

Impact of Artificial Intelligence on the Hypothetical Performance of Scholars at University Level

Abstract

This research investigates the impact of Artificial Intelligence (AI) tools on the hypothetical performance of postgraduate scholars. Several factors shape academic performance at the university level, and this study focuses on those that influence students' outcomes and contribute to academic performance. The population consisted of 460 postgraduate scholars, with a sample of 210 drawn from federal public sector universities in Islamabad. Data were collected through a structured questionnaire and analyzed using inferential statistics (χ^2 test). Findings reveal that AI tools significantly enhance students' problem-solving skills, which positively affect their hypothetical academic performance. Based on these results, the study recommends that academicians actively integrate AI tools into teaching and mentoring practices to strengthen students' academic development and overall performance at the university level.

Keywords: AI tools, Artificial Intelligence, Hypothetical Performance, Learning, Scholars

INTRODUCTION

AI stands for Artificial Intelligence. It comprises all the computational tools used to learn from Web 3.0 and 4.0 tools. Artificial intelligence (AI) is a set of technologies that enable computers to perform a variety of advanced functions, including the ability to see, understand, and translate spoken and written language, analyze data, make recommendations, and more. Some of these AI types are not even scientifically possible right now. According to the current classification system, there are four primary AI types: reactive, limited-memory, theory-of-mind, and self-aware. In contrast, ICT is a comprehensive term that encompasses all communication devices that transfer information via the internet, including radio, TV, cellular headphones and headsets, personal computer hardware/software, broadcasting schemes, and so on. The numerous facilities, including internet, wireless systems, cell phones, electronic mail, etc., are several facilities related to teaching and learning, such as video-conferencing, teleconferencing, telephone conferencing, and education-based social networking websites. ICT relates to storing, retrieving, transferring, and influencing digital information; it is a prolonged manifestation of information technology (IT) that emphasizes the attractiveness of incorporated infrastructures and the integration of communications and broadcasting (phone lines and wireless signals). PCs serve as elementary, innovative software, storage, and audio-visual systems that help operators admit, store, communicate, and process

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influencing their educational experiences and personal development. From personalized information (Burnett, 2001). The impact of AI in education and on students is profound, learning to innovative tools, AI is reshaping how students engage with information, fostering critical skills for the future. AI tools are effective devices for expanding educational avenues in both formal and non-formal instruction, as students are sometimes prohibited from learning through direct instruction due to specific social or communal limitations, such as cultural subgroups, adolescents and females, individuals with disabilities, and the aging (Bossaert, 2011).

Objectives of Research

Main objectives were:

1. To find out the use of AI tools by the students at the university level.
2. To find the impact of AI tools on the progress of students' hypothetical execution.

Significance of the Study

The AI tools are an important part of all subjects, fields, and in every arena of learning, including industry, agriculture, business, medicine, and engineering. The HEC has taken steps to improve the university-industry relationship to prepare skilled human resources better, enhance economic and industrial outputs, and develop a global competence initiative. The use of AI tools plays a vital role in the sustainability of educational initiatives and enhances understanding. The framework and online availability of learning materials for educators within the country may help in preparing educational programs, learning materials, and lesson plans (HEC, 2020).

Ethical Considerations

Artificial intelligence is progressing at an astonishing pace, raising profound ethical concerns regarding its use, ownership, accountability, and long-term implications for humanity. As technologists, ethicists, and policymakers look to the future of AI, ongoing debates about control, power dynamics, and AI's potential to surpass human capabilities underscore the need to address these ethical challenges in the present. Some significant steps are being taken to understand and mitigate these challenges to harness AI's immense potential. Here is a look at some of the most pressing ethical issues surrounding AI today: Bias and Discrimination, Transparency and Accountability, Creativity and Ownership, Social Manipulation and Misinformation, Security and Surveillance, and Job Displacement.

LITERATURE REVIEW

The radical changes in the research component at the postgraduate level have transformed the themes and philosophy of the specified subjects of learning from a country's culture and civilization to global comparative aspects, with a focus on critically antagonistic views of the world scholarly community. This change has been integrated simultaneously across new themes and issues due to the development of computer and information technology applications in this new global village of learning. Now, no view, theme, theory, or philosophy could be restricted to a closed community without revealing its secrets to global civilization. The Higher Education Commission of Pakistan demonstrates a significant step toward stimulating higher education

through computer-based technologies by consolidating research associations across the country. On the other hand, AI researchers are influencing postgraduate research. The researcher conducted various investigations and concluded that several barriers influence AI-based research, including control, budgetary, communal, individual, and regulatory. The related literature now focuses on the "Artificial Intelligence (AI) Tools for the Hypothetical Execution of Scholars at the University Level".

