University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

Generative Artificial Intelligence-Based Learning Resources for Computing Students in Tanzania Higher Learning Institutions

Hadija Mbembati
University of Dar es Salaam
Email: hadija@udsm.ac.tz

Hussein Bakiri
The Institute of Finance Management
Email: hussein.bakiri@ifm.ac.tz

Abstract

In higher education institutions, students pursuing information and communication technology and other computer-related fields are increasingly using Generative Artificial Intelligence (GenAI) as a learning tool. The GenAI tools, such as Chat Generative Pre-Trained Transformer (ChatGPT), assist students with learning tasks that are always available and on demand. However, the preferred GenAI learning resources in the context of awareness of different GenAI tools, their applicability in various learning tasks, and GenAI usage are unclear. Therefore, this paper investigates the preferred AI-based learning resources for computing students in Higher Learning Institutions (HLIs) using statistical methods, including mean, standard deviation, and cross-tabulations. The survey data were collected from 571 undergraduate students in three Tanzania HLIs through an online questionnaire distributed via Google Forms. The results show that, despite the widespread use of GenAI learning resources, traditional learning resources continue to be employed in the learning process. The preferred learning resources differ depending on the tasks and the year of study. The study findings showed that computing students mostly use GenAI tools, such as ChatGPT and OpenAI, in various learning tasks. The findings offer valuable guidance for educators and policymakers on how to safely implement GenAI-based learning tools that effectively support students' learning needs in this GenAI era.

Keywords: Learning Resources, Computing Students, Higher Learning Institutions, Generative AI.

https://dx.doi.org/10.4314/udslj.v20i1.9

Introduction

The emergence of information and communication technology (ICT) services expands the availability of learning resources to higher-learning students. Higher learning students (HLS) can access materials through traditional and modern learning resources. Traditional learning resources include lectures, textbooks, and tutorials (Wynter et al., 2019), while contemporary learning resources encompass question banks, digital libraries, and social networks accessible through e-learning tools (Atuase & Maluleka, 2023). Technological advances, such as the use of artificial intelligence (AI), have enhanced modern learning resources for HLS (Deng & Yu, 2023). Recently, the use of Generative AI (GenAI), such as Chat Generative Pre-Trained Transformer (ChatGPT), has been extensively discussed regarding its potential as a learning

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

resource for HLS (King, 2023). Exploring GenAI as a learning resource can help HLIs explore new pedagogical approaches incorporating emerging technologies. A significant increase in the latest modern learning resources for HLS calls for studying preferred learning resources for HLS (Beyene et al., 2023). The study findings provide helpful information to education stakeholders for the HLS curriculum review or development process.

Higher education stakeholders in Tanzania, such as the Tanzania Commission for Universities (TCU), encourage the use of blended learning and quality learning resources to accelerate the learning process and improve student performance. The preferred quality learning resources for students in different fields have been reported in the literature (Almaiah et al., 2019; Awidi et al., 2019; Hilton, 2016; Hou et al., 2024; Kaiser, 2007; Lebenicnik & Starcic, 2018; Wynter et al., 2019). Despite the valuable findings disseminated by previous studies, some limitations remain, including the survey's small sample size and the limited number of AI-based learning resources included. To achieve more precise results, a greater sample size is necessary (Omair, 2014). These limitations call for further research with a larger and more diverse sample size, adding more learning resources for comparison, and comparing the perception of AI-based learning resources between HLSs (Hou et al., 2024).

Novelty and Contributions

This study contributes to the growing body of knowledge on using GenAI-based learning resources in HLIs by highlighting statistical evidence from the Tanzanian HLIs context. Compared to existing literature exploring the challenges, opportunities, and benefits of using GenAI tools, this research investigates students' preferences and usage patterns of AI-based versus traditional learning resources. Despite the widespread usage of GenAI tools such as ChatGPT, the study reveals that conventional resources remain relevant, with preferences varying across academic years of study and task types. The findings provide practical insights for educational stakeholders and policymakers to safely adopt GenAI-based learning resources that align with students' learning needs.

The specific contributions of this study are summarised as follows:

- Introducing the preferred learning resources (AI-based vs. traditional) among computing students in Higher Learning Institutions
- Establishing the GenAI usage trends by academic year of study and type of learning task
- Exploring the awareness of computing students of different GenAI tools and the applicability of these tools across various learning activities in Higher Learning Institutions

The remaining parts of this paper are organised as follows: the next section presents the literature review, followed by a section on related works, and then the methodology section describes the study's approach. After this, the results and discussion are presented. The last session presents the conclusion of the study.

Literature Review

Learning Resources for HLS

Learning resources can be utilised to acquire information that enhances teaching and improves the quality of students' learning (Gomis et al., 2023). These resources include tools, equipment, printed materials, online documents and videos, as well as adaptive learning technology (Karmadi et al., 2023). The availability of learning resources enhances learning effectiveness for HLSs and improves students' performance. Given its importance, learning resources have become one of the pillars of learning activities in HLIs (Balderas-Solís et al., 2022). HLIs offer higher-level education, which is more complex and requires students to acquire knowledge from various resources to meet the required grade point average. Concentrating on lecture notes and tutorials might be insufficient for in-depth learning and knowledge development (Simui et al., 2017). Therefore, instructors emphasise that HLSs should use available learning resources from academic libraries and other reputable resources to enhance learning and research.

Recently, HLSs leveraged advanced development technology such as artificial intelligence (AI) based learning resources (Farrelly & Baker, 2023). This emerging technology can help students solve problems, write documents, and obtain new knowledge (Qadir, 2023). The AI-based learning resources provide several educational benefits, including content creation, language acquisition, and evaluation. (Mae et al., 2023). This benefit resulted in several publications exploring AI-based learning resources as a formal learning and assessment tool in HLIs (Perkins, 2023; Qadir, 2023).

