Оригинальная статья / Original paper

doi:10.17853/1994-5639-2025-9551

ChatGPT in the context of competence-based education in Tanzania higher learning institutions

M.J. Chandafa
Mbeya University of Science and Technology (MUST), Mbeya, United Republic of Tanzania.
E-mail: moabuchandafa95@gmail.com

H. Fang
Huazhong University of Science and Technology, Wuhan, People's Republic of China.
E-mail: fanghuang@hust.ed.cn

✉ *moabuchandafa95@gmail.com*

Abstract. *Introduction.* ChatGPT has the potential to revolutionise education as it evolves and may significantly alter teaching and learning methodologies. However, the viability, effectiveness, and contextual relevance of utilising ChatGPT within the competence-based curriculum of Tanzanian higher education have not been thoroughly studied. *Aim*. The present paper *aims* to investigate how ChatGPT can support teachers' efforts, enhance student achievement, and overcome structural obstacles in a competence-based education system. *Methodology and research methods*. The study focuses on the implementation of a competence-based approach in education. A total of 240 participants, including 40 teachers and 200 students, voluntarily took part in the research. Data were collected through interviews, focus groups, and questionnaires. Quantitative data were analysed using SPSS Version 21, while qualitative data were analysed using thematic analysis methods. *Results and scientific novelty*. The results indicate that integrating ChatGPT into the learning process, grounded in the principles of the competence-based approach, enhances the development of critical thinking and decision-making skills among students. It addresses resource shortages and fosters the implementation of personalised learning strategies. The study emphasises the necessity of actively incorporating ChatGPT into teaching practices in Tanzania, underscoring the importance of professional development for both teachers and students. A balanced integration of AI tools, which support rather than supplant essential human elements of learning and teaching, necessitates the establishment of various mechanisms to tackle the ethical issues that arise during the educational process. *Practical significance.* The results offer practical guidance for teachers, curriculum developers, and educational leaders on effectively integrating ChatGPT to enhance teaching and learning within competence-based education.

Keywords: artificial intelligence, teaching and learning, ChatGPT, higher learning institutions

For citation: Chandafa M.J., Fang H. ChatGPT in the context of competence-based education in Tanzania higher learning institutions. *Obrazovanie i nauka = The Education and Science Journal.* 2025;27(10). doi:10.17853/1994-5639-2025-9551

ChatGPT в контексте компетентностного образования в высших учебных заведениях Танзании

М.Дж. Чандафа
Университет науки и технологий Мбея (MUST), Мбея, Объединенная Республика Танзания.
E-mail: moabuchandafa95@gmail.com

Х. Фан
Хуачжунский университет науки и технологии, Ухань, Китайская Народная Республика.
E-mail: fanghuang@hust.ed.cn

✉ *moabuchandafa95@gmail.com*

Аннотация. *Введение*. ChatGPT имеет потенциал трансформировать образование по мере его развития и, возможно, изменить методы преподавания и обучения. Однако жизнеспособность, эффективность и контекстуальная релевантность использования ChatGPT в компетентностно-ориентированной учебной программе высшего образования Танзании не была тщательно изучена. *Цель* исследования – изучить, как ChatGPT может поддерживать усилия учителей, повышать достижения студентов и преодолевать структурные препятствия в системе компетентностного образования. *Методология и методы*. Работа основывается на реализации идей компетентностного подхода в образовании. В исследовании приняли добровольное участие 240 человек (40 учителей и 200 студентов). Для сбора данных использовались интервью, фокус-группы и анкеты. Количественные и качественные данные были проанализированы с использованием SPSS V. 21 и методов тематического анализа соответственно. *Результаты и научная новизна.* Результаты показывают, что интеграция ChatGPT в учебный процесс, который основывается на возможностях компетентностного подхода, способствует развитию критического мышления и навыков принятия решений у студентов, решает проблемы нехватки ресурсов и содействует реализации идей персонализированного обучения. Исследование подчеркивает необходимость активного привлечения ChatGPT к процессам обучения в Танзании, акцентируя внимание на важности профессионального развития в данном вопросе для учителей и студентов. Сбалансированная интеграция инструментов ИИ, которые усиливают, а не заменяют важные человеческие элементы обучения и преподавания, требует разработки ряда механизмов для решения возникающих в процессе обучения этических вопросов. *Практическая значимость*. Результаты предоставляют практические рекомендации для учителей, разработчиков учебных планов и руководителей о том, как эффективно интегрировать ChatGPT для улучшения преподавания и обучения в рамках компетентностного образования.

Ключевые слова: искусственный интеллект, обучение и преподавание, ChatGPT, высшие учебные заведения

Для цитирования: Чандафа М.Дж., Фан Х. ChatGPT в контексте компетентностного образования в высших учебных заведениях Танзании. *Образование и наука.* 2025;27(10). doi:10.17853/1994-5639-2025-9551

Introduction

In recent decades, education has undergone significant transformations, moving from a traditional model centred on memorisation and standardised assessments to a more flexible and personalised educational system called compe-

tence-based education. Competence-based education (CBE) is a modern strategy that emphasises the acquisition of relevant information, practical skills, and critical cognitive abilities necessary for success in our modern society [1]. The incorporation of artificial intelligence (AI) into the educational process has been a significant change in this transition, offering cutting-edge technology and solutions that enhance the efficacy, efficiency, and relevance of the learning process. According to W. Fosso, R. Bawack, C. Guthrie, M. Queiroz and K. Carillo [2], artificial intelligence has become a fast-growing field of study and application that is truly revolutionising many facets of contemporary life. ChatGPT has emerged as a crucial tool in the educational sector with remarkable potential to enhance teaching and learning procedures, converting conventional techniques into creative and customised strategies. The study investigated how ChatGPT can support teacher efforts, enhance student achievements, and get beyond structural obstacles in Tanzania's competence-based education system.

Literature Review

Competence-based education has been a hot subject in pedagogical practice and educational research [3]. A competent graduate is one who can autonomously operate in a variety of real-world practical circumstances by using what they have learned. Instead of concentrating only on theoretical knowledge, CBE places an emphasis on the development and assessment of certain abilities. By emphasising the development of skills and aptitudes relevant in a variety of situations, CBE aims to equip students to successfully address real-world issues [4]. This educational strategy is appropriate and designed to support the development of the practical skills and competencies that people need to accomplish their goals, both personal and professional. CBE does not follow a set schedule for homework and class attendance like traditional education does. Because of this, students frequently finish courses or even whole programmes faster, which can lower costs and increase access to education [5]. Under competence-based education, learning occurs in modules, and students advance to the next subject or ability when they have adequately mastered the related skills [6]. CBE promotes critical and analytical thinking abilities as well as motivation and involvement in the learning process. These advantages imply that the adoption of a competence-based approach in education may greatly enhance both the educational process and the overall growth of students. The transformation of international educational systems has been greatly aided by the CBE, thus key skills for compulsory education should be defined in a variety of methods by reformers, legislators, educators, and specialists [7]. Competence-based learning has been incorporated into or experimented in the curricula of many nations in an effort to match education with the needs of contemporary society and the labour market. There are difficulties in putting CBE into practice; it may be a complicated process that calls for a large investment in both technology and course design [1]. In order to create a better model for improving students' learning and development of the nec-

essary competences, teachers must streamline both the good and bad components of competence-based education.