Characteristics of ICTs

AI's attributes are its abilities, and these characteristics enable it to be much more than just a computer and to learn, comprehend, and adapt to its surroundings. In this research, we examined the intricacies of these characteristics.

1. **Learning Capability:** One of the main characteristics of AI is its capacity to draw lessons from the data. Unlike conventional AI systems, AI does not require explicit instructions for all tasks. Machine learning algorithms process information, identify patterns, and make assumptions or decisions. The more information AI gets exposed to, the better it gets at what it does.
2. **Problem-Solving:** AI is a master at solving complex issues, including those humans are unable to solve. AI employs algorithms and data to analyze problems and develop efficient solutions. Often, it is faster than any human could.
3. **Reasoning:** Thinking is a different key characteristic that AI has. AI can make rational decisions based on the data it holds, using rules and logic to conclude.
4. **Perception:** AI's ability to sense the environment around it is a different characteristic that makes AI stand out. AI uses sensors and data to understand its environment, much like humans use their senses.
5. **Adaptability:** It is the most important characteristic of AI applications. AI systems are constantly evolving and adapting to the latest information or changes in their surroundings without needing to be reprogrammed.
6. **Automation:** Automation is among the main features that AI can utilize. Automated completion of tasks with no human involvement, thereby increasing the speed and decreasing mistakes.
7. **Data Handling:** AI's capacity to process vast quantities of data is a fantastic characteristic. AI can store, process, and analyze data at speeds humans cannot.
8. **Natural Language Processing (NLP):** AI comprehends and communicates with humans in a way that makes it much easier to communicate with machines.
9. **Self-Correction:** Self-correction is an attribute of AI that improves its precision as time passes. AI systems learn from mistakes and adapt their strategies to improve efficiency.
10. **Efficiency:** One of the attractive features of AI applications is that they can improve effectiveness. AI can complete tasks faster and more precisely than humans, thereby saving time and energy.
11. **Decision-Making:** The ability of AI to make choices is crucial to many sectors. AI uses data analysis and pattern recognition to make accurate, informed decisions.
12. AI tools are available worldwide, anywhere, and anytime (Macharia & Pelsler, 2021).

Advantages of ICTs in education

The Council for Educational Technology (2020) has set out a comprehensive approach to the use of AI tools in learning. AI emphasizes how the increasing capabilities of technology can build on and strengthen human intelligence to improve teaching and learning experiences. That includes:

- Building partnerships among educators, innovators, researchers, and community members to establish a shared vision of powerful teaching and learning with AI
- Engaging in research partnerships and hosting research communities to understand the transformative potential and address the risks
- Connecting our values and knowledge to rigorous approaches to AI research and development
Informing policymakers on how to safeguard learners' rights, data privacy, and ensure equitable opportunities to learn
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Integration of AI Tools

ICTs play a significant role in knowledge progression. Hargittai (2019) has pondered their tendency and degree, which is condensed as:

1. **Usage in organization, testing, and guidance: Commonly, the instructional innovation is utilized for all-inclusive managerial, testing, and instructional drives.**
2. **Proper utilization of automated assemblies and broad communications:** The field of instructional innovation comprises machines and various broad communications; projectors, tape recorders, and so on.
3. **Describing the objectives and destinations:** It can help in advancing small-scale education, reproductions, amusements, framework approach, showing professional morals and qualities through study hall associations, and so on.
4. **Assortment, creation, and manipulation of AV aids: Appropriate determination and utilization of instructional innovation broad media help in material choice and data dissemination—**these guide and help instructors as well as students to accomplish the learning targets unequivocally.
5. **Presentation of framework strategy:** Educational innovation is obliging in using this tactic for the evaluation of framework and sub-frameworks in an educational institution.

Limitations of ICTs in education

The National Council for Educational Technology (2019) has given some limitations in educational practices. As artificial intelligence continues to integrate into various sectors, its application in education is both celebrated and scrutinized. While AI holds significant potential to transform learning experiences, it also presents several disadvantages that require careful consideration and must be addressed to ensure a balanced, effective learning environment. The main points that outline the learning system are as follows;

1. AI tools hypothetically endanger the student's collective development.
2. AI tools are apparently imperiling the learner's intellectual improvement.

