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Evolving students' learning habits from books to robotics: A case of college of business education, Dar es Salaam Campus, Tanzania

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ABSTRACT

The use of robotics and Artificial Intelligence (AI)-powered conversational tools is quickly transforming the way education operates, especially at the higher learning level. This research examined how these innovations are being adopted at the College of Business Education (CBE) in Dar es Salaam and investigated their influence on students' academic outcomes and learning patterns. The study was guided by the Technology Acceptance Model (TAM), which explains how perceptions of ease of use and usefulness affect the adoption of technology, and by Cognitive Load Theory (CLT), which highlights the importance of controlling mental effort in the learning process. A mixed methods approach was applied, bringing together survey data from 389 respondents chosen through stratified and simple random sampling along with qualitative insights collected from interviews. The study gathered information through structured questionnaires and detailed interviews. Quantitative data were analyzed using SPSS, while qualitative responses were examined through thematic analysis. Findings showed that students who had access to robotics tools demonstrated higher levels of engagement, stronger motivation, and better academic performance. The main factors that encouraged adoption included ease of use, the ability to adapt to individual learning styles, and the support provided by the instructors. Students especially appreciated the interactive and personalized learning environments made possible through robotics, as these enhanced their overall learning experience. However, the study also pointed out important challenges. Serious concerns remain regarding limited access, especially for students from less privileged backgrounds, and the possibility of becoming overly dependent on technology. These challenges bring up questions about digital equity and the potential decline of independent learning abilities. The study suggests that access to robotics technologies should broaden, provide focused training for both students and instructors, and officially weave robotics into the curriculum. It is essential to adopt a steady approach that takes advantage of robotics while still honoring traditional teaching methods. Striking this balance is key to helping students grow into independent, critical thinkers. The study provides important insights for using robotics effectively and fairly in higher education, especially in developing countries.

Keywords: AI-powered Tools, Learning Habits, Robotics, Robotic Tools, Technology Adoption

I. INTRODUCTION

The use of robotics and Artificial intelligence (AI) driven technologies is reshaping how education is delivered around the world. Once primarily used in factories and industrial settings, robotics has now expanded into fields like healthcare, social services and especially education (Arocena et al., 2022). In education, robotics sits at the crossroads of mechanical engineering, computer science and artificial intelligence, focusing on creating machines capable of performing tasks with little human input (Uslu et al., 2023). Robots and Artificial intelligence tools such as virtual tutors and chatbots are becoming common in classrooms. They are not only taking over repetitive or detail oriented tasks but also supporting more engaging ways of learning. This development is helping to increase student participation and in many cases improve academic performance. The use of these technologies is reshaping traditional teaching methods and creating opportunities for more personalized and dynamic learning experiences (Soori et al., 2024).

Robotic technologies are now firmly embedded in education, providing interactive platforms that deliver lessons, give instant feedback, and adapt to unique needs of each student. AI powered tools such as chatbots that act like human tutors are able to tailor instruction, respond to student questions at any time, and guide learners throughout their studies. Making the learning process more personalized, these systems encourage stronger engagement and motivation while also helping students to achieve better understanding (Casheekar et al., 2024).

Robotics is playing an important role in promoting socio-economic development and connects closely with global initiatives such as the United Nations Sustainable Development Goals. Its influence is particularly evident in SDG 4, which aims to improve education, and SDG 9, which highlights the value of industry and innovation. Beyond their technical capabilities, robotics technologies are actively driving progress in these key areas (Mai et al., 2022). Robotics is transforming industries including healthcare, agriculture, logistics and education. These technologies help make operations more efficient, reduce costs, and increase productivity. Since there are ongoing concerns about job displacement, it is also evident that robotics creates new roles and opportunities that were not available before. Overall, the use of robotics promotes greater efficiency and adaptability in these essential sectors (Licardo et al., 2024).

In today's educational settings, the use of robotic systems helps create a more inclusive and high quality learning experience. These technologies assist students in developing critical thinking and problem solving skills, which are becoming increasingly important in a technology driven workforce. Instead benefiting only advance learners, these systems give all students the chance to engage deeply with challenging concepts, preparing them for the changing demands of the modern workplace (Rane et al., 2024).