Competence-Based Education and ChatGPT

Significant changes in society, the economy, and the environment have been brought about by the quick speed of technology advancement and global interconnection. Megatrends are the aggregate term for these shifts. These megatrends are anticipated to persist as the twenty-first century goes on [8]. Recent years have seen tremendous advancements in the field of artificial intelligence, which has resulted in the creation of cutting-edge technologies like Open AI's ChatGPT, a language model that has the potential to revolutionise the educational landscape. It is imperative to use ChatGPT in educational settings in accordance to ethical and responsible norms [9]. As of right now, ChatGPT stands as the most sophisticated chatbot ever developed. Unlike other chatbots, it can produce exceptional content in a matter of seconds, and it has caused a lot of commotion and apocalyptic predictions about student evaluation in higher education, among other things [10]. OpenAI's Generative Pretrained Transformer (GPT) language model was modified to create ChatGPT, a state-of-the-art language model. It is designed to produce text that is indistinguishable from human-authored material. A. Barrett and A. Pack stated that artificial intelligence includes the system's ability to accurately interpret external data, learn from the data, and apply the knowledge to achieve particular tasks and objectives through flexible adaptation [11]. It can have conversations with users in a way that is deceptively simple and easy to understand. As a result, these systems are capable of thinking and acting like humans, using sophisticated mathematical models and algorithms to accomplish particular goals [12]. For instance, ChatGPT is an example of an artificial intelligence model that is more precisely, an OpenAI language generation model that uses machine learning techniques to generate text that closely mimics human language. As noted by M. A. Peters, L. Jackson, M. Papastephanou et al., a revolutionary change in the educational scene has occurred with the introduction of ChatGPT [13]. Customising individual learning experiences is one of AI's amazing educational features [14]. AI systems can modify the curriculum and teaching strategies to accommodate different learning styles and demands by analysing students' behaviour and development [15]. Students feel more motivated and involved as a result, and learning becomes more effective and efficient. Additionally, G. J. Hwang, H. Xie, B. W. Wah, and G. Gašević [16] investigated the relationship between the development of critical competences in students and the design of artificial intelligence curricula. This is especially crucial since academic institutions should carefully evaluate their own capacities and work hard to equip students with the newest information and talents to meet the difficulties of the real world. AI is capable of identifying emotions, including a student's dissatisfaction, while occasionally being criticised for lacking empathy. This capacity can be crucial in CBE, since students' potential is unlocked via acknowledgment [17]. Based on each student's emotional state, degree of knowledge, unique personality features, and held competences, adaptive learning systems create accurate student profiles

and models. AI also provides ongoing feedback and real-time support. AI assistants and virtual tutors can respond to inquiries from students, offer more clarifications, and provide thorough feedback on their academic progress [18]. This guarantees that students may get individualised coaching at any moment, which aids in information consolidation and skill development. AI has a substantial influence on academic institutions and teachers in addition to the advantages it offers students [19]. While evaluations are carried out more effectively, teachers can concentrate more on direct instruction, human interaction, creative content creation, and creating a collaborative learning environment by using an automated system to grade student assignments, among other administrative tasks [20]. Furthermore, AI helps academics analyse vast amounts of data and identify trends and patterns, which helps them build new theories and tackle complex problems in a variety of scientific fields [15]. The enormous potential of artificial intelligence to revolutionise research and education is highlighted by all of these factors. Beyond all of these benefits, AI-based education comes with a number of hazards and difficulties. Despite the fact that AI systems could ultimately be less expensive than highly compensated human resources, university administrators may not want to use them since they jeopardise the ability to customise instruction [21]. There are continuous discussions about ethical issues like data privacy and making sure that every student is in a safe and equitable environment [22]. AI in education usually entails gathering and analysing vast amounts of personal data, from face recognition to monitoring systems that provide in-depth details on the behaviour and preferences of teachers and students [20]. Because AI was developed by humans, it may have built-in biases that penalise some students [23]. An excessive dependence on technology and the possibility for robots to take the job of teachers are two further probable problems [24]. According to G. Lazaroiu and E. Rogalska, AI technologies lead to some job displacement even as they increase labour productivity [25]. However, AI has the ability to significantly improve student learning experiences and the educational process globally with ethical and responsible management.

Tanzania education system still has difficulties reaching its full potential even after implementing competence-based education. In order to successfully enable CBE, teachers frequently face challenges related to high student-to-teacher ratios, little resources, and inadequate professional development [7]. Furthermore, there are differences between urban and rural regions' access to high-quality education, which results in unequal chances for students to acquire the skills needed for the workforce of the twenty-first century [26]. By offering scalable and customised learning support, the incorporation of AI technologies like ChatGPT offers a viable remedy for some of these issues [27]. Research on ChatGPT's viability, efficacy, and contextual relevance in Tanzania educational system is nonetheless scarce. There are still concerns over how well it can accommodate Tanzanian learners' language and cultural requirements, how well it can fill in the infrastructural gaps that already exist, and how teachers and decision-makers may use these technologies. The purpose of this study is to investigate how ChatGPT can support teacher efforts,

enhance student achievements, and get beyond structural obstacles in Tanzania competence-based education system. The study aims to further knowledge on how AI might facilitate educational reform in environments with limited resources by tackling these issues.

Theoretical Framework of the Study

The constructivism learning theory served as the study's compass. Levy Vygotsky (1986–1934), Maria Montessori (1870–1952), John Dewey (1859–1952), and Jerome Bruner (1915) all contributed to the theory's development. The constructivism theory offers a fundamental perspective for exploring ChatGPT within the framework of competence-based education. According to constructivism, students actively create their own knowledge by interacting with their social settings, experiences, and surroundings [28]. By highlighting the learner's participation in forming understanding, this idea moves the emphasis of education from the passive reception of knowledge to active engagement in learning. Using a constructivist framework, the study explored how ChatGPT, an AI tool, might enhance and revolutionise competence-based education (CBE) in Tanzania by facilitating individualised, contextualised, and active learning. As both stress the development of meaningful skills, knowledge, and attitudes via experiential learning, constructivism is especially pertinent to CBE [29]. CBE, which reflects constructivist ideas of learning by doing, focuses on giving students the skills they need to address challenges in the real world. Constructivism aids in directing the study to explore how ChatGPT might offer a platform for inquiry-based, interactive, and problem-solving-oriented learning in Tanzania, where CBE is becoming more popular. It backs up the idea that ChatGPT and other AI technologies may serve as facilitators in a learner-centred classroom setting, encouraging critical thinking and exploration [30]. The constructivist idea of scaffolding, in which students get direction and assistance based on their present level of comprehension, is consistent with ChatGPT's ability to provide dynamic and interactive replies. The theory guides this study's investigation of how ChatGPT might provide scaffolding by decomposing difficult ideas, providing real-time answers to student inquiries, and adjusting to the learner's speed [31]. Constructivism also emphasises the value of contextualised learning, in which information is linked to the learner's surroundings and cultural background. This viewpoint motivates the study to investigate how ChatGPT might provide culturally appropriate content, particularly in light of Tanzania's multilingual educational system (English and Kiswahili), making sure that students can connect the information to their socioeconomic circumstances. Furthermore, social connection is emphasised as being crucial to the learning process by constructivism [32]. Although ChatGPT is not a human collaborator in and of itself, it can support collaborative learning by serving as a tool for teachers and students to solve group problems, to start conversations, or to model problem-solving situations [33]. This feature directs the research to explore how ChatGPT may enhance peer learning and traditional classroom interactions, especially in settings with limited human resources, such trained teachers. Constructivism also brings up important issues for the research, such the need for

cultural and contextual alignment and the genuineness of learning experiences. The theory guides the exploration of how the usage of ChatGPT might enhance rather than replace the function of human instructors [34]. Additionally, it draws attention to equity concerns that may affect Tanzania access to AI-based solutions, such as differences in digital infrastructure. Constructivism therefore acts as a critical lens for addressing issues pertaining to technology integration in education as well as a guiding paradigm for exploring ChatGPT's possible advantages in CBE.

