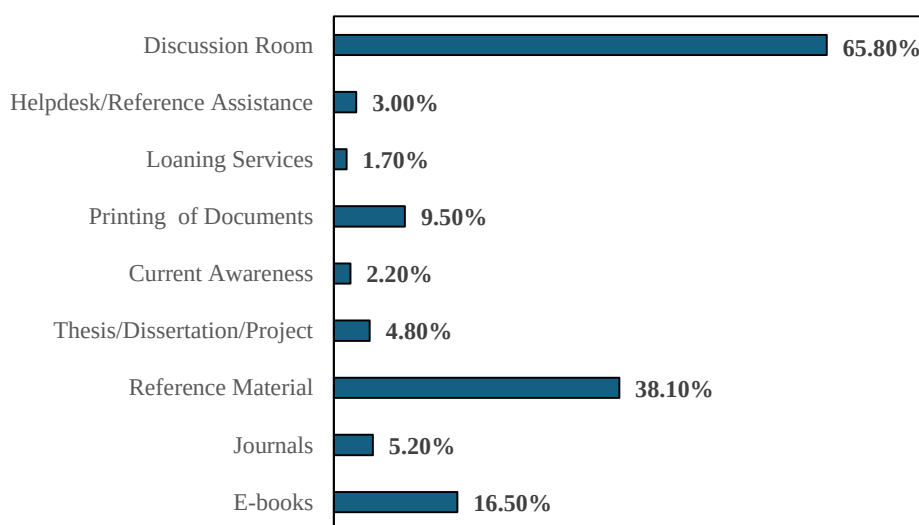


Figure 4. Library services used by respondents.

The students' main areas of concern for improved library performance were digital infrastructure, library operational and accessibility hours, space and furniture comfort, learning materials or resources, and academic support and professional development (Table 1). Digital infrastructure and operating hours amount to over 50% of the student feedback. The WI-FI coverage in most areas of the library is weak or slow. Students heavily rely on digital platforms like Zoom, YouTube and online learning systems, making stable internet a baseline necessity for modern learning. In terms of digital expansion, the students stressed the need for high-speed internet bandwidth with more coverage. Also, the installation of computers at vantage points in the library is useful to boost students' connectivity to online learning resources.

The time libraries operate is also a main concern for students in the engineering circle. Students specifically prefer 24/7-hour operating hours. Although the university currently runs such services during exams. A better accessibility system to meet the demands of students studying. Students also prioritise space and comfort in the library, and thus libraries must be well designed to provide a quality space and comfort environment for learning. While the library holds books, students note that relevant, program-specific course textbooks are missing, outdated, or insufficient in quantity.

Table 1. Services students need in the library

Theme	Percentage (%)
Digital Infrastructure & Connectivity	34.0
Library Access & Opening Hours	23.0
Facility Space, Furniture & Physical Comfort	19.1

Learning Materials & Academic Resources	15.4
Academic Support & Professional Development	8.5

Table 2. Other sources students use aside from the library

Theme	Percentage (%)
Video-Based Learning Platforms	72.7
Institutional & Academic Repositories	14.6
Open-Access Tutorial Websites	4.7
AI-Powered Chatbots & Assistants	4.1
Search Engines & Research Databases	3.0
Specialized Apps & Mobile Tools	0.8

The study shows that aside from normal lectures and studies, students mainly focus on asynchronous, visual, and step-by-step video explanations, rather than traditional textbook reading (see Table 2). Therefore, YouTube serves as a decentralized virtual platform where students fill in the gaps from lectures. This means that libraries need to explore this opportunity by creating virtual learning platforms focused on engineering students' studies. Furthermore, when looking for structured, curriculum-aligned academic texts, past questions, and lecture notes, students turn to dedicated digital repositories and e-libraries. This is used simultaneously with Open-Access Tutorial Websites such as Khan Academy, Sanfoundry, and Alison for practice problems, foundational concepts, and standard engineering multiple-choice questions (MCQs). Students leverage well-established, free educational portals. The massive 72.7% reliance on YouTube perfectly maps to the "just-in-time" visual learning model identified by Purcell et al¹². Because core engineering concepts (such as fluid dynamics, thermodynamic cycles, or well-logging transformations) are highly fluid and kinetic, traditional static text diagrams are frequently insufficient. Quintero-Rodríguez and Colás-Bravo¹³ proved that technical undergraduates systematically use animated video content to bridge immediate comprehension gaps left by fast-paced live lectures.

4. Conclusion

This study evaluated the current patterns of library utilization, student satisfaction, and alternative digital learning platform preferences among undergraduate engineering students at the School of Petroleum Studies, University of Mines and Technology (UMaT). While a substantial (97.5%) of respondents continue to utilize the physical library space, primarily driven by the need for a quiet, serene environment for personal study (89.5%) and collaborative group discussions (65.8%), their functional interaction with traditional library services has fundamentally evolved. Traditional benchmarks of library efficacy, such as book lending (2.5%) and internal database navigation (27.3%), have grown largely dormant. This shift highlights a clear operational mismatch between conventional university library frameworks and the active habits of modern engineering undergraduates.

The thematic analysis of student recommendations highlights critical infrastructure gaps that must be bridged to restore institutional relevance in the fourth industrial revolution education era. Digital infrastructure and connectivity (34.0%), alongside restricted operational hours (23.0%), constitute the primary pain points for more than half of the student body. Students are strongly advocating for upgraded bandwidth, expanded Wi-Fi coverage, increased physical workstation deployment, and a permanent transition toward a 24/7 access model that extends beyond seasonal examination weeks. Furthermore, the

demand for updated, program-specific engineering textbooks, structural facility enhancements (such as consistent climate control and direct desk power outlets), and structured academic workshops emphasizes the need to transform the library from a static storage space for books into an interactive learning hub. Simultaneously, the investigation into alternative learning networks confirms a profound reliance on external, decentralized digital environments. Video-based learning platforms, overwhelmingly dominated by YouTube (72.7%) and targeted technical channels like Einstein Mechanics and Skancity Academy, have effectively become the primary virtual classrooms where students resolve conceptual ambiguities outside formal lecture periods. This visual-heavy ecosystem is supported by secondary engagements with localized digital repositories like Uhall (14.6%), open-access tutorial portals (4.7%), and emerging AI-powered assistants (4.1%).

Ultimately, engineering students have not abandoned academic engagement; they have decentralized it. To remain a vital driver of academic excellence, the university library must aggressively adapt to these behavioural shifts. Rather than competing with external digital spaces, modern university libraries should systematically absorb them, expanding institutional high-speed digital infrastructure, curating curriculum-aligned video resources, offering virtual learning environments, and optimizing physical real estate for technology-dependent collaboration. Implementing these changes will allow institutions to directly fulfil their core educational mandates, maximize resource utility, and properly support the academic excellence of future engineering professionals.

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