Countries such as the United States, Japan, and Germany are leading the way in adapting robotics, largely due to significant investments and well developed infrastructures (Rakhmanina et al., 2022). In these nations, robotics education often starts early, helping students build strong foundation in Science Technology Engineering and Mathematics (STEM) subjects (Uslu et al., 2023). Developing countries, on the other hand, face challenges like high costs and limited expertise. Despite these obstacles, progress is being made with support from non-governmental organizations and international partnerships (Aderibigbe et al., 2023).

Policy frameworks such as European Union's Digital Education Action Plan and Tanzania's National ICT Policy strongly support the use of robotics to improves educational outcomes and reduce disparities (Bowman, 2023). Robotics technologies not only strengthen digital literacy but also promote active and hands-on learning, helping students connect theory with practical skills and better preparing them to participate in digital economies (Bhatia et al., 2024).

1.1 Statement of the Problem

The use of robotics in educational settings has shown positive results around the world, especially in increasing student engagement , encouraging critical thinking, and enhancing academic performance (Ghofur, 2025). Many studies highlight the important role robotics plays in STEM education, particularly in developing students' technical and cognitive skills (Casheekar et al., 2024). However, most of these research come from developed countries with strong technical infrastructure. There is still a significant gap in understanding how robotics works in less resourced environments, such as Tanzania, where access to technology is much more limited (Safonov et al., 2022).

In Tanzania, and specifically at institutions like the College of Business Education (CBE), the use of robotics remains relatively unexplored. Although technology integration in academic settings has been gradually increasing, there is limited data on how robotics actually affects student learning habits and academic performance. Ongoing challenges include restricted access to robotic equipment, insufficient institutional readiness, and difficulties with how user friendly these technologies are. This study aims to fill these gaps by examining how robotics is currently being used at CBE, evaluating its impact on students' learning approaches and academic outcomes, and identifying the obstacles that prevent more effective implementation.

1.2 Research Objectives

This paper aims to examine the factors influencing students' shift from traditional methods to robotic-assistive approaches at College of Business Education, Dar es Salaam Campus.

II. LITERATURE REVIEW

2.1 Theoretical Review

2.1.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM), introduced by Davis in 1989, offers a foundational way to understand how people engage with and adopt new technologies. The model focuses on two main factors: perceived usefulness and perceived ease of use, both of which strongly influence users' attitudes toward adopting technological innovations (Liesa-Orús et al., 2023). Perceived usefulness refers to the degree to which a person believes that using a specific technology will improve their performance or outcomes (Ratnawati & Darmanto, 2023). In education, students' views on robotic tools, especially regarding how these tools enhance understanding, engagement, and overall learning outcomes, can greatly affect how well such technologies are accepted and used.

Perceived ease of use relates to how simple and intuitive a technology feels to users (Liesa-Orús et al., 2023). The moment students interact with robotic tools that are easy to operate, they are more likely to use them. Technologies that are difficult to understand or navigate can discourage learners, intuitive and user-friendly design make a real difference. Students' willingness to adopt robotics in learning environments often depends on their confidence that the tools are manageable. Peer opinions and general attitudes toward new technology also play a role; the simplicity of the interface remains a key factor. TAM provides a helpful framework for understanding what drives the use of robotics in education. It emphasizes the importance for educators and developers to focus on accessibility and efficiency, ensuring that robotics is both approachable and effective, which in turn encourages wider adoption in learning settings.

2.1.2 Cognitive Load Theory (CLT)

Sweller's Cognitive Load Theory explains that people have limited mental capacity, so it is important not to overwhelm learners with too much information at once. When learning materials are overly complex or disorganized, they can hinder understanding and memory (Sweller, 2023). Robotics technology helps address this challenge by breaking down complicated concepts into more manageable pieces, making them easier for learner to grasp. Students can focus on what really matters without feeling lost in unnecessary details.

Robotic tools, including virtual tutors, enhance learning by dividing complex material into simpler components and adjusting instruction to match each learner's progress and understanding (Nie et al., 2024). These technologies provide personalized learning pathways, creating a structured yet flexible environment that supports cognitive efficiency. Through presenting content in an organized and interactive way, robotic tools not only improve comprehension but also encourage greater engagement and better long term retention. As a result, even the most difficult topics become more approachable and sustainable for learners.