Constructivism, in general, offers a thorough theoretical framework that serves as the foundation for the investigation of how ChatGPT might improve competence-based education in Tanzania. Constructivism directs the research into how AI technologies might enable students to acquire skills pertinent to their lives and futures by placing an emphasis on active, contextualised, and socially linked learning.

Methodology

Philosophy of the Study

Our study employed pragmatic philosophical perspective which stresses the use of several approaches to completely address research problem. Pragmatics enables the use of both qualitative and quantitative data to investigate different facets of the phenomenon from several perspectives [35]. In addition, pragmatic philosophical perspectives were used because the perspectives promote the use of empirical data to explore ChatGPT's use in competence-based education in higher education institutions. This dual approach ensures a thorough understanding of the research topic by finding a balance between rich, contextual insights and numerical data. Additionally, it highlights metrics that are both objective and subjective.

Research Approach

Our study used a mixed-methods research approach in order to investigate the subject in greater detail. This approach allowed for information triangulation and provided a more thorough understanding of the topic by gathering and analysing both quantitative and qualitative data. According to A. Amadi, the use of mixed methods research approach enables to properly capture the breadth and complexity of the research issue by integrating two data sources, resulting in a more reliable and strong analysis [36]. It was essential to employ a variety of approaches in order to uncover patterns and insights that were not apparent with just one.

Research Design

Our study used an exploratory sequential design as a continuous roadmap to guide the process to provide a relevant and flexible framework for identifying, evaluating, and integrating primary quantitative and qualitative data. The objective of this design was to prioritise gathering qualitative data to examine a phenomenon and then acquiring quantitative data to clarify any connections or patterns found in the qualitative data [37]. This design was also selected because it aligns with the objectives set forth by the guiding research questions and the types of data that are available through the partner platforms. It was determined that relying solely on qualitative or quantitative data would not be sufficient to capture the fine details, broad

patterns, and unique characteristics of the various data types that, when examined collectively, provide the insights and contextualisation required for a sound analysis.

Research Area

Our study explored how ChatGPT was used in four Tanzanian higher education institutions within the framework of competence-based education. These consist of Mzumbe University (MU), Catholic University of Mbeya (CUOM), Mbeya University of Science and Technology (MUST), and the Open University of Tanzania (OUT). These universities were chosen because of their solid reputation, wealth of resources, and concentration on technology-related courses.

Sample Size and Sampling Techniques

The primary focus was on teachers and third-year students taking educational courses. Because of their considerable exposure to ChatGPT technology through experience-based learning, students are more aware of its potential and applications. Teachers working in education departments were the study's primary focus. It is expected that teachers working in these domains will be better familiar with ChatGPT and its integration into education.

Sample of Students

It was not possible to include every third-year student. To guarantee that every student had an equal opportunity of taking part in our study, both probability and non-probability sampling techniques were employed. The cluster sampling technique used to choose third-year student based on their programmes. Male and female students were then separated into two groups, or strata, within each cluster. A simple random sampling technique was then used to choose students for each programme to participate in our study. This ensured that every student have equal chance of participating in our study.

Sample of Teacher

The sample size consisted of ten teachers from each university. All teachers were given an equal chance to participate in the study through the use of a straightforward random sampling procedure. To ensure equal representation and allow for fair comparisons between the universities, we maintained this sample size constant for each. Every university contributes equally to the overall usage of ChatGPT in competence-based education, and the steady sample size facilitates more systematic and manageable data collection. It also simplifies the logistics of data collection, improving process efficiency and uniformity because the same number of teachers participated in interviews. To ensure that the results cover a broad range of experiences and opinions on the integration of ChatGPT in higher education, the study gathered a diversity of perspectives from ten teachers at each university. See Table 1 below.

Table 1

Participants' breakdown (n = 240)

Participants	Sample size
Teachers (10 from each university)	40

Students (50 from each university)	200
Total sample size	**240**

Source: Field data, 2024.

Data Collection Techniques

Both quantitative and qualitative data were gathered using focus groups, interviews, and the distribution of questionnaires. This section explained the techniques and results of each approach that was used to collect a complete set of data from various viewpoints.

Interview

Data were gathered through semi-structured interviews. Semi-structured interviews used to obtain first-hand information by exploring participants' opinions, experiences, and suggestions about the usage of ChatGPT in Tanzania higher education institutions. Additionally, semi-structured interview allowed a greater latitude on how to probe and formulate the questions, thus reducing biases in the data collection process. A total of sixteen (16) interview sessions were conducted with participants from all four universities. Each interview lasted 45 to 50 minutes in order to provide ample opportunity for interaction with the participants. Prior to the interviews, participants received an explanation of the study's objectives. In order to preserve the original data and obtain a verbatim account of the sessions, digital recorders used to capture the interviews. Each interview was conducted with consent from the participants. Field notes and participant interviews were transcribed to prepare the data for writing, editing, and review.

Focus Group Discussions (FGD)

FGD was used to collect student data. Students were allowed to voice their ideas on their usage of ChatGPT in competence-based education during these focus group discussions (FGDs). The selected institutions hosted a total of eight FGDs. A small group of four to ten people is ideal for effective data collecting using FGD [38]. Therefore, seven students were selected to participate in FGD for each group using the basic random sample approach. After school hours, each discussion session was held within the classrooms and lasted around 25 to 30 minutes. The topic was introduced, followed by the discussions on FGD questions, thus giving participants an equal opportunity to contribute. A tape recorder used to capture every opinion students voice during FGD sessions. The information obtained through focus group discussions (FGDs) was utilised to supplement and validate the information obtained through questionnaires and interviews.

Questionnaire

A closed-ended questionnaire was used to collect views and practices on the usage of ChatGPT in competence-based education from both teachers and students. It was expected that the questionnaire would provide relevant data for this study due to three key features. First of all, in the majority of cases, the questionnaire's responses are quite constant and dependable. Second, questionnaire can obtain a large amount of data in a fair amount of time by using a questionnaire. Thirdly, in a private setting, the questionnaire enables respondents to openly express their thoughts [39]. The questionnaire was developed on the basis of existing literature.

Additionally, the questionnaire was created with assistance from other experienced individuals working in research undertakings. The purpose of the questionnaire was to convey the aim of our study and respond to the research questions.