Artificial Intelligence-Based Learning Resources

AI-based learning in education started 50 years ago, as reported by Niemi (2021). Recently, the use of AI-based learning resources has increased, driven by advancements in information and communication technologies. The AI-based learning resources are more similar to human-generated learning resources; therefore, AI-based learning resources can be saved as supplementary materials (Denny et al., 2023). The prevalent AI-based learning resource tool is generative artificial intelligence (GenAI). Generative AI can be defined as a technology that adopts a deep learning model to generate human-like content based on user prompts (Michel-Villarreal et al., 2023). Generative AI covers a wide range of applications, and the famous applications that significantly contributed to learning (Content generation) are ChatGPT, Google Bard, and Microsoft Bing (Dhanvijay et al., 2023).

The rapid adoption of GenAI has sparked an intense debate over its applicability for learning in HLIs. The use of GenAI in HLI significantly impacts students and instructors (Smolansky et al., 2023). During the COVID-19 pandemic, most HLS students use online tools such as GenAI to learn and do assignments (Perkins, 2023). However, it was challenging for instructors to distinguish between the work done by students and GenAI during learning assessments (Denny et al., 2023). This results in several studies exploring the adoption of AI-based learning resources in HLIs, focusing on ethical considerations, opportunities, and challenges (Farrelly & Baker, 2023; Michel-Villarreal et al., 2023; Yu et al., 2023).

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

The AI-based learning resources offer opportunities for HLS, including saving time, providing personalised tutorials and feedback, facilitating collaboration, and enhancing accessibility. For example, providing timely and meaningful input through automated marking is a crucial benefit (Ngo, 2023). However, the main challenges researchers report are widespread cheating and plagiarism, which can render their application in HLI (Gill et al., 2024; Umme et al., 2023). To prevent plagiarism and cheating, researchers recommend the best practice to leverage AI-based learning resources in academic and scientific research (Alshahrani, 2023; José Segovia Juárez & Robert Baumgartner, 2023; Matto et al., 2025; Mwogosi & Simba, 2025; Naseem et al., 2025).

The integration of GenAI in pedagogical frameworks has been proposed in the literature to ensure practical and safe application in education (Shailendra et al., 2024). The conceptual framework for higher education, which considers the generative artificial intelligence adult learning ecology (GenAI-ALE) framework, has been designed to guide the effective integration of generative AI technologies into adult learning environments (Ewert et al., 2024). The learner and teacher behaviours on the use of Gen AI in education have been examined following the technology acceptance model (TAM) (Ghimire & Edwards, 2024). The results indicate perceived usefulness, ease of use, and enjoyment in engaging with Geni AI tools for learning and teaching (Hsiao & Tang, 2024).

Related Works

Considering the importance of the research on learning resources in HLI, several related research works are in the literature (Gomis et al., 2023). For example, (Wynter et al., 2019) conducted a study investigating the preferred learning resource for doctoral students in Australian HLI. Among several available learning resources, question banks have emerged as the most preferred tools for revision and learning among doctoral students. Social networks such as Twitter, Instagram, and Facebook have been reported as learning resources for HLS (Awidi et al., 2019). The most preferred social network for learning is Twitter (Erhel et al., 2022; Hortigüela-Alcalá et al., 2019). Another study by Almaiah et al. (Almaiah et al., 2019) investigated using mobile learning applications in HLI. The results suggest that smartphones can be a valuable learning tool for HLS. Mai et al. (2021) conducted a study to explore the learning behaviour of programming students. The findings showed that lower-performing students preferred to use lecture notes only as learning and revision resources. To fill the gap, researchers introduce blended learning to increase students' knowledge and skills (Coyne et al., 2018). Instructors and students mostly prefer blended learning due to its flexibility.

Due to the emergence of new modern learning resources worldwide, researchers continue to conduct more research in the learning resources field, focusing on AI-based learning resources (Denny et al., 2023). The adoption of AI-based learning resources for computing students to assist students in coding has been discussed in the literature, and findings show that some HLIs discourage the adoption. Despite the discouragement of adoption, students still use AI-based learning resources to seek help in their computing courses. Therefore, the recent study examined the preferred learning resources for computing students, including ChatGPT and GitHub, with a sample size of 55 computing students. The findings showed that the frequency of usage of online resources and ChatGPT are 70.2 per cent and 23.4 per cent, respectively (Hou et al., 2024).

Methodology

Research Design

The primary objective of this paper is to determine the most preferred learning resources among the students of higher learning institutions (HLI) in Tanzania. The category of students selected for this study is from undergraduate programs that offer computing-related courses. The reason for considering this category is that undergraduate students cover a large sample of students in HLIs (Abdalla Shaame & Tabu Kondo, 2024). Moreover, computing students are primarily concerned with the use of ICT tools as learning resources (Ayanwale & Molefi, 2024).

This study is limited to three (3) renowned Tanzanian institutions of higher learning: the Institute of Finance Management (IFM), the University of Dar es Salaam (UDSM), and the University of Dodoma (UDOM), owing to its alignment with the study's focus on computing-related programs. One primary criterion used to choose these HLIs deliberately is that approximately 2,800 students were enrolled at UDOM's College of Informatics and Virtual Education, 1,200 at UDSM's College of Information and Communication Technologies, and 1,280 at IFM's ICT departments. These students are considered the largest in computing-related fields (University of Dodoma, 2024; University of Dar es Salaam, 2024; Institute of Finance Management, 2024).

The study employs a descriptive research design to determine the most preferred learning resources. These resources are categorised into online and offline resources. Furthermore, the study considers modern, sophisticated learning tools, such as ChatGPT and Capilot, among others. The descriptive research design is chosen because the study seeks to explore the frequency of use of these tools without manipulating any variables. The research design procedure carried out in the study to determine the preferred learning resources of the students is depicted using six steps, as shown in Figure 1. Data collection is the first step, followed by descriptive analysis and visualisation to present the data correctly. These three initial steps output a list of informed preferred learning resources. Finally, appropriate recommendations are put forward considering each of these implications to enhance the delivery of educational resources in alignment with student needs.