2.2 Empirical Review

2.2.1 Students' shift from traditional methods to robot-assistive approaches

Higher education has undergone a remarkable transformation, moving away from the traditional lecture style that kept students in a passive role for many years (Lai, 2021). With the growth of technology, and robotics in particular, classrooms are becoming more dynamic and interactive. Students are no longer limited to listening and taking notes; they now have the opportunity to engage directly, experiment with ideas, and take part in shaping their own learning. This change is not just cosmetic, it reflects a strong need for education to be practical, flexible, and aligned with the rapid pace of the modern world. Robotics brings abstract theories to life, turning them into tools that students can apply in real situations. The shift makes difficult concepts more concrete and understandable, and it represents an important move toward education that is both meaningful and relevant to the demands of contemporary society (Soori et al., 2024).

A major advantage of robotics is its ability to personalize the learning process. These systems respond to individual needs by offering immediate feedback and guidance (Zhang & Zhu, 2024). Despite allowing students to learn at their own pace, robotics reduces stress and encourages deeper understanding. Research has also shown that personalized learning improves both performance and motivation (Bhatia et al., 2024). Robotics also equips students with critical and analytical skills that are in high demand in the job market. Skills in coding, automation, and artificial intelligence are developed through hands-on use of robotics (Licardo et al., 2024). Through integrating robotics into their curricula, institutions prepare graduates to succeed in industries undergoing rapid digital transformation (Bhatia et al., 2024).

Despite these benefits, challenges remain. Some institutions lack the infrastructure needed to fully implement robotics, while others fear losing the human interaction that is central to teaching and learning (Zhang et al., 2024). The challenge, therefore, is to balance robotics with traditional methods so that technology enhances learning without replacing the essential human connection (Soori et al., 2024).

III. METHODOLOGY

3.1 Research Design

The study was conducted to explore how students engage with robotics in their learning journey. Rather than depending on a single approach, the researchers adopted both qualitative and quantitative methods, which offered a broader and more advanced perspective (Adeoye, 2024). This mixed-methods design not only captured measurable outcomes but also highlighted the personal experiences and viewpoints of the students involved. It provided a richer understanding of how learners perceive robotics and the reason for their shift.

3.2 Population of the Study

The research focused on the Dar es Salaam campus of the College of Business Education (CBE), which has a student population of about 14,219 across different academic levels. From this large population, a carefully chosen sample of 389 students was drawn using a combination of stratified and simple random sampling. This ensured that different groups within the student body were fairly represented.

3.3 Sampling Strategies

In this study, students were first grouped according to their level of study, which included Certificate, Diploma, Bachelor's, Postgraduate diploma, and Master's programs. They were also categorized according to their prior exposure to robotics tools. From within each group, a simple random selection was used, giving every student an equal opportunity to take part in the research (Rahman, 2023). This sampling approach helped to minimize selection bias and added strength to the findings by ensuring that a wide range of perspectives and experiences with educational robotics were represented (Reddy & Khan, 2023). As a result, the study achieved greater reliability and validity in its conclusions.

3.4 Sample Size

A total of 389 students were chosen for study using Slovin's formula, a method frequently used to determine sample sizes for large populations when the level of variation is unknown (Anggraini et al., 2025). The total population at the campus was 14,219, and a margin error of 0.05 was applied to ensure the sample accurately represented the larger group.

$$n = \frac{N}{1 + N.(e^2)}$$

Where: n – is number of sample (required)

N – Total population (14219) and

e – Error tolerance (level) or margin of error (0.05)

Using the formula, sample size was calculated as follows;

$$n = \frac{14219}{1 + 14219(0.05)^2}$$

Therefore:

$$n = 389$$

3.5 Data and Data Collection Methods

The researchers used a combination of methods, relying on structured questionnaires as well as in-depth interviews to study how robotics is being integrated into education. The questionnaire offered measurable insights into the extent of robotics use and its influence on students' academic performance. At the same time, interviews provided a closer look at students' real experiences, bringing out both the benefits and the challenges they faced. This combination of approaches made it possible to capture not only the statistical patterns but also a deeper and more detailed picture of how robotics is reshaping the learning environment at the College of Business Education (CBE).