Data Analysis

The Statistical Package for the Social Sciences (SPSS) V.21 programme was used to analyse data obtained from questionnaires given to teachers and students. Descriptive statistics were used to analyse the quantitative data obtained from the questionnaires. The qualitative data from focus groups and interviews were examined using theme analysis, in accordance with the methods outlined by V. Braun and V. Clarke [40]. This approach involved categorising the data, identifying patterns, and comparing these themes across various universities in order to identify similarities and differences on how ChatGPT is utilised to enhance learning at higher education institutions.

Data Quality. Validity and Reliability of Quantitative Data

The quality of the quantitative data was guaranteed by piloting the questionnaire. This helped to discover inconsistency and ambiguities before the final instrument (questionnaire) is used to gather data from selected higher learning institutions in Tanzania. Additionally, the validity of instruments was guaranteed by disseminating questionnaire questions to colleagues for confirmation that they measure the desired variables. Some of the questionnaire items were modified, and those with ambiguities were eliminated, to ensure that the research findings accurately reflect the aim and objectives of our research.

Quality of Qualitative Data

Triangulation of data sources through the use of various data collecting methods decreased participant response bias and assured the trustworthiness of the qualitative data. Our study also used peer debriefing to determine whether there was consensus on how to interpret the findings. Colleagues were given the research findings for critical evaluation, feedback, and helpful suggestions that were implemented to enhance our study.

Ethical Consideration

Ethical considerations were met by providing participants with advance notice of the study's objectives, the data being collected, its intended use, and the possible advantages and results that might be obtained from the data. Respondents were assured that the data gathered from them would only be used to achieve the goals of the study and would not be disclosed without the respondents' consent. Furthermore, references and in-text citations were employed to acknowledge the origins of the data and materials used in order to uphold intellectual integrity.

Results

Demographic Features of the Respondents

The demographics of the participants varied by age, gender, level of education, and experience.

Demographic Data for Teachers

The sample was made up of teachers with a range of backgrounds, including male and female teachers with varying degrees of education and experience. The demographic characteristics of teachers are presented in Table 2.

Table 2

Demographic characteristics of teachers (*n* = 40)

Demographic variables	Categories	*n*	%
Universities	U1	10	25%
	U2	10	25%
	U3	10	25%
	U4	10	25%
Gender	Male	25	62.5%
	Female	15	37.5%
Education level	Bachelor	10	25%
	Masters	20	50%
	PhD	10	25%
Teaching experience	1–5 years	10	25%
	5–10 years	20	50%
	10 and above	10	25%

Source: Field data, 2024.

Table 2 represents teachers who completed questionnaire on the use of ChatGPT in competence-based education in higher learning institutions. There were 15 (37.5%) female teachers and 25 (62.5%) male teachers. This suggests that both sexes were included in the study. Regarding educational attainment, 10 teachers (25%) had a bachelor's degree, 20 teachers (50%) had a master's degree, and 10 teachers (25%) had a doctorate. This suggests that participants had a solid understanding of ChatGPT in CBE as a result of their exposure. Additionally, 10 teachers (25%) had 1–5 years of teaching experience, 20 teachers (50%) had 5–10 years, and 10 teachers had experience of 10 years and above. This suggests that the participants had enough experience, making them valuable contributors to share their perspectives and ChatGPT related practices in CBE.

Students' Demographic Characteristics

Students of various ages, both male and female, and with a range of features made up the sample. The demographic characteristics of participants of this study are presented in Table 3.

Table 3

Demographic characteristics of students (*n* = 200)

Demographic variables	Categories	*n*	%
Universities	U1	50	25%
	U2	50	25%
	U3	50	25%
	U4	50	25%
Gender	Male	120	60%
	Female	80	40%
Age	15–20 years	120	60%
	20–25 years	70	35%
	25 and above	10	5%

Source: Field data, 2024.

Table 3 represents students who completed questionnaire on the use of ChatGPT in competence-based education in higher learning institutions. There were 80 (40%) female students and 120 (60%) male students. This suggests that both sexes were included in the study. In term of age group of students, students with 15–20 years were 120 (60%), with 20–25 years were 70 (35%) and with 25 years and above were 10 (5%). This suggests that research participants were sufficiently developed to offer adequate knowledge on the use of ChatGPT in competence-based education in Tanzania higher learning institutions.

ChatGPT in the Context of Competence-Based Education

Competence-based education (CBE) has gained prominence in Tanzanian higher learning institutions as they shift from traditional content-based teaching to approaches that prioritise skills development and practical knowledge application. ChatGPT's integration in this context greatly aids in the development of critical thinking and problem-solving abilities, fills in resource gaps, enables individualised learning through the simulation of real-world situations, and involves students in scientific research and tutorial-based learning, as detailed in the section below.

Simulation of Real-World Scenarios

According to the results of the teachers' survey, 38 (95%) of the respondents agreed that ChatGPT is crucial for competence-based learning since it replicates real-world situations in the disciplines being taught, while 2 (5%), on the other hand, disagreed. In a similar vein, 15 students (7.5%) disagreed and 185 students (92.5%) agreed. These results demonstrate that competence-based education (CBE) places a strong emphasis on helping students acquire the particular abilities, know-how, and dispositions necessary to succeed in real-world situations. One effective way to do this is to simulate real-world situations, and ChatGPT greatly improves these simulations. ChatGPT, an AI-powered conversational agent, provides learners with a platform to apply their knowledge in interesting and useful ways by creating and facilitating situations that replicate real-life problems in a variety of subjects. Its capacity to create intricate, level-appropriate situations guarantees that the instruction stays current and in line with the students' developmental objectives. In an interview with a university U2 Teacher (T3), it was noticed that:

"In competence-based education, students must actively participate in the teaching and learning process. I usually make simulated material using ChatGPT so that students may comprehend the lesson more fully. The purpose of these simulations is to help students better comprehend the lecture and make it more tangible" (Interview, T3 at U2: October 24, 2024).

Furthermore, University U2 Teacher T5 stated that:

"I create lesson-related materials and simulated videos using ChatGPT. I utilise these simulated videos to teach students abstract concepts that are difficult for them to understand. Every student participates in the class and it becomes more interesting" (Interview, T5 at U2: October 14, 2024).

These results suggest that by mimicking real-world situations, ChatGPT greatly improves competence-based education (CBE) by giving students chances for experiential learning that develop their practical abilities. Because CBE places a strong emphasis on mastering certain abilities, simulations are an essential practice and assessment tool. Through dynamic, individualised, and immersive encounters that promote skill development, ChatGPT's interactive features enable it to mimic real-life scenarios. Furthermore, during focus group talks, University U1 students added that:

"We use ChatGPT, and it is really easy to use. Although certain science ideas are hard to understand, ChatGPT is helpful. A capability for simulated practicals, experiments, and other topic-related information is available in ChatGPT. Through this, even without the assistance of the teacher, we gain a comprehensive comprehension of the subject matter" (FGD at U1: October 17, 2024).

According to university U1 students' findings, ChatGPT helps them navigate difficult problem-solving procedures and mimic scientific investigations. For instance, ChatGPT may guide students through a virtual lab experiment on projectile motion in a physics class, letting them change variables and see the results. Students' comprehension of the subject content is subsequently enhanced by these. Students at University U4 also had a similar thought. They said:

"... in the modern world, learning has shifted from relying on teachers to being individualised. ChatGPT is available! Ask for the response you would like to get. Generally speaking, we favour simulations, especially in scientific courses like chemistry, physics, and biology where some ideas are difficult to grasp" (FGD at U4: October 16, 2024).