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

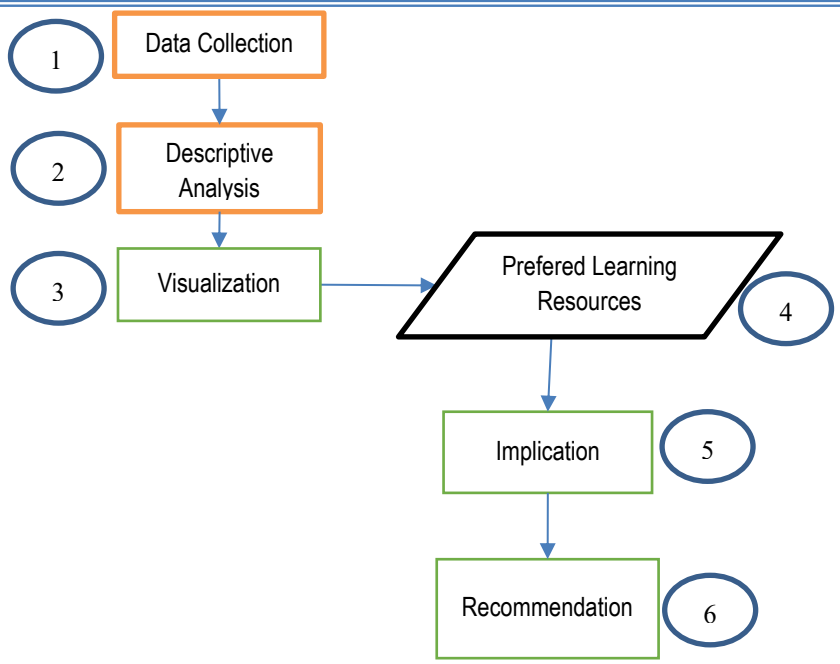

Figure 1: Study Design Procedure

Population and Sampling

According to the recent information published on the HLIs' websites, the total population of students from the College of Information and Communication Technology (UDSM) departments of Computer Science and Information Technology (IFM) and the College of Informatics and Visual Education (UDOM) approximately amounted to 1200, 1280, and 2800, respectively. Therefore, the total estimated sample size, as calculated from Equation (1), was 540, as shown in Table 1. However, the actual sample size of the respondents was 571. These students were from undergraduate programs taking computing courses. The sample size was estimated using Cochran's Formula, which is based on the probability sampling technique. The following equation represents the formula (Coyne et al., 2018).

$$n = (z^2 * p * (1 - p)/E^2 \quad (1)$$

Where:

n = required sample size

z = Z-score corresponding to the desired confidence level

p = estimated population proportion

E = the desired margin of error

We further applied the Finite Population Correction (FPC) formula to adjust the population size as seen in the following equation (Rizzo & Rust, 2011);

$$n_{ajd} = n/(1 + (n - 1)/\mathrm{N}) \quad (2)$$

Where:

n_{ajd} = adjusted sample size

n = initial sample size from the previous formula

N = population size

Finally, the confidence interval was calculated based on the following formula;

$$CI = p \pm Z * SE \quad (3)$$

Where:

CI = Confidence Interval

p = estimated population proportion

z = Z-score corresponding to the desired confidence level

SE = Standard Error

Table 1 shows the parameter values that were used in Cochran's formula (Equation 1). A confidence level of 95% (Z = 1.96) was used in this study because it is considered a common practice in social science and educational research, as it offers a balance between statistical reliability and data collection feasibility (Coyne et al., 2018). Given the dispersed characteristics of the student population across institutions, a 3% margin of error was selected to guarantee a manageable sample size and a comparatively high degree of precision (Das et al., 2020). These values support the generalisability of the findings within the chosen institutions and align with previous investigations that target university student populations.

Table 1Sampling Parameters and Results

Population Size (N)	Confidence Level (Z)	Margin of Error (E)	Standard Error (SE)	Estimated Proportion (p)	Sample Size (n)
5280	*95% (Z=1.96)*	*3% (0.03)*	*3% (0.03)*	*0.5*	*540*

Data Collection Methods

Data was collected using questionnaires distributed online. The questionnaire included items intended to gather information about gender, age group, year of study, name of the HLI, familiarity with and usage of AI, online and offline resources, and the purpose of using these resources. Moreover, the study employed an online questionnaire developed using Google Forms. This approach enabled respondents to access the information at a lower cost and with greater accessibility, regardless of their geographical diversity. The questionnaire can be accessed through the link provided in the appendix.

Although an online link was used to collect the data, IFM, UDSM, and UDOM were chosen purposefully as sample institutions. These institutions were selected to provide representation from various situations based on their diversity in academic services, student populations, and geographic dispersion across Tanzania. Additionally, while the online approach provided greater accessibility, extending the sample to other institutions would have necessitated institutional cooperation and official permissions, which were beyond the scope of this study's control, schedule, and ethical clearance. As a formal pilot study was not carried out before the data collection process, two ICT subject-matter and linguistic experts reviewed the

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

questionnaire to ensure it was appropriate and valid for the intended student population. Based on their input, minor modifications were made to improve content relevance and clarity.

Data Analysis

The data collected was analysed using descriptive statistics to provide insightful information about students' preferred learning resources. Notably, categorical characteristics, including gender, the types of learning tools used, and the year of study, were summarised using frequency distribution and percentages. Additionally, means and standard deviations were computed for Likert-scale values, determining the degree of utilisation and attitudes about tools (e.g., Copilot, ChatGPT). Cross-tabulations were used to investigate the association between preferred learning resource categories and demographic characteristics (e.g., institution, year of study). Visualisation tools, including pie charts and bar charts, were also employed to help interpret and present the results. Furthermore, all descriptive statistics methods specified were computed using the R programming language version 4.4.1.