3.6 Validity and Reliability of Data

The researchers first piloted the questionnaire with 10 students who were not included in the main sample. This step helped to confirm that the questions were clear and interpreted in the same way by participants. Cronbach's alpha was calculated and scored above 0.70, which indicated reliable results (Izah et al., 2023). For qualitative side, respondent validation was used, allowing interviewees to review their transcripts and confirm that everything was accurate (Kennedy, 2022). The instruments were reviewed by experts to ensure the content aligned with the study's objectives. Construct validity was further checked through factor analysis for thoroughness (Lambert & Newman, 2023). Finally, triangulation was applied by combining data from questionnaires, interviews, and existing literature. This blended approach enhanced both the credibility and the overall rigor of the study.

3.7 Data Analysis

The study used a mixed method design that brought together both quantitative and qualitative approaches to better address the research goal. On the quantitative part, Statistical Package for the Social Sciences (SPSS) was used to meticulously clean, code, and analyze data from structured questionnaires using descriptive statistics, such as means and frequencies. Researchers used thematic analysis to sort through interview transcripts for the qualitative article highlighting important details and grouping related concepts into broad themes. Combining the two approaches allowed the study to provide deeper, context-rich insights in addition to numerical trends, leading to a more complete understanding of the findings.

IV. FINDINGS & DISCUSSIONS

4.1 Profile of Respondents

Findings from table 1 provide a clear view of the demographic composition among the 389 respondents from the College of Business Education (CBE). Female participants account for 54%, while males make up 46%, reflecting a balanced gender distribution. The age distribution shows a predominantly young population, with 27.2% aged between 16-20 and 30.3% in the 21-25 range. Older age groups are also represented, with 18% aged between 26-30, 14.1% aged between 31-35, and 10.3% aged 36 and above. Regarding educational attainment, most respondents are pursuing or have completed a bachelor's degree, making up 69.2% of the sample. Others hold certificates at 19%, diplomas at 9.3%, postgraduate diplomas at 1%, and master's degree at 1.5%. This demographic overview reflects a diverse group of learners, both young and mature, with varying academic backgrounds which could influence their readiness and attitudes toward embracing new educational technologies.

Table 1
General Respondents Information (n=389)

Demographic	Category	Frequency	Percentages (%)
Gender	Male	179	46.0
	Female	210	54.0
	Total	**389**	**100**
	16-20 years	106	27.2
	21-25 years	118	30.3
Age	26-30 years	70	18.0
	31-35 years	55	14.1
	36 years and above	40	10.3
	Total	**389**	**100**
Education Level	Certificate	74	19.0
	Diploma	36	9.3
	Bachelor	269	69.2
	Postgraduate Diploma	4	1.0
	Masters	6	1.5
	Total	**389**	**100**

4.2 Factors Influencing Students' Shift from Traditional Methods to Robotic-Assistive Approaches

4.2.1 Reasons to Shift from Traditional Learning Methods to Robotic Tools

The study set out to explore the reasons students are moving away from traditional learning methods in favor of robotic tools. To get to the bottom of this, researchers presented participants with a series of focused questions. The data collected from these responses is presented in Table 2.

Table 2
Reasons to Shift from Traditional Learning Methods to Robotic Tools (n=389)

Statement	Frequency	Percent
Easier access to resources	112	28.8
Better engagement and interaction	86	22.1
Adaptability to personal learning needs	106	27.2
Encouragement from instructors	85	21.9
Total	**389**	**100**

Table 2 shows that the main reason students turned to robotics tools, chosen by 28.8% of respondents was the easier access to learning materials. Instead of spending a lot of time searching through textbooks or lecture notes, students could quickly find the information they needed. This observation is supported by recent research, which indicates that technology enhanced learning environments greatly reduce the time required retrieve information compared to traditional methods (Hu et al., 2025). Almost as important, 27.2% of participants highlighted the flexibility of these tools. Students were able to learn at their own style and in ways that suited their individual preferences, rather than being restricted to a single uniform approach. Research shows that systems that adapt to learners' needs increase both satisfaction and performance by customizing content for each individual (Contrino et al., 2024). These findings suggest that both quick access to information and personalized learning experiences play an important role in keeping students engaged and supporting their learning progress effectively.