These results demonstrate ChatGPT's ability to provide simulated scenarios tailored to students' requirements in competence-based education. ChatGPT may customise situations according to students' proficiency levels, leading them through more difficult assignments to guarantee mastery. This method efficiently fills in skill gaps while allowing students to study at their own speed. ChatGPT is an affordable solution for building simulations that are accessible from anywhere at any time because to its scalability and accessibility. Accordingly, ChatGPT may be used by educators and learners to monitor student replies, offering valuable information about learning outcomes and pinpointing areas in need of development [41]. Through the creation of a secure, engaging, and flexible learning environment, ChatGPT enables students to hone the skills necessary for success in the real world. Both teachers and students may benefit greatly from using ChatGPT to simulate real-world situations in the classroom. Through dynamic, interactive settings created by ChatGPT, students may interact with real-world scenarios that reflect social, intellectual, and professional issues. These simulations are perfect for getting students ready for the challenges of real life because they provide them practical experience, encourage critical thinking, and help them build abilities in a risk-free environment [42].

Improving Critical Thinking and Problem-Solving Capabilities

According to the results of the teachers' survey, 30 (75%) of the respondents agreed that ChatGPT improves students' critical thinking and problem-solving abilities in competence-based education (CBE), whereas 10 (25%) disagreed. In a similar vein, 30 students (15%) disagreed and 170 students (90%) agreed. Competence-based education (CBE) places a strong emphasis on mastering the abilities and information required to successfully handle problems in the actual world. Thus, incorporating ChatGPT into educational settings greatly improves students' capacity for critical thought and problem-solving. ChatGPT helps students build these vital skills by providing engaging and flexible learning opportunities. The university U2 teacher (T4) clarified that:

"ChatGPT presents students with a variety of real-world challenges that need critical thinking and the development of a tenable solution. Students gain critical thinking abilities by interacting with and resolving these issues. Therefore, ChatGPT plays a significant role in helping students develop their problem-solving skills" (Interview, T4 at U2: October 17, 2024).

Furthermore, university (U2) teacher (T1) said that:

"ChatGPT guides students through challenges and offers a variety of solutions. Then, if ChatGPT is used properly, it encourages students to learn more about the subject and develop those key skills" (Interview, T1 at U2: October 14, 2024).

According to these teacher results, ChatGPT encourages students to have meaningful conversations that lead to knowledge processing, assessment, and synthesis. It pushes students to examine presumptions, recognise biases, and formulate logical arguments by asking probing questions. For example, whereas scientific students might investigate the effects of experimental factors, arts students can argue the reasons of events by looking at evidence and counterarguments. Using frameworks like cause-and-effect chains or lists of pros and drawbacks, ChatGPT helps users organise their thoughts in a methodical manner. As a result, by offering many viewpoints on problems, it fosters empathy and improves decision-making abilities, both of which are essential for success in challenging, real-world circumstances. During the university U1 focus group discussion, students made the following comments:

"Since most teacher assignments and activities require us to learn more and come up with solutions, it is our responsibility as students to ask pertinent and real-world questions. ChatGPT is an amazing AI tool in education that helps us find better solutions to these problems" (FGD at U1: October 26, 2024).

Additionally, during the focus group discussion, university U3 students clarified that:

"Because ChatGPT is an interesting and dynamic tool, we utilise it to improve our ability to solve real-world challenges that teachers offer. It offers services based on students' interests and requirements and offers a variety of problem-solving techniques, which aids in the development of critical thinking abilities" (FGD at U3: October 18, 2024).

These results demonstrate how well ChatGPT's customisation capabilities match with competence-based education's emphasis on tailored learning. ChatGPT ensures an ideal challenge level by modifying the complexity and difficulty of the content according to the learner's degree of skill. Students are empowered to investigate ideas on their own, at their own speed and with flexibility.

These results also suggest that ChatGPT fosters the growth of reflective thinking, which is essential to competence-based learning. ChatGPT promotes metacognition and self-reflection by asking students to explain their ideas, which enhances comprehension and fosters personal development. Therefore, in competence-based education, ChatGPT is a game-changing tool for improving critical thinking and problem-solving skills. It is a priceless addition to conventional teaching techniques because of its capacity to provide engaging, customised, and reflective learning experiences [17]. Through careful integration, ChatGPT enables students to acquire the abilities and proficiencies required for success in a world that is becoming more and more complicated.

Access to High Quality Educational Resources

According to the results of the teachers' survey, 34 (85%) of the respondents agreed that ChatGPT gives teachers access to excellent teaching resources, while 6 (15%) disagreed. In a similar vein, 25 students (12.5%) disagreed while 175 students (87.5%) agreed. These results demonstrate how ChatGPT augmented instruction changes the way knowledge is delivered and absorbed by providing teachers and students with access to top-notch educational resources. In competence-based education, ChatGPT is a powerful tool for teachers and students to gather current, pertinent resources tailored to the particular requirements of their classroom. Systems that are driven by ChatGPT, such as digital libraries and content recommendation engines, evaluate the curriculum and provide instructional resources like articles, videos, and lesson plans that align with the educational objectives of imparting competences to students. In addition to saving teachers time, this guarantees that they have access to a variety of excellent tools that improve instruction and better engage students. Teachers T4 at University U3, for instance, said that:

"I can easily produce multimedia tutorials including animations, movies, and other tech-based resources using ChatGPT. These materials aid in my student's comprehension of the material and are frequently engaging. Students have an equal chance to engage in instruction and learning using ChatGPT" (Interview, T4 at U3: October 24, 2024).

Additionally, the university U4 teacher (T3) mentioned that:

"My teaching strategies have changed as a result of ChatGPT's advancement in education. Students currently like engaging with instructional materials produced by artificial intelligence (AI) that simplify concepts for them. In a similar vein, students can obtain structured and well-organised knowledge using AI technologies" (Interview, T3 at U4: October 12, 2024).

Teachers' results revealed that by offering a wide range of materials catered to each student's interests and ability level, ChatGPT eliminates traditional learning

obstacles. For instance, by providing interactive materials like gamified exercises, simulations, and real-world case studies, adaptive learning systems can make abstract ideas more approachable. These tools usually come in a range of media, such as text, audio, video, and interactive activities, to fit different learning styles and help students better comprehend challenging subjects. Additionally, ChatGPT ensures that instructional materials are accurate and current, providing students with a strong foundation upon which to build their knowledge. Similarly, U3 students discussed their experiences using ChatGPT in the age of competence-based learning. They said the following:

"Particularly at this university, we are allowed to use ChatGPT and other AI technologies. Usually, we check for books and relevant references and make notes using AI technologies. In general, we can state that we value the advances in science and technology and that learning is simpler these days" (FGD at U3: October 20, 2024).

In a similar vein, University U2 students observed during focus groups that:

"For us, using ChatGPT is simple, especially when I need to comprehend something that I didn't fully understand in class. I can find videos, animations, and other resources that reinforce the topics I've studied in class with the aid of ChatGPT" (FGD at U2: October 22, 2024).