3. By the use of AI tools, students' emotional progress has been waning at the same time.
4. By utilizing AI tools, students' well-being has been imperiled.
5. Misuse of AI tools creates a massive hurdle in the learning process.
6. Complete control could not be possible over the student's usage of AI tools.
7. AI tools are moderately expensive.

How to successfully implement and use AI in education

Successfully using AI in education requires careful planning, teacher training, good infrastructure, and constant evaluation. Higher education institutions need to set clear goals for how they want to use AI, whether to improve personalized learning, streamline administrative tasks, or better engage students. By setting measurable objectives and aligning them with the school's mission, administrators can ensure that AI initiatives are purposeful and focused. Investing in teacher training and professional development is essential. Teachers need to learn how to use AI tools effectively and understand how AI can enhance traditional teaching methods. As AI continues to evolve, teachers must stay up to date on the latest AI advancements and teaching strategies through ongoing professional development programs. Institutes must have the right technology in place to support AI. Institutes should also use flexible AI platforms that can grow and adapt to changing needs. Regular evaluation and feedback from students and teachers are crucial for assessing the impact of AI and making necessary improvements, ensuring that AI tools enhance the educational experience for everyone.

The future of artificial intelligence in education is promising, thanks to technological advancements and a better understanding of how AI can improve learning. Personalized learning is a key area where adaptive learning systems and intelligent tutoring systems create customized learning experiences for students. These systems adjust to each student's strengths and weaknesses, making learning more effective. AI is also set to revolutionize administrative tasks in education. Automated grading systems can save teachers a lot of time, especially in subjects like math and coding. AI can also streamline tasks like enrolment, scheduling, and record-keeping, allowing educators to focus more on teaching. Additionally, AI can enhance student engagement with interactive content and gamified educational software, making learning more enjoyable (Clugston, 2022).

AI can support teachers and promote accessibility and inclusion. AI-powered professional development tools can recommend resources and training tailored to teachers' needs and interests, fostering continuous professional growth. Classroom management tools can help teachers monitor student engagement and provide valuable insights. Assistive technologies, such as speech-to-text applications for hearing-impaired students and text-to-speech for visually impaired students, along with real-time language translation services, can make education more accessible to diverse student populations. While the potential benefits of AI in education are vast, it is crucial to address ethical considerations and challenges. Ensuring that artificial intelligence systems are free from bias and provide fair opportunities for all students is essential (Clugston, 2022).

Impact of ICTs on Academic Achievement

AI supports teachers in administrative tasks, such as grading and assessment, freeing up valuable time. Automated grading systems powered by AI streamline routine tasks, enabling educators to focus on interactive teaching methods, mentorship, and targeted interventions for struggling students. The essential concerns that highlight the impact of AI on students' hypothetical accomplishment were as follows:

1. The constructive outcome of AI usage in preparing lessons has not been illustrated. At the end of the day, many of the impacts on academic achievement are hard to measure.
2. Is the positive impact practically convincing when associated with an instructional strategy? It is acknowledged that specific uses of AI tools can influence students' achievement when ICTs are used to enhance a teacher's thinking strategies.
3. AI tools prove to be less fruitful when the endpoints for their usage are not vibrant. While such an announcement would appear, apparently, self-evident, the unambiguous targets for ICT use in guidance are constantly, rather unclearly described.
4. Broadcast type pedagogics are seen as increasingly successful in the foundation for state authoritative testing, which tend to quantify the outcomes of such evident practices, are supplementary 'constructivist' in academic elegances, creating sophistications and complexities (Vincent, 2020).

RESEARCH METHODOLOGY

This study was quantitative in nature, and a survey method was employed; responses were collected on a five-point Likert scale. The research was based on two variables. The first one was the AI tools, which were an independent variable, while the second one, the hypothetical accomplishment of scholars, was a dependent variable (Gay, 2010).

Population of the Study

The population was selected from federal public sector general universities. There are sixteen universities in FCI, twelve of which are in the government sector, and the remaining four are private entities. Four universities fall within the general public sector, where both male and female learners study Education and History at the postgraduate level.

Sample of the Study

Consequently, 210 students out of the population of 460 (45% of the population) have been selected as a sample using proportionate random sampling (Gay, 2010).