22.1% of respondents reported that robotics made learning more engaging and less repetitive, largely because of interactive features and instant feedback which seemed to increase their motivation. Previous research by Li et al., (2024) supports this, showing that interactive technologies are linked to higher motivation and deeper cognitive involvement. This heightened engagement may be key to encouraging the long-term use of robotic tools in education. About 22% of students highlighted the influence of instructor support. When lecturers recommended or incorporated these tools into their lessons, students felt more confident and willing to try them. This finding aligns with research by Dehghani and Mashhadi (2024), who observed that instructor endorsement strongly shapes students' readiness to adopt new educational technologies. These results indicate that factors such as ease of use, personalized learning, student engagement, and lecturer support work together to encourage the shift toward robotic-assisted learning.

4.2.2 Challenges When Transitioning to Robotic Tools

The researchers aimed to explore the specific challenges that students encountered while adapting to robotic tools. To gather more insights, they posed a series of targeted questions to the students. The results, along with more detailed responses, can be seen in Figure 1.

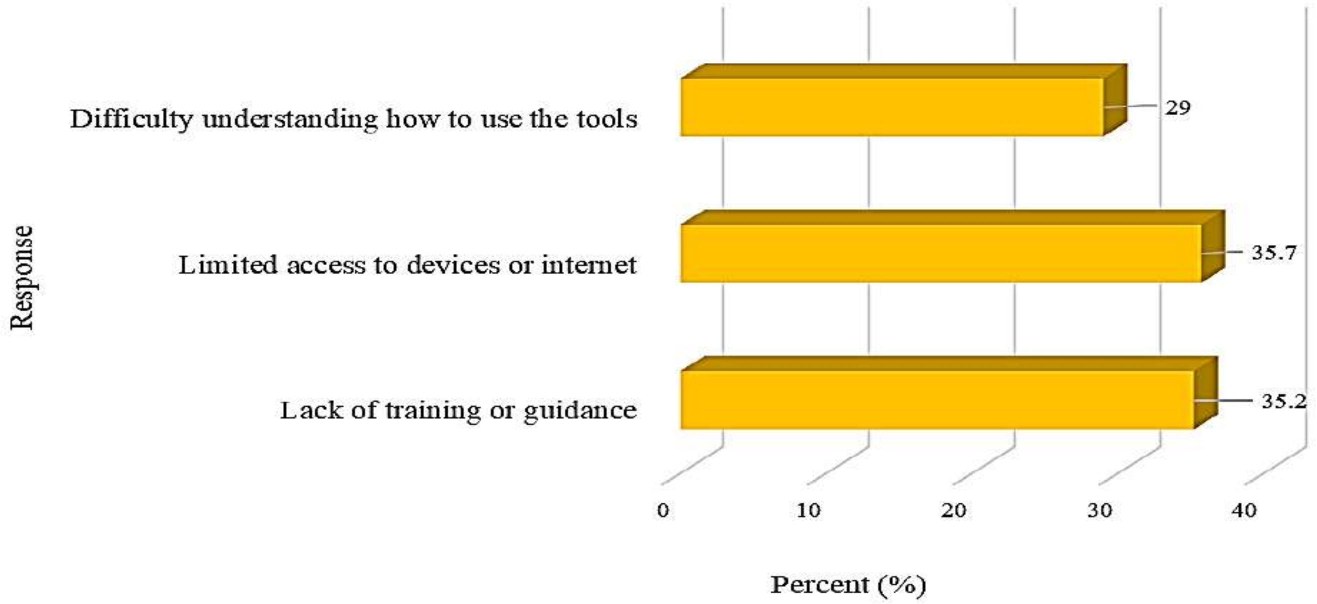

Figure 1
Challenges When Transitioning to Robotic Tools

Moving from traditional textbooks to robotic learning tools has not been easy for students, as Figure 1 illustrates. Only 35.2% received sufficient training, around 35.7% faced difficulties with devices and internet access, and 29% struggled to understand the new technology. These challenges are not entirely new, as previous research by Abuali and Ahmed (2025), identified poor training and weak infrastructure as major barriers to incorporating technology in education. It is therefore not surprising to see similar issues appearing in this context. Many students initially felt overwhelmed, not frustrated, or even left behind, particularly in areas where reliable internet or devices were limited. Without proper guidance to engage, while others simply did not have the necessary resources to participate. Despite these obstacles, the situation is not without hope. With persistence and adequate support, many students have been able to overcome these challenges. As one participant reflected,