According to teacher and student findings, ChatGPT-enhanced instruction democratises access to high-quality resources, making high-quality education accessible regardless of geographic or budgetary constraints. Students may access excellent instructional information using open-source ChatGPT technologies and platforms to bridge the gaps in resource availability. Additionally, ChatGPT's translation and accessibility features ensure that students with disabilities or non-native languages may access the same top-notch resources as their peers [8]. Teachers and students alike may access a wider range of interesting, pertinent, and inclusive materials by utilising ChatGPT in the classroom, improving the teaching and learning process as a whole.

Conducting Online Tutorials and Scientific Practicals

In virtual laboratories powered by ChatGPT, 95% of students and 85% of teachers said they might conduct experiments that replicate real-world scenarios. These labs eliminate the need for physical laboratory items by allowing teachers and students to conduct experiments using computers or mobile devices. In a virtual biology lab, for instance, a student may be led through the steps of extracting DNA from a synthetic substance. The lab's AI system monitors each step, corrects errors, gives real-time feedback, and ensures that students understand the procedure and the underlying scientific concepts. Additionally, the following was said by Teacher (T2) from University U1 during the interview:

"I develop procedures for doing testing using ChatGPT. This enables me to know how to do the experiments and provides me with adequate exposure to a variety of experimental approaches. Similar to this, I can utilise a number of tutorials on prompts to assist my students in thinking" (Interview, T2 at U1: October 15, 2024).

Furthermore, the university U4 teacher (T3) observed that:

"I effectively include ChatGPT into my teaching strategies since it allows me to select as many lessons as I need to enhance my students' understanding of the subject matter. Additionally, I obtain useful videos and instructions on how to do tests using AI's feature" (Interview, T3 at U4: October 18, 2024).

According to these findings, ChatGPT is crucial for customising scientific courses. ChatGPT intelligent tutoring systems adapt to each student's particular learning style and pace by analysing performance data. For example, if students are unable to understand a certain concept, ChatGPT could offer simpler examples or more assignments. However, advanced students may be given more challenging problems. By giving them thorough data that highlights each student's development and areas in need of improvement, these systems assist teachers in better tailoring their instructional strategies. Additionally, students brought up the following points about ChatGPT in competence-based education during focus groups:

"We frequently use artificial intelligence (AI), namely ChatGPT, to find online guides and familiarise ourselves with the many stages required to do scientific research. This facilitates understanding and mastery of several practical without the need for teachers support" (FGD at U2: October 20, 2024).

Also, during the focus group session students mentioned that:

"ChatGPT is essential for online lessons and practical. We utilise these new tools to explore a variety of scientific phenomena and get new insights" (FGD at U3: October 24, 2024).

According to these results, ChatGPT technologies have the potential to enhance education in a variety of ways. Students can access cutting-edge scientific learning opportunities regardless of their location or the resources offered by the university. ChatGPT systems offer a safe and risk-free environment, especially when simulating hazardous processes like chemical reactions [43]. They also encourage inclusiveness and the development of the desired competences by providing accommodations for a variety of learning needs and ensuring that each student may progress at their own pace. These technologies assist teachers in improving classroom management by addressing individual learning gaps and making it easier to administer larger groups.

Discussion

The integration of ChatGPT in competence-based education is revolutionising the educational landscape by offering innovative solutions to enhance learning and cognitive skills development as revealed in the findings from teachers and students [44]. These findings comply with the findings from the literature view that exposes the significance of the ChatGPT in competence-based education particularly in improving students' critical thinking and problem-solving skills. These skills are essential for the student's survival in this era that require students to have necessary competence. ChatGPT is a potential tool for modifying conventional teaching techniques, creating interactive learning environments, and facilitating individualised educational experiences as the education sector adopts technology more and

more [11]. According to B. Michalon and C. Camacho-Zuñiga [45], a sophisticated language model in ChatGPT can comprehend and produce text that is similar to that of a person. This feature enables it to foster dynamic learning experiences, give real-time feedback, and involve students in meaningful interactions that are crucial in competence-based education. The augment from this scholar complements with the findings and the constructivism learning theory that requires students to construct their own knowledge based on learning experience they encounter throughout the instructions. This enables students to learn at their own pace and develop meaningful solutions to real-world problems. It also allows students to access a variety of learning materials that are essential for understanding the subject matter.

These findings align with those by I. Billy and H. Anush [46], who found that ChatGPT provides responsive and dynamic interactions that actively engage students in their learning process, in contrast to traditional teaching approaches that frequently rely on the transmission of static material. These findings also support the constructivism theory that insists on students' engagement as active participant in the teaching and learning process. This enhances students' grasp of knowledge and skills because the learning becomes a two-way process of augments and feedbacks in the classroom instructions. A. Rejeb, K. Rejeb, A. Appolloni et al. [47] concluded that the main advantages of incorporating ChatGPT into the classroom are its capacity to encourage competence building and active learning. Additionally, A. Rejeb, K. Rejeb, A. Appolloni et al. [47] noted that traditional teaching methods might occasionally be passive, giving students' knowledge without much application or participation. In order to solve this problem, ChatGPT offers scenario-based exercises, interactive discussions, and problem-solving exercises that motivate students to use what they have learned in real-world situations [14, 19]. As noted by S. Joshi, R. K. Rambola, P. Churi [24] and W. Holmes, F. Iniesto, S. Anastopoulou [27], students' critical thinking and analytical abilities are developed through active participation with ChatGPT augmented training, which promotes a better comprehension of the subject matter and the development of the desired competences. Furthermore, ChatGPT's flexibility enables it to customise its replies to each student's needs, learning preferences, and skill level [48]. This flexibility is consistent with the constructivism learning theory which encourages students to learn at their own pace so as to develop a thorough understanding of concepts in respective subject matter. This enhances students' access to quality educational resources that in turn supports learning and mastery of essential skills.

ChatGPT guarantees that every student receives pertinent coaching that tackles their unique issues and improves their learning experience by offering personalised feedback and support [21]. For example, if a student is having trouble understanding a certain idea, ChatGPT can provide further clarifications, illustrations, or other strategies to help comprehend and acquire the desired competence. Likewise, H. Yu's findings [18] support these study findings that ChatGPT facilitates the growth of critical cognitive abilities via interactive and iterative education. Students may practice problem-solving, decision-making, and analytical thinking by using

ChatGPT's capacity to mimic real-world situations and lead discussions [26, 49]. Because it allows students to hone their cognitive skills and lay a strong basis for future learning, this hands-on experience is essential for both academic performance and real-world applicability. Despite its promise, careful preparation and execution are necessary for ChatGPT's successful incorporation into the competence-based education [50]. This includes using ChatGPT ethically to enhance teaching and learning.

AI-driven activities must adhere to strict accuracy and relevance criteria and be in line with educational goals, which teachers and students must make sure of. Although ChatGPT offers helpful assistance, it should be used in conjunction with human instruction rather than to replace it, since teachers are essential in providing context, guidance, and emotional support aspects that AI cannot completely replace.