Theoretical Framework

The Technology Acceptance Model (TAM) is the theoretical framework used in this study. This model, developed by Fred Davis in 1986, explains the factors that influence individuals' decisions to adopt or reject new technologies. The model posits that perceived usefulness and perceived ease of use are the key determinants of an individual's intention to use a technology, which, in turn, influences actual use. According to the TAM, perceived usefulness refers to the extent to which a technology is perceived to improve job performance, while perceived ease of use refers to the degree to which the technology is perceived to be easy to use. These

two factors, along with other external variables such as social influence, determine an individual's attitude toward using a technology, which ultimately influences their intention to use it. The TAM has been widely used and tested across various settings, including higher education. Previously, TAM has been applied in studies on the introduction of calculators into mathematics education and on computer integration in educational spaces. Drawing from the main tenets of TAM, it can be viewed as a helpful lens for addressing the introduction of artificial intelligence into educational spaces. Artificial intelligence, such as chatbots (ChatGPT, ChatSonic, etc.), requires testing in higher education; therefore, TAM provides a lens for interrogating the findings to a certain extent.

Chatbots are computer programs designed to simulate human conversation, and they can be used for a variety of purposes, including providing student support, answering questions, and offering personalized learning experiences. In the context of higher education, the TAM can be applied to understand students' acceptance of chatbots as a new technology. For example, students may perceive chatbots as applicable when they provide timely and accurate information, help with academic tasks, and offer personalized recommendations. On the other hand, students may perceive chatbots as challenging to use if they require a high level of technological expertise or are not user-friendly. In addition to perceived usefulness and ease of use, social influence can also play a role in students' acceptance of chatbots. For example, if students perceive that their peers or instructors are using chatbots, they may be more likely to adopt them. Overall, the TAM can provide a helpful framework for understanding and predicting students' acceptance of chatbots in higher education. By identifying the factors that influence students' attitudes and intentions toward using chatbots, educators can design more effective interventions to promote their adoption and enhance students' learning experiences.

Research Instruments

The questionnaire was formulated on a five-point (Likert) scale. The trustworthiness of the questionnaire was found satisfactory after the consultation of academic experts.

Table: *Determined Standards of Cronbach Alpha*

Scales	No. of Items	Alpha value
Checklist for AI tools	30	0.96
Examining Existing AI Tools	22	0.92
Use of AI tools and its impact on Scholars	22	0.94

Data Collection

The data was collected through various methods: individual visits, email, and contact with companions and associates. The questionnaire was handed over to two hundred and ten (210) students. Respondents were able to comprehend the items, as each was associated with the research procedures.

Data Analysis and Interpretation

Descriptive and inferential statistics were used to analyze the data. In descriptive measurement graphs, percentages, mean scores, and correlation coefficients (r) were used to assess numerical variation in the data. For the determination of inferential statistics, regression or chi-square was employed.

Data Analysis of Facilities to Check List

To assess the availability of basic facilities in the respective sampled universities' concerned departments, they were first classified and then quantified to verify learners' proficiency in the use of ICT tools. So, the checklist was formulated to verify the item-wise facilities to improve the research study. The item-wise data was further tabulated according to their relevance to the ICT lab.

Table: *Use of ICT skills in Microcomputer at Federal Public Sector Universities. (N=210)*

Statement	Description	VH	H	Avg.	L	VL
Usage of AI skills regarding computational tools	Frequency	167	38	05	00	00
	Percentage	79.5%	18.1%	2.4 %	0.0 %	0.0 %

Table 4.4 indicates that 79.5% have very high proficiency in using AI skills on computers, 18.1% have high proficiency, and only 2.4% have average proficiency.

Table: *AI skills regarding access to websites at Federal Public Universities. (N=210)*

Statement	Description	VH	H	Avg.	L	VL
Use of ICT instruments regarding access to websites	Frequency	26	169	15	00	00
	Percentage	12.4%	80.5%	7.1%	0.0 %	0.0 %

Table 4.12 shows that 12.4% have very high proficiency in using AI to access websites, whereas 80.5% have high proficiency, and 7.1% have average proficiency.

Data Analysis Related to Examining the AI Tools

The subsequent tables show the competency levels of postgraduate students in examining current ICT tools and their impact on academic achievement.