> *"Initially, the process of adjusting to robotic tools provided to be challenging, leaving me feeling overwhelmed; however, I have since improved my grades and gained greater confidence in my skills." (Student, Interview Session, April 2025)*

This progression is quite common, as initial uncertainty often shifts toward greater proficiency when students become familiar with new technologies. Research by Cantutay and Taganas (2024), shows that regular engagement and hands-on use of digital tools significantly improve both technological skills and academic performance. In this case, consistent use of robotic tools not only made them a part of students' daily routines but also helped make their study habits more organized, effective, and enjoyable. The benefits went beyond better grades, as students also reported feeling more confident and capable when using technology. One respondent shared,

> *"I required training to utilize the tools effectively. After I grasped how to operate them, my reading speed increased, and I also noticed an enhancement in my comprehension..." (Student, Interview Session, April 2025)*

Accounts like these highlight the important impact that well-planned training and practical experience can have. Mastery of new educational tools does not happen instantly; students need chances to explore and learn through direct involvement. This idea is supported by recent research (Saparbayeva et al., 2024), which shows that structured training programs can accelerate learning and lead to clear academic improvements. In the context of this study, providing focused training initiatives seems to be an effective way to address the challenges students face during the transition.

While the initial adjustment period may feel intimidating, having access to proper resources and ongoing support can make the long term benefits of robotic-assisted learning far outweigh the early.

4.2.3 Comparison between the Effectiveness of Robotic Tools and Traditional Methods

The main objective of this research was to assess the efficacy of robotic instruments relative to conventional educational methods. Participants answered a set of questions, and the data obtained are displayed in Table 3.

Table 3

Comparison between the Effectiveness of Robotic Tools and Traditional Methods (n=389)

Statement	Frequency	Percent
More effective	142	36.5
Equally effective	122	31.4
Less effective	125	32.1
Total	**389**	**100**

According to Table 3, students have differing opinions about robotic tools compared to traditional teaching methods. Around 36.5% of respondents stated that robotic tools are more efficient than traditional methods. This result is in line with research by Su and Zou (2024), which highlights that using technology improves understanding and memory. The findings imply that the preference for robotics is backed by quantifiable cognitive advantages and is not just a fad.

About 31.4% of students believe that both robotic and traditional approaches are equally successful. According to Ghofur (2025), this balanced perspective could be influenced by things like familiarity or the work required to get used to new technologies. The finding suggests that often students judge educational tools based on comfort and personal experiences. However, 32.1% of students still prefer traditional approaches, presumably due to the controlled teacher-led setting they offer. For some students, such environments can feel more reliable and less mentally demanding (Kundu & Das, 2025). This demonstrates that not every student is equally prepared or eager to use cutting edge technology in the classroom.

Overall, the findings indicate that the three viewpoints are nearly evenly divided, which reflects the continuing discussion regarding the relative merits of technology and traditional teaching methods. Although many students recognize the advantages of robotics, a sizable portion still favors or values traditional teaching methods. This diversity of viewpoints demonstrates the broad range of beliefs regarding what constitutes effective learning.

V. CONCLUSION & RECOMMENDATIONS

5.1 Conclusion

This study showed that robotics is beginning to change how students at CBE learn. Students appreciated the flexibility, interactivity, and personalization offered by robotics, and many reported improved academic outcomes. Although, barriers such as limited access to devices, lack of training, and unequal opportunities remain major challenges. Though robotics can enhance education, it should not fully replace traditional teaching. A balance is needed so that students benefit from technology while also developing independence and critical thinking.

5.2 Recommendations

For robotics to be successfully integrated into education, institutions must ensure that every student has fair access. Both instructors and students need ongoing training to build confidence and skills in using robotics. At the same time, robotics should be used into teaching in a way that complements, rather than replaces, traditional methods. Policymakers and higher learning bodies should regularly review the effectiveness of robotics in education and address challenges as they arise. Lastly, future research should explore sustainable models for robotics adoption in contexts with limited resources.

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