Conclusion

The incorporation of ChatGPT into the classroom is a major step towards improving student learning and helping them acquire critical skills in competence-based education. The usage of ChatGPT presents revolutionary prospects to overcome conventional teaching issues and create more efficient, interesting, and customised learning environments as educational methods continue to change. One of ChatGPT's main advantages in competence-based education is its capacity to provide interactive learning experience. ChatGPT encourages active engagement and the real-world application of information by involving students in scenario-based activities, problem-solving exercises, and real-time interactions. Compared to passive learning techniques, this dynamic approach offers a more interesting and successful educational experience that aids students in expanding their knowledge and honing their critical thinking abilities. Even though ChatGPT offers a lot of potential to enhance competence-based education, the study suggests that incorporating it requires a thorough approach. This means establishing programmes that improve teacher and student proficiency, investing in infrastructure to close the digital divide, and fostering a culture of ethical AI use. It is imperative that stakeholders, educators, and policymakers work together for creating an environment that maximises AI's benefits while limiting its downsides in the context of competence-based education.

Limitation and Future Research

A key limitation is on generalisability due to potential differences across Tanzania higher learning institutions in terms of infrastructure, digital access, academic discipline and geographical locations. Findings drawn from small sample or specific sample may not accurately reflect the diverse experiences of institutions national wide, particularly between public and private universities, or urban and rural areas. These variations can affect how ChatGPT is adopted and its effectiveness within

competence-based education. To improve generalisability, future research should include a broader, more diverse sample of institutions across different regions and academic contexts.

References

1. Nkya H., Fang H., Mwakabungu F. Implementation of competence-based curriculum in Tanzania: perceptions, challenges and prospects. A case of secondary school teachers in Arusha region. *Journal of Education and Practice*. 2021;12(19):34–41. doi:10.7176/JEP/12-19-04
2. Fosso Wamba S., Bawack R.E., Guthrie C., Queiroz M.M., Carillo K.D.A. Are we preparing for a good AI society? A bibliometric review and research agenda. *Technological Forecasting and Social Change*. 2021;16(4):120–482. doi:10.1016/j.techfore.2020.120482
3. Paek S., Um T., Kim N. Exploring latent topics and international research trends in competence-based education using topic modeling. *Education Sciences*. 2021;11(6):25–45. doi:10.3390/educsci11060303
4. Brammer M.K., Goodrich K.M. Competence-based education model. *Social Science Journal*. 2021;2(6):1–12. doi:10.1080/03623319.2021.1883380
5. Radu C., Ciocoiu C.N., Veith C., Dobrea R.C. Artificial intelligence and competence-based education: a bibliometric analysis. *Amfiteatru Economic*. 2024;26(65):220–240. doi:10.24818/EA/2024/65/220
6. Evans C.M., Landl E., Thompson J. Making sense of K-12 competence-based education: a systematic literature review of implementation and outcomes research from 2000 to 2019. *The Journal of Competence-Based Education*. 2020;(4)1:1–28. doi:10.1002/cbe2.1228
7. Anderson-Levitt K., Gardinier M.P. Introduction contextualising global flows of competence-based education: polysemy, hybridity and silences. *Comparative Education*. 2021;57(1):1–18. doi:10.1080/03050068.2020.1852719
8. Haluza D., Jungwirth D. Artificial intelligence and ten societal megatrends: a GPT-3 case study. *Preprints*. 2023;20(2):301–474. doi:10.20944/preprints202301.0474.v1
9. Mhlanga D. Artificial intelligence in the industry 4.0 and its impact on poverty, innovation, infrastructure development, and the sustainable development goals: lessons from emerging economies. *Sustainability*. 2021;13(11):57–88. doi:10.3390/su13115788
10. Rudolph J., Tan S. ChatGPT: bullshit spewer or the end of traditional assessments in higher education. *Journal of Applied Learning and Teaching*. 2023;6(1):78–90. doi:10.37074/jalt.2023.6.1.9
11. Barrett A., Pack A. Not quite eye to AI: student and teacher perspectives on the use of generative artificial intelligence in the writing process. *International Journal of Educational Technology in Higher Education*. 2023;20(1):59–80. doi:10.1186/s41239-023-00427-0
12. Kasneci E., Küchemann S., Bannert M., Dementieva D. ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and Individual differences*. 2023;10(3):102–274. doi:10.1016/j.lindif.2023.102274
13. Peters M.A., Jackson L., Papastephanou M., Jandrić P., Lazaroiu G., Evers C.W., et al. AI and the future of humanity: ChatGPT-4, philosophy and education critical responses. *Educational Philosophy and Theory*. 2023;7(5):1–35. doi:10.1080/00131857.2023.2213437
14. Chen L., Chen P., Lin Z. Artificial intelligence in education. *IEEE Access*. 2020;8(9):75264–75278. doi:10.1109/ACCESS.2020.2988510
15. Kuleto V., Ilić M., Dumangiu M., Ranković M., Martins O.M.D., Păun D., et al. Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions. *Sustainability*. 2021;13(18):104–124. doi:10.3390/su131810424
16. Hwang G.J., Xie H., Wah B.W., Gašević D. Vision, challenges, roles and research issues of artificial intelligence in education. *Artificial Intelligence*. 2020;4(7):25–55. doi:10.1016/j.caeai.2020.100001

17. Vázquez-Cano E., Ramirez-Hurtado J.M., Saez-Lopez J.M., López-Meneses E. ChatGPT: the brightest student in the class. *Thinking Skills and Creativity*. 2023;4(9):71–85. doi:10.1016/j.tsc.2023.101380
18. Yu H. The application and challenges of ChatGPT in educational transformation: new demands for teachers' roles. *Heliyon*. 2024;7(5):124–150. doi:10.1016/j.heliyon.2024.e24289
19. Crompton H., Song D. The potential of artificial intelligence in higher education. *Revista Virtual Universidad Catolica Del Norte*. 2021;6(2):1–4. doi:10.35575/rvucn.n62a1
20. Akgun S., Greenhow C. Artificial intelligence in education: addressing ethical challenges in K-12 settings. *AI and Ethics*. 2022;2(3):431–440. doi:10.1007/s43681-021-00096-7
21. Kaplan A., Haenlein M. Rulers of the world, unite: the challenges and opportunities of artificial intelligence. *Business Horizons*. 2020;63(1):37–50. doi:10.1016/j.bushor.2019.09.003
22. Nguyen A., Ngo H.N., Hong Y., Dang B., Nguyen B.P.T. Ethical principles for artificial intelligence in education. *Education and Information Technologies*. 2022;28(4):4221–4241. doi:10.1007/s10639-022-11316-w
23. Baker R.S., Hawn A. Algorithmic bias in education. *International Journal of Artificial Intelligence in Education*. 2022;32(4):1052–1092. doi:10.1007/s40593-021-00285-9
24. Joshi S., Rambola R.K., Churi P. Evaluating artificial intelligence in education for next generation. *Journal of Physics, Conference Series*. 2021;3(3):8–90. doi:10.1088/1742-6596/1714/1/012039
25. Lazaroiu G., Rogalska E. How generative artificial intelligence technologies shape partial job displacement and labor productivity growth. *Oeconomia Copernicana*. 2023;14(3):703–706. doi:10.24136/oc.2023.020
26. Kelly A., Sullivan M., Strampel K. Generative artificial intelligence: university student awareness, experience, and confidence in use across disciplines. *Journal of University Teaching and Learning Practice*. 2023;20(6):33–45. doi:10.53761/1.20.6.12
27. Holmes W., Iniesto F., Anastopoulou S., Boticario J.G. Stakeholder perspectives on the ethics of AI in distance-based higher education. *The International Review of Research in Open and Distributed Learning*. 2023;24(2):96–117. doi:10.19173/irrodl.v24i2.6089
28. Allen A. An introduction to constructivism: its theoretical roots and impact on contemporary education. *Journal of Learning Design and Leadership*. 2022;1(1):1–11.
29. Givi Efgivia M., Rinanda A. R., Hidayat A., Maulana I., Budiarjo A. Analysis of constructivism learning theory. *Advances in Social Science, Education and Humanities Research*. 2021;8(5):208–212. doi:10.2991/assehr.k.211020.032
30. Kieu Oanh P.T., Hong Nhung N.T. Constructivism learning theory: a paradigm for teaching and learning English in secondary education in Vietnam. *International Journal of Scientific and Research Publications*. 2022;12(12):93–98. doi:10.29322/ijsrp.12.12.2022.p13211
31. Prakash Chand S. Constructivism in education: exploring the contributions of Piaget, Vygotsky, and Bruner. *International Journal of Science and Research*. 2023;12(7):274–278. doi:10.21275/sr23630021800
32. Wibowo S., Wangid M.N., Firdaus F.M. The relevance of Vygotsky's constructivism learning theory with the differentiated learning primary schools. *Journal of Education and Learning*. 2025;19(1):431–440. doi:10.11591/edulearn.v19i1.21197
33. Umida K., Dilora A., Umar E. Constructivism in teaching and learning process. *European Journal of Research and Reflection in Educational Sciences*. 2020;8(3):134–137.
34. Wang Y. Research on the implications of constructivism to education. *Advances in Social Science, Education and Humanities Research*. 2022;4(6):2793–2797. doi:10.2991/assehr.k.220504.507
35. Ngulube P., Ngulube B. Are we there yet? Mixed methods research in the South African. *Journal of Economic and Management Sciences*. 2022;22(1):120–150. doi:10.4102/ac.v22i1.1013