Ethical Considerations

The authors did not seek formal ethical clearance because the research involved minimal risk, as it strictly observed personal anonymity and did not involve identifiable or sensitive personal information. Additionally, the study focused on general academic habits, which prompted it to fall under the category of low-risk educational research, exempt from formal review requirements at the time due to institutional norms. Informed consent was provided in the preamble of the questionnaire to ensure the reinforcement of ethical issues. Participants were required to consent before completing the questionnaire. Furthermore, to ensure confidentiality and privacy, all responses were anonymised. Additionally, the collected data were stored securely, in accordance with ethical guidelines.

Results

Respondents' Characteristics

The total number of students who participated in this study was 571. This number aligns with the one calculated using the probability sampling formula in Equation 1. Table 1 summarises the characteristics of the respondents from the students surveyed. The table indicates that all the respondents were bachelor's degree students, as was intended by the study. It also shows that 61.5 per cent of the respondents were male, and the rest (38.5%) of the students who participated were female. In addition to the respondents' characteristics, most students were in their first year (48%), followed by the second (25.6%), third (25.6%), and fourth (0.8%) year. The lower number of fourth-year students is because most computing courses in HLIs involve three-year programmes.

Table 2; Respondents' characteristics

Degree Programme	Gender		Year of Study			
Bachelor's	*Male*	*Female*	*1st*	*2nd*	*3rd*	*4th*
571	421	150	138	242	170	21

Offline vs Online Learning Resources

The survey, as depicted in Figure 2, indicates that students prefer using notes and attending lectures and tutorials over relying on offline resources. On average, many students are content that they "always" use these resources. Meanwhile, most students use textbooks occasionally: 202 out of 571, 154 out of 571, and 55 out of 571 reported using them sometimes, rarely, and never, respectively. This is contrary to the rest of the groups (notes, lectures, and tutorials), where the majority reported using these resources "always" or "often".

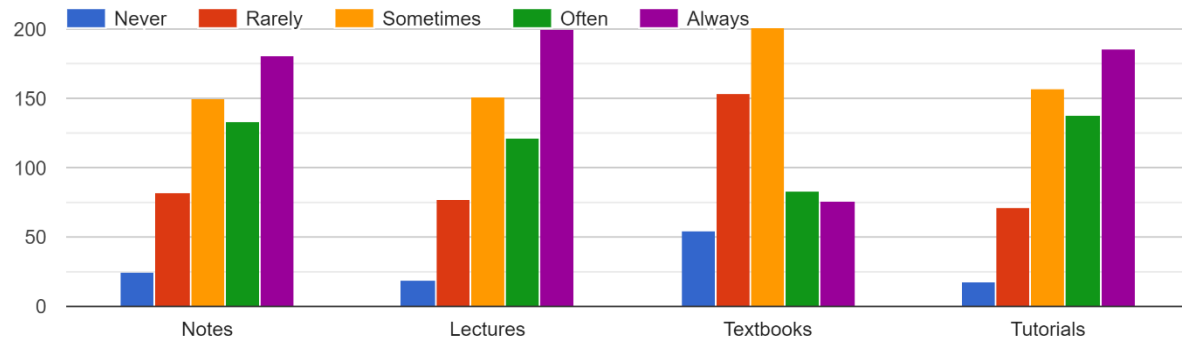

Figure 2: The use of offline resources

Considering online resources for learning, Figure 3 shows that most students used offline resources occasionally ("sometimes"). Furthermore, online resources appeared to differ slightly when using question banks and consulting computing literature, as some students chose "never" and "rarely," as shown in Figure 3. Examining the two figures (Figures 2 and 3), the graphs indicate that most students appear to fall within the "always" cluster of offline resources, except for books, which are used occasionally. For the online resources, most of the students seem to fall within the "sometimes" cluster.

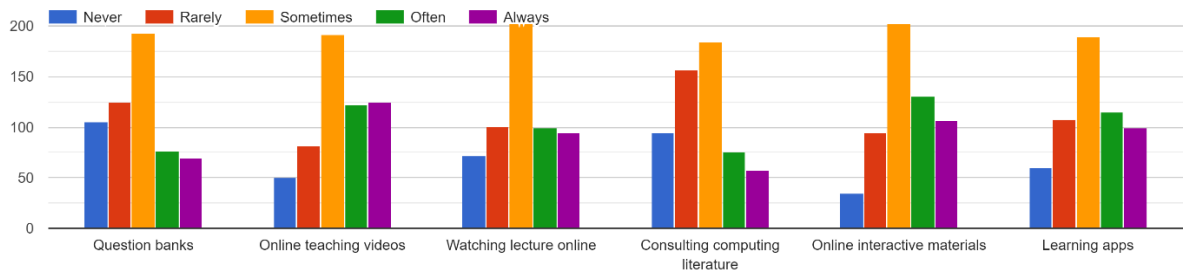

Figure 3: Use of Online Resources

Awareness and usage of GenAI tools

When asked about their familiarity with GenAI, many students indicated they were familiar with the tools. Additionally, when asked whether they had ever used the tools, many respondents reported using GenAI applications for educational purposes. The percentages of responses are shown in Figures 4 and 5. The findings presented in the two figures (Figure 4

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

and Figure 5) indicate that the level of awareness and use of the tools is high among the students in HLIs.