Table: *Cross tabulation between Formulas for tabulating data (N=210)*

		Result (CGPA)			Total	χ^2 - value	P-value
Statement	Level	3.00	2.00	1.00			
Developing, formulating, and using Arithmetic, Statistical Formulas and Functions on an Excel Sheet for tabulating and analyzing data*	5.00	59	17	00	76	23.049	0.003
	4.00	19	16	00	35		
	3.00	23	7	00	30		
	2.00	21	18	03	42		
Result (CGPA)	1.00	19	08	00	27		
Total		141	66	03	210		

Level of significance = $\alpha = 0.05$, $df = 8$

The table indicates that the χ^2 value is 23.049, with a P-value of 0.003 at 0.05 and $df=8$. So, the null hypothesis (H_0), "there is no significant impact of AI usage for tabulating and analyzing data in an Excel Sheet on students' academic achievement (CGPA)" was rejected.

Table: Cross tabulation among AI tools to for video/audio conferencing (N=210)

Statement	Level	Result (CGPA)			Total	χ^2 -value	P-value
		3.00	2.00	1.00			
Proficiency in the use of AI for operational usage of video and audio conferencing and online lectures*	5.00	55	27	00	82	24.221	0.002
	4.00	37	06	00	43		
	3.00	19	18	03	40		
	2.00	22	12	00	34		
	1.00	08	03	00	11		
Total		141	66	03	210		

Level of significance = $\alpha = 0.05$, $df = 8$

The table indicates that the Chi-square test was applied and that a significant relationship was found between the dependent and independent variables, with a χ^2 (Chi-Square) value of 24.221 and a corresponding p-value of 0.002 at the 0.05 level. Resultantly, the null hypothesis (H_0), "there is no significant impact of AI tools for effective usage of audio conferencing on students' academic achievement (CGPA)," is therefore rejected.

AI Usage and Its Impact on the Hypothetical Accomplishment of Scholars

The subsequent tables are as follows:

Table: Cross tabulation between ETV and Hypothetical Accomplishment (N=210)

Statement	Level	Result (CGPA)			Total	χ^2 - value	P-value
		3.00	2.00	1.00			
ETV promotes two-way communication, hence it covers a vast area of information for the best intellect of scholars *	5.00	47	23	00	70	36.172	0.000
	4.00	47	07	00	54		
	3.00	12	18	03	33		
	2.00	25	11	00	36		
	1.00	10	07	00	17		
Total		141	66	3	210		

The data indicate that the χ^2 -value is 36.172 with a p-value of 0.000, at the 0.05 level, and $df = 8$. Hence, the null hypothesis (H_0) is rejected, concluding that educational television has an impact on the hypothetical accomplishment of scholars at the university level.

RESULTS & DISCUSSION

The study was quantitative (descriptive/survey-based) in nature, with questionnaires consisting of seventy-two (72) items, arranged and applied to the sample, even though two open-ended questions (suggestions) were also included after the questionnaire. Now, in the third millennium, science and technological advancement have been used to achieve more positive results in daily life, for example, through "computer-based learning". These findings align with studies by Colliver (2019) and Roslan (2020), who report that the impact of

internet/web technologies on students' academic achievement was greater for declarative knowledge and for the unquestionable presentation. Reciprocal examination of mean problem-interpretation skill scores from the review technique revealed a distinction in critical-thinking proficiencies between the assemblies. Measurable investigation of the information on problem-solving abilities evaluations did not strengthen the null hypothesis that "There is no significant impact taking place by the usage of AI tools for providing remarkable outcomes and on the academic achievement of students at the post-graduate level"; therefore, the null hypothesis is rejected.

Based on the analysis of the data, the following findings emerged.

Findings related to objective I (checklist for AI tools)

By the analysis of data based on the checklist after survey and observation, the following subsequent findings emerged and materialized:

1. Majority (36%) of the learners were of the age cluster in the middle of >20-30 years, 34% between 31-40 years, 20% between 41-50 years, and 10% between 51- <60 years.
2. About two-thirds of students 69% were unemployed, whereas 31 % were employed.
3. Nearly four-fifths of the students, 79.5%, strongly agreed, 18.1% agreed, whereas the others showed average retention regarding the learning through the assistance of AI-based tools (Table 4.4)

Findings related to objective I, II (Examining the Existing AI Tools)

There is an association between students' academic achievement and the usage of AI for MS PowerPoint. Cross-tabulation was applied; χ^2 -test values were 26.706, 29.559, and 23.063, with subsequent p-values of 0.001, 0.00001, and 0.003 at a significance level of 0.05. So, the null hypothesis, "There is no significant impact in the use of AI tools for presentation (MS PPT) on academic achievement," was rejected.