36. Amadi A. Integration in a mixed-method case study of construction phenomena: from data to theory. *Engineering, Construction and Architectural Management*. 2023;30(1):210–237. doi:10.1108/ECAM-02-2021-0111
37. Taherdoost H. What are different research approaches? Comprehensive review of qualitative, quantitative, and mixed method research, their applications, types, and limitations. *Journal of Management Science and Engineering Research*. 2022;5(1):53–63. doi:10.30564/jmser. v5i1.4538
38. Baig U., Arsalan Hashmi M., Babar Ali S., Zehara S. Exploratory sequential mixed methods in doctorate research: extended application of constructivist grounded theory. *IBT Journal of Business Studies (JBS)*. 2020;16(2):47–65. doi:10.46745/ilma.jbs.2020.16.02.04
39. Kumatongo B., Muzata K.K. Research paradigms and designs with their application in education. *Journal of Lexicography and Terminology*. 2021;5(1):16–32.
40. Braun V., Clarke V. Conceptual and design thinking for thematic analysis. *Qualitative Psychology*. 2022;9(1):3–10. doi:10.1037/qup0000196
41. Silva A.D.O., Janes D.D.S. Exploring the role of artificial intelligence in education: a comprehensive perspective. *Review of Artificial Intelligence in Education*. 2020;1(00):e05. doi:10.37497/rev.artif.intell.education.v1i00.5
42. Singh N. Digital literacy and AI integration in African higher education: issues and solutions. *Journal of Global Education*. 2020;5(3):28–46.
43. Alotaibi A.H.E. The impact of AI-powered grammarly on enhancing grammar proficiency among Saudi EFL students. *Remittances Review*. 2023;8(4):76–87. doi:10.33182/rr.v8i4.256
44. Sagın F.G., Ozkaya A.B., Tengiz F., Geyik O.G., Geyik C. Current evaluation and recommendations for the use of artificial intelligence tools in education. *Turkish Journal of Biochemistry*. 2024;48(6):620–625. doi:10.1515/tjb-2023-0254
45. Michalon B., Camacho-Zuñiga C. ChatGPT, a brand-new tool to strengthen timeless competencies. *Frontiers in Education*. 2023;8(2):1–13. doi:10.3389/feduc.2023.1251163
46. Billy I., Anush H. A study of the perception of students and instructors on the usage of Artificial Intelligence in education. *International Journal of Higher Education Management*. 2023;9(2):120–150. doi:10.24052/IJHEM/V09N02/ART-6
47. Rejeb A., Rejeb K., Appolloni A., Treiblmaier H., Iranmanesh M. Exploring the impact of ChatGPT on education: a web mining and machine learning approach. *International Journal of Management Education*. 2024;22(1):1–14. doi:10.1016/j.ijme.2024.100932
48. Fabiyi S.D. What can ChatGPT not do in education? Evaluating its effectiveness in assessing educational learning outcomes. *Innovations in Education and Teaching International*. 2024;7(4):1–16. doi:10.1080/14703297.2024.2333395
49. Niu S.J., Luo J., Niemi H., Li X., Lu Y. Teachers' and students' views of using an AI aided educational platform for supporting teaching and learning at Chinese schools. *Education Sciences*. 2022;12(12):8–18. doi:10.3390/educsci12120858
50. Onesi-Ozigagun O., James Ololade Y., Eyo-Udo N.L., Ogundipe D.O. Revolutionizing education through AI: a comprehensive review of enhancing learning experiences. *International Journal of Applied Research in Social Sciences*. 2024;6(4):589–607. doi:10.51594/ijarss.v6i4.1011

Information about the authors:
Moabu Jimmy Chandafa – Assistant Lecturer, Department of Technical Education, Mbeya University of Science and Technology (MUST), Mbeya, United Republic of Tanzania; ORCID 0009-0006-3513-6938. E-mail: moabuchandafa95@gmail.com
Huang Fang – Professor, School of Education, Huazhong University of Science and Technology, Wuhan, People's Republic of China. E-mail: fanghuang@hust.ed.cn

Contribution of the authors:
M.J. Chandafa – research designing, data collection, analysis and preparation of the first draft of the manuscript as well as its associated revisions.
H. Fang – research designing, data collection, analysis and making revisions leading to the production of the final manuscript.

Conflict of interest statement. The authors declare that there is no conflict of interest.

Received 26.01.2025; revised 18.06.2025; accepted 02.07.2025.
The authors have read and approved the final manuscript.

Информация об авторах:
Чандафа Моабу Джимми – младший преподаватель кафедры технического образования Университета науки и технологий Мбея (MUST), Мбея, Объединенная Республика Танзания; ORCID 0009-0006-3513-6938. E-mail: moabuchandafa95@gmail.com
Фан Хуан – профессор Школы образования Хуачжунского университета науки и технологии, Ухань, Китайская Народная Республика. E-mail: fanghuang@hust.ed.cn

Вклад соавторов:
М.Дж. Чандафа – проектирование исследования, сбор данных, анализ и подготовка первого черновика рукописи, а также связанные с этим доработки.
Х. Фан – проектирование исследования, сбор данных, анализ и внесение исправлений, ведущих к созданию окончательного варианта рукописи.

Информация о конфликте интересов. Авторы заявляют об отсутствии конфликта интересов.

Статья поступила в редакцию 26.01.2025; поступила после рецензирования 18.06.2025; принята к публикации 02.07.2025.
Авторы прочитали и одобрили окончательный вариант рукописи.