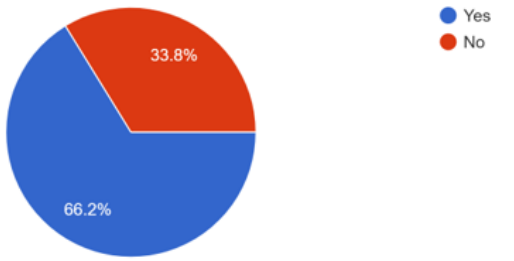

Figure 4: Awareness with GenAI

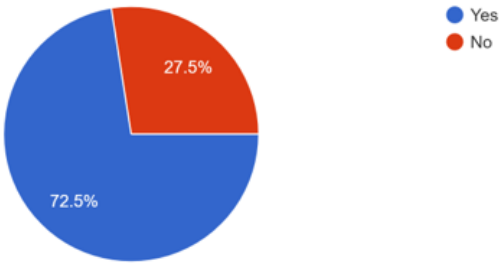

Figure 5: Usage of GenAI

Preferred GenAI Resource among the Students

Six tools were provided in the questionnaire to explore the most used AI resource for learning: ChatGPT, Jasper Chat, Google Bard, OpenAI, Copilot, and Codex. The results obtained are presented in Figure 6:

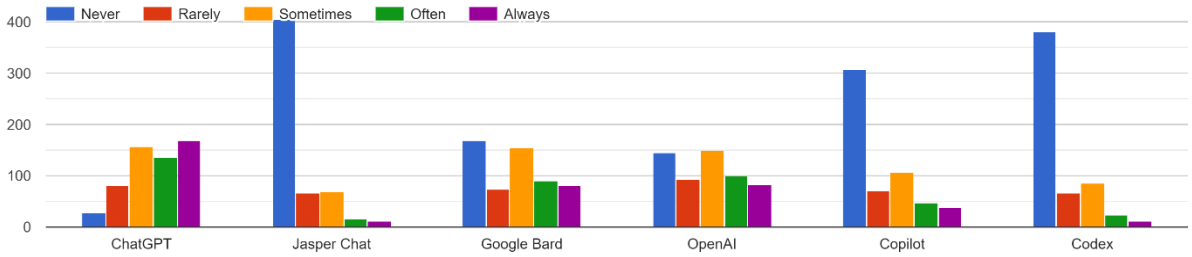

Figure 6: GenAI resources

The findings in Figure 6 indicate that ChatGPT is the preferred GenAI tool among students in HLIs. 157 out of 571, 170 out of 571, and 135 indicated that they "sometimes," "always," and "often" use ChatGPT as a learning resource, respectively. Another tool that students prefer to use is OpenAI. About OpenAI, 156 out of 571 and 91 out of 571 indicated that they "sometimes" and "often" use OpenAI for learning purposes, respectively.

Purpose of using the learning resources

The students were also probed concerning the purpose of using those learning resources. This question is intended to explore the student's intention towards these resources. Figure 6 presents the findings, illustrated by histograms. When researching online resources, 62.52 per cent of the surveyed students indicated they intend to acquire new knowledge (Figure 7). Another observation is that 41.15 per cent and 40.80 per cent use offline resources (notes, lectures, and books) to acquire new knowledge and revise. Additionally, concerning the intention of using GenAI tools, 51.48 per cent and 34.32 per cent said they use the tool for acquiring new knowledge and assignments, respectively.

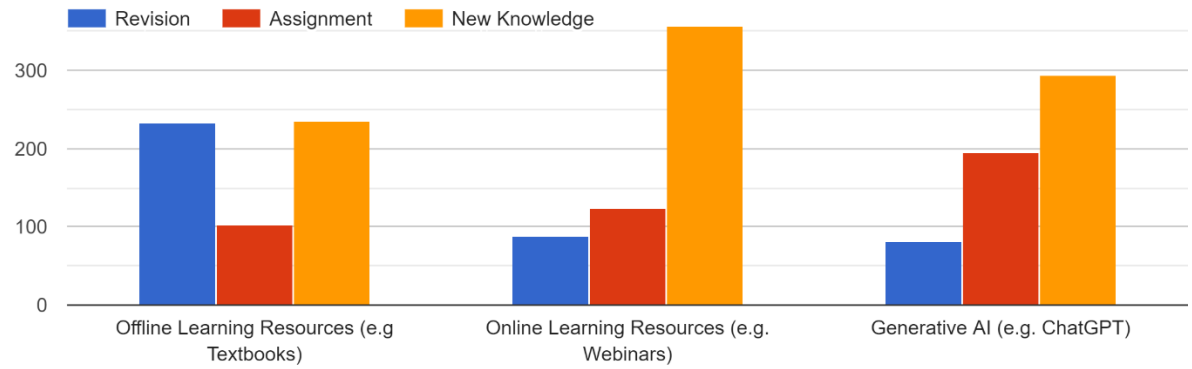

Figure 7: Purpose of using learning resources

Discussion

The findings of this study provide important insight into the learning resource preferences, usage trends, and intentions of undergraduate computer students in Tanzanian Higher Learning Institutions (HLIs). The findings show a complex relationship between emerging generative AI (GenAI) technologies, internet resources, and conventional (offline) learning methods.

Preference for Offline Learning Resources

A prevailing pattern was the high preference for offline learning materials, especially lecture attendance, tutorials, and personal notes, which were commonly reported as "always" or "often" used. This implies that traditional pedagogical practices are still ingrained in students' learning patterns, even in the face of the growing availability of digital technologies. These results align with previous research emphasising the persistent reliance on note-taking and human-delivered content as vital components of learning success in low- and middle-income nations (Shaame & Kondo, 2024; Muganda & Nyarunda, 2021). Significantly, the least preferred offline resource was textbooks, which a significant proportion of students said they utilised "sometimes" or "rarely". This could be attributed to limited access to up-to-date books or the perception that textbooks are less responsive to the evolving nature of computing knowledge than dynamic digital sources.

Limited Integration of Online Resources

Most students chose "sometimes" as their frequency of use, indicating that they mostly used online resources infrequently, rather than offline. This could result from several factors, such as a lack of systematic curricular integration, digital literacy gaps, or infrastructure barriers, including intermittent internet connectivity. Although students may be aware of online resources, their infrequent and irregular use suggests that they are supplementary rather than essential to education. Additionally, some students reported using online resources, such as question banks and computational literature repositories, by responding "never" or "rarely," indicating minimal involvement. This finding poses the possibility of a disparity between students' understanding of the resources' usefulness or accessibility and their actual availability.