Findings to objective II (use of AI and its impact on Academic Achievement)

An association was found between the usage of ETV for online tutorials and students' academic achievement. The chi-square test was used to cross-tabulate the dependent and independent variables, yielding $\chi^2 = 23.331$ with a p-value of 0.003 at $\alpha = 0.05$ and 8 degrees of freedom. So, the null hypothesis, "There is no significant impact of the use of AI tool for online tutorials as well as computer simulations on academic achievement of students," was rejected (Table 4.5).

CONCLUSIONS

Based on the statistical/numerical exploration of the data and the study's findings, the researcher draws these conclusions. Artificial Intelligence (AI) / web tools are more effective than conventional skills in the consistent academic achievement of students in universities. Artificial Intelligence (AI) tools are operative in a wide range of perspectives on students' academic achievement. Scholars have reported promising results from the use of web-based technology in tutoring. Artificial Intelligence (AI) tools are more accommodating in easing objective problem-solving abilities of learners as well as in the learning process, which is associated with the outcome strategy.

Recommendations

In light of the findings of existing studies and the drawn conclusions, the researcher may propose the following recommendations for development in Pakistan.

1. Consequences of the study show that the application of AI tools has been found more operational for the academic achievement of students at the postgraduate level. To brand its integration more associative in computational education at the grassroots level. For this reason, it is recommended that ICTs be introduced as an inclusive discipline in the curricula of Pakistan at the primary and elementary levels.
2. Results of the study found that Artificial Intelligence (AI) has been more effective for the academic achievement of learners at the university level. Because in public-sector institutions, more accommodations for the application of AI tools have been available, particularly at the postgraduate level. Therefore, it is recommended that the government assign the forthcoming financial plan for education to increase funding and enhance the effective use of these facilities, so that amenities for AI tools are increased in small cities and rural regions as well.
3. To stimulate AI tools in education at the post-graduate stage for students to become more familiar with their usage. Therefore, it is recommended that the libraries in educational institutions should be transformed into online libraries. It is because the learners from the underprivileged families do not have access to IT services at home.
4. Research centers for the alumni of educational institutes and post-graduate students might become famous with an ample number of PCs linked to the internet. Online tutoring might be used to address this problem, as replication and guided hands-on practice are very important at the graduate and postgraduate levels.

REFERENCES

- Aribamikan, C. A. (2017). Relevance of the information and communication technologies in the Teaching of Physical Education, Special Edition on ICT (*IKEJE 321-345*)
- Asiabeka, L. (2020). *Sustained blended professional development in the 21st century*. Retrieved from <http://etec.ctlt.ubc.ca>
- Barnett, R. (2021). *Improving higher education: Total quality care*. The Open University Press, 1900 Frost Rd., Suite 101, Bristol, PA 19007
- Clugston (2022). *ICT and Its Impact on Academic Achievement: Development, Application, Evaluation*. New Jersey: Education Technology Publications.
- Fletcher-Flinn, C. M., & Gravatt, B. (2021). The efficacy of computer-assisted instruction (CAI): A meta-analysis. *Journal of Educational Computing Research, 14(4), 219*
- Gay, L. (2010). *Educational Evaluation and Measurement*. (10th Edition). The New York: Macmillan Publishing.
- Hargittai, E. (2019). Weaving the western web: Explaining differences in internet connectivity among countries. *The Journal of the Tele communication policy. 23* (10/11) 701-718
- Macharia, J. K., & Pelsler, T. G. (2021). Key factors that influence the diffusion and infusion of information and communication technologies in Kenyan higher education. *Journal of Education and Technology, 39(4), 695-709*.
- National Education For educational technology (2019). *21st century students for a global society: An educator's guide to the "four Cs."* Washington, DC: Author. Retrieved from <http://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf>
- Ryann, K. E. (2023). Computer-based micro worlds: A bridge between constructivism and direct instruction. *Journal of Educational Technology Research and Development, Vol. (40), No. (1)*.
- Training Magazine. (2020). *Curriculum and evaluation standards for technological social interaction*. Reston, VA: NCTM.
- Vincent (2020): *Success stories for learning in the digital age*. San Francisco: Jossey-Bass.