University of Dar es Salaam Library Journal
Vol 20, No 1 (2025), pp 146 - 162
ISSN: 0856-1818

High Awareness and Use of GenAI Tools

High awareness and use of GenAI services, especially ChatGPT, which emerged as a very popular AI-powered resource, were among the most notable findings. Most students indicated that they used ChatGPT at least "sometimes" or more often, which suggests they are interested in utilising AI for their studies. The findings align with global observations, which indicate that GenAI technologies are gaining popularity (Ayanwale & Molefi, 2024; OpenAI, 2023). The necessity for GenAI in technical education is further supported by the desire for tools like OpenAI and Codex, which indicate that students are taking steps to explore AI resources meant for programming and computing contexts. However, the usage trend indicates the early adoption stages, as fewer students chose “always” than “sometimes” or “often.”

Learning Intentions Behind Resource Usage

The use of learning resources was motivated by slightly different reasons for each category. For offline resources, for example, the motivations were revision and acquiring knowledge, highlighting their importance in academic preparation. Acquiring knowledge remained the primary motivation for using online resources. However, it was not as strong overall as it was for offline modes. Regarding GenAI technologies, students mostly used them to accomplish assignments (34.32%) and acquire new knowledge (51.48%). This dual intent demonstrates the adaptability and utility of AI technologies, particularly in fields that require extensive processing. It also raises significant concerns regarding academic integrity and the application of AI for tasks that involve assessments.

Implications

The findings demonstrate the transitional aspect of learning in Tanzanian HLIs, where digital platforms and GenAI gradually replace traditional instruments, which still dominate the field. Institutional regulations, curriculum design, and instructor training will be crucial to ensure that this transition promotes deep learning rather than just completing tasks. To guarantee equitable and practical education for all student groups, it is also evident that better access, training, and integration of online resources and GenAI tools are required. This slight difference suggests that the students still require both resources. As mentioned above, the finding complies with the findings reported in the studies conducted by (Fabito et al., 2021). However, the lesser usage of online resources might be attributed to the financial limitations students face when paying for internet bundles. Our findings are confined to those reported by the authors (Lau & Guo, 2023). Both findings emphasise the need for educational stakeholders to adopt, embrace, and support the provision of GenAI tools to our students.

The findings indicate that students are demanding these technologies, particularly ChatGPT and OpenAI, for their learning process. The findings align with other research existing in the body of knowledge. Such studies include (Farrelly & Baker, 2023; Qadir, 2023; Smolansky et al., 2023). Therefore, the Ministry of Education, policymakers, and other relevant stakeholders can consider embracing these technologies as learning resources. Moreover, the findings indicate that students use offline resources for both the acquisition of new knowledge and revision. A few students use these resources to complete their assignments. However, it is pretty different regarding online and AI-based resources, which many students indicated they use for knowledge acquisition and class assignments. This observation is consistent with findings from research studies (Hou et al., 2024). Therefore, the Ministry of Education,

policymakers, and other relevant stakeholders can consider embracing these technologies to supplement learning resources.

Conclusion

In this study, we investigated AI-based learning resource usage for computing students in HLIs through an online questionnaire. Our findings reveal that Generative AI learning resources such as ChatGPT and OpenAI are preferable in various learning tasks. These GenAI application tools have become more prevalent in HLIs; however, educational stakeholders do not officially recognise them as learning and teaching tools. Therefore, the authors recommend that educational stakeholders and policymakers prepare a better learning environment or guidelines that can formally adopt the GenAI learning resources in HLIs. The students' continued use of online and offline learning resources for learning tasks implies that both learning resources help strengthen students' understanding and performance. Although these learning resources are used interchangeably, allocating learning resources based on the student's priority is crucial for cost-effectiveness. Therefore, this study identifies the preferred learning resources that can be utilised by instructors, librarians, and other education stakeholders to enhance students' performance. Additionally, the results provide valuable insights into the preferred learning resources by year of study, which can inform the curriculum review process and enhance the teaching approach. As such, future research may explore the association between students' years of study, gender, and GenAI learning resource usage based on robust statistical methods. Further research can also increase the number of respondents by including more HLIs, allowing for the generalisation of the results.

References

Abdalla Shaame, & Tabu Kondo. (2024). Students' Perceptions of Using Massive Open Online Courses (MOOCs) in Higher Learning Institutions. *International Journal of Education and Development Using ICT, Vol. 20, No. 2, 2024*.

Almaiah, M. A., Alamri, M. M., & Al-Rahmi, W. (2019). Applying the UTAUT Model to Explain the Students' Acceptance of Mobile Learning Systems in Higher Education. *IEEE Access*, *7*, 174673–174686. https://doi.org/10.1109/ACCESS.2019.2957206

Alshahrani, A. (2023). The impact of ChatGPT on blended learning: Current trends and future research directions. *International Journal of Data and Network Science*, *7*(4), 2029–2040. https://doi.org/10.5267/j.ijdns.2023.6.010

Atuase, D., & Maluleka, J. (2023). Marketing of library resources and their impact on the library usage of distance-learning students. *Digital Library Perspectives*, *39*(1), 111–123. https://doi.org/10.1108/DLP-03-2022-0025

Awidi, I. T., Paynter, M., & Vujosevic, T. (2019). Facebook group in the learning design of a higher education course: An analysis of factors influencing positive learning experience for students. *Computers and Education*, *129*(October 2018), 106–121. https://doi.org/10.1016/j.compedu.2018.10.018

Ayanwale, M. A., & Molefi, R. R. (2024). Exploring the intention of undergraduate students to embrace chatbots: from the vantage point of Lesotho. *International Journal of*

Educational Technology in Higher Education, *21*(1). https://doi.org/10.1186/s41239-024-00451-8

Balderas-Solís, J., Roque-Hernández, R. V., Salazar-Hernández, R., & Ramos-Monsivais, C. L. (2022). The Importance of Learning Resources for University Students During Emergency Remote Learning. *International Journal of Emerging Technologies in Learning*, *17*(14), 221–234. https://doi.org/10.3991/ijet.v17i14.30677

Beyene, W. M., Mekonnen, A. T., Giannoumis, G. A., Balderas-Solís, J., Roque-Hernández, R. V., Salazar-Hernández, R., Ramos-Monsivais, C. L., Hilton, J., Pickering, J. D., Swinnerton, B. J., TCU, C., E., Rands, H., Frommolt, V., Kain, V., Plugge, M., Mitchell, M., H., M., Knight, B., … Bleasel, J. (2023). Exploring the Dimensions of Medical Student Engagement with Technology-Enhanced Learning Resources and Assessing the Impact on Assessment Outcomes. *Sustainability (Switzerland)*, *15*(1), 1–7. https://doi.org/10.1007/s11423-016-9434-9

Coyne, E., Rands, H., Frommolt, V., Kain, V., Plugge, M., & Mitchell, M. (2018). Investigation of blended learning video resources to teach health students clinical skills: An integrative review. *Nurse Education Today*, *63*(April 2017), 101–107. https://doi.org/10.1016/j.nedt.2018.01.021

Das, S., Dongare, P., Goneppanavar, U., Garg, R., & Bhaskar, S.B. (2020). Study design, errors and sample size calculation in medical research. *Airway*, *3*(2), 76. https://doi.org/10.4103/arwy.arwy_29_20

Deng, X., & Yu, Z. (2023). A Meta-Analysis and Systematic Review of the Effect of Chatbot Technology Use in Sustainable Education. *Sustainability (Switzerland)*, *15*(4). https://doi.org/10.3390/su15042940

Denny, P., Khosravi, H., Hellas, A., Leinonen, J., & Sarsa, S. (2023). *Can We Trust AI-Generated Educational Content? Comparative Analysis of Human and AI-Generated Learning Resources*. 1–15.

Dhanvijay, A. K. D., Pinjar, M. J., Dhokane, N., Sorte, S. R., Kumari, A., & Mondal, H. (2023). Performance of Large Language Models (ChatGPT, Bing Search, and Google Bard) in Solving Case Vignettes in Physiology. *Cureus*, *15*(8), 4–10. https://doi.org/10.7759/cureus.42972

Erhel, S., Michinov, N., Noël, A., & Gonthier, C. (2022). Tweet to teach: Using a Twitter-based instructional method to improve student motivation and academic outcomes in higher education. *Internet and Higher Education*, *55*. https://doi.org/10.1016/j.iheduc.2022.100876

Ewert, J., Mr, D., Lu, X., Mcgivern, P., Jing, Y., Dr, X. L., & Dr, P. M. (2024). GenAI-Infused Adult Learning in the Digital Era: A Conceptual Framework for Higher Education. *Journals.Sagepub.Com*. https://doi.org/10.1177/10451595241271161

Fabito, B., Trillanes, A., & Sarmiento, J. (2021). Barriers and Challenges of Computing Students in an Online Learning Environment: Insights from One Private University in the Philippines. *International Journal of Computing Sciences Research*, *5*(1), 441–458. https://doi.org/10.25147/ijcsr.2017.001.1.51

Farrelly, T., & Baker, N. (2023). Generative Artificial Intelligence: Implications and Considerations for Higher Education Practice. *Education Sciences*, *13*(11), 1109.

https://doi.org/10.3390/educsci13111109

Ghimire, A., & Edwards, J. (2024). *Generative AI Adoption in the Classroom in the Context of the Technology Acceptance Model (TAM) and the Innovation Diffusion Theory (IDT)*.

Gill, S. S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., Fuller, S., Singh, M., Arora, P., Parlikad, A. K., Stankovski, V., Abraham, A., Ghosh, S. K., Lutfiyya, H., Kanhere, S. S., Bahsoon, R., Rana, O., Dustdar, S., Sakellariou, R., … Buyya, R. (2024). Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots. *Internet of Things and Cyber-Physical Systems*, *4*(May 2023), 19–23. https://doi.org/10.1016/j.iotcps.2023.06.002

Gomis, M. K. S., Oladinrin, O. T., Saini, M., Pathirage, C., & Arif, M. (2023). A scientometric analysis of global scientific literature on learning resources in higher education. *Heliyon*, *9*(4), e15438. https://doi.org/10.1016/j.heliyon.2023.e15438

Hilton, J. (2016). Open educational resources and college textbook choices: a review of research on efficacy and perceptions. *Educational Technology Research and Development*, *64*(4), 573–590. https://doi.org/10.1007/s11423-016-9434-9

Hortigüela-Alcalá, D., Sánchez-Santamaría, J., Pérez-Pueyo, Á., & Abella-García, V. (2019). Social networks to promote motivation and learning in higher education from the students' perspective. *Innovations in Education and Teaching International*, *56*(4), 412–422. https://doi.org/10.1080/14703297.2019.1579665

Hou, I., Metille, S., Li, Z., Man, O., Zastudil, C., & MacNeil, S. (2024). The Effects of Generative AI on Computing Students' Help-Seeking Preferences. *Academic Medicine*. https://doi.org/10.1145/3636243.3636248

Hsiao, C. H., & Tang, K. Y. (2024). Beyond acceptance: an empirical investigation of technological, ethical, social, and individual determinants of GenAI-supported learning in higher education. *Education and Information Technologies*. https://doi.org/10.1007/s10639-024-13263-0

José Segovia Juárez, & Robert Baumgartner. (2023). The Use of Artificial Intelligence Applications for Education and Scientific Research. *Hatun Yachay Wasi*, *3*(1), 98–111. https://doi.org/10.57107/hyw.v3i1.61

Kaiser, K. M. (2007). *A simulation study of predictive maintenance policies and how they impact manufacturing systems*. 171.

Karmadi, R. M. D., Suhartini, S., & Sukri, A. A. M. (2023). The potential of folklore as biodiversity learning resources in high school. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, *9*(1), 74–89. https://doi.org/10.22219/jpbi.v9i1.22502

King, M. R. (2023). A Conversation on Artificial Intelligence, Chatbots, and Plagiarism in Higher Education. *Cellular and Molecular Bioengineering*, *16*(1), 1–2. https://doi.org/10.1007/s12195-022-00754-8

Lau, S., & Guo, P. (2023). From "Ban It Till We Understand It" to "Resistance is Futile": How University Programming Instructors Plan to Adapt as More Students Use AI Code Generation and Explanation Tools such as ChatGPT and GitHub Copilot. *ICER 2023 - Proceedings of the 2023 ACM Conference on International Computing Education*

Research V.1, 106–121. https://doi.org/10.1145/3568813.3600138

Lebenicnik, M., & Starcic, A. I. (2018). *and Students' Use in Higher Education*. Springer International Publishing. https://doi.org/10.1007/978-3-319-99737-7

Mae, S., Choe, M., Graduate, C., Unidos, E., & Bannister, P. (2023). *Review of Generative AI and (English Medium Instruction) Hi-*.

Mai, T. T., Crane, M., & Bezbradica, M. (2021). Students' Behaviours in using Learning Resources in Higher Education: How do behaviours reflect success in Programming Education? *International Conference on Higher Education Advances*, 47–55. https://doi.org/10.4995/HEAd21.2021.12939

Matto, G., Ponera, J., & Kyumana, V. (2025). *GenAI and effective reading among university students: Prospects, challenges, and future directions*.

Michel-Villarreal, R., Vilalta-Perdomo, E., Salinas-Navarro, D. E., Thierry-Aguilera, R., & Gerardou, F. S. (2023). Challenges and Opportunities of Generative AI for Higher Education as Explained by ChatGPT. *Education Sciences*, *13*(9). https://doi.org/10.3390/educsci13090856

Mwogosi, A., & Simba, R. (2025). Integration of AI into teaching methodologies in health training institutions in Tanzania. *Journal of Research in Innovative Teaching and Learning*. https://doi.org/10.1108/JRIT-03-2025-0069

Naseem, A., Guzikova, M., … S. H.-… J. for S., & 2025, U. (2025). Artificial intelligence and student-teacher relationships: Reflections on a conversation across the contexts of Kyrgyzstan, Tajikistan, Pakistan, Tanzania, and Australia. *Mulpress.Mcmaster.Ca*, *9*. https://doi.org/10.15173/ijsap.v9i1.5945

Ngo, T. T. A. (2023). The Perception by University Students of the Use of ChatGPT in Education. *International Journal of Emerging Technologies in Learning*, *18*(17), 4–19. https://doi.org/10.3991/ijet.v18i17.39019

Niemi, H. (2021). AI in learning: Preparing grounds for future learning. *Journal of Pacific Rim Psychology*, *15*. https://doi.org/10.1177/18344909211038105

Omair, A. (2014). Sample size estimation and sampling techniques for selecting a representative sample. *Journal of Health Specialities*, *2*(4), 142. https://doi.org/10.4103/1658-600x.142783

Perkins, M. (2023). Academic Integrity considerations of AI Large Language Models in the post-pandemic era: ChatGPT and beyond. *Journal of University Teaching and Learning Practice*, *20*(2). https://doi.org/10.53761/1.20.02.07

Qadir, J. (2023). Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education. *IEEE Global Engineering Education Conference, EDUCON*, *2023-May*. https://doi.org/10.1109/EDUCON54358.2023.10125121

Rizzo, L., & Rust, K. (2011). *Finite Population Correction (FPC) for NAEP Variance Estimation*. 2501–2515.

Shailendra, S., Kadel, R., & Sharma, A. (2024). Framework for Adoption of Generative Artificial Intelligence (GenAI) in Education. *IEEE Transactions on Education*, 1–9. https://doi.org/10.1109/te.2024.3432101

Simui, F., Mundende, K., Mwewa, G., Kakana, F., & Namangala, P. B. (2017). Distance Learners' Perspective on User-friendly Instructional Materials at the University of Zambia. *Journal of Learning for Development*, *4*(1). https://doi.org/10.56059/jl4d.v4i1.154

Smolansky, A., Cram, A., Raduescu, C., Zeivots, S., Huber, E., & Kizilcec, R. F. (2023). Educator and Student Perspectives on the Impact of Generative AI on Assessments in Higher Education. *L@S 2023 - Proceedings of the 10th ACM Conference on Learning @ Scale*, *September*, 378–382. https://doi.org/10.1145/3573051.3596191

Umme, L., Shah, Z. A., Yu, P., Mulli, J., Khurram, M., & Ahmed, M. (2023). Innovative Teaching Methodology in Higher Education With Generative AI- Engineering Education in Developing Countries. In *igi-global.comL Umme, ZA Shah, P Yu, J Mulli, M Khurram, M Ahmed. Facilitating Global Collaboration and Knowledge Sharing in Higher Education, 2024•igi-global.com* (pp. 287–315). https://doi.org/10.4018/979-8-3693-0487-7.ch012

Wynter, L., Burgess, A., Kalman, E., Heron, J. E., & Bleasel, J. (2019). Medical students: What educational resources are they using? *BMC Medical Education*, *19*(1), 1–8. https://doi.org/10.1186/s12909-019-1462-9

Yu, P., Lu, S., Long, Z., Chen, Y., Qian, J., & Shah, Z. A. (2023). Exploring Ethical Considerations in Utilising Generative AI for Global Knowledge Sharing in Higher Education. In *igi-global.com* (pp. 1–27). https://doi.org/10.4018/979-8-3693-0487-7.ch001

Appendix

https://docs.google.com/forms/d/e/1FAIpQLSc6tIj0t3EnRGnCVpFilREfOu3tQ8b7vv-3PuLARKaX9qqgMQ/viewform