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TECHNOLOGY-SUPPORTED TOOLS AS A CORRELATE OF SENIOR SECONDARY SCHOOL STUDENTS' COGNITIVE SKILLS IN RIVERS STATE

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Abstract

This paper examined technology-supported tools as a correlate of senior secondary school students' cognitive skills in Rivers State. Correlation research design was utilized for the study. Three research questions guided the study. The study population comprised 63,486 SS1 students in Rivers State. The sample size consisted of 400 SS1 students, selected through a simple random sampling technique. A self-designed instrument titled 'Technology-Supported Tool and Cognitive Skills' (TSTCS) was used for data collection. An expert in Measurement and Evaluation validated the instrument. The reliability of the instrument was established using Cronbach's Alpha for a measure of internal consistency, which yielded a reliability coefficient of 0.85. Pearson's Product-Moment Correlation was used to answer the research questions and test the null hypotheses at the 0.05 level of significance. The study's findings revealed a strong positive correlation between learning, training, communication, collaboration, coding, and programming tools, and the cognitive skills of senior secondary school students in Rivers State. Based on the findings, it was recommended that schools in Rivers State should adopt technology-supported adaptive learning platforms that cater to individual learning styles and paces. Schools should incorporate coding and programming courses that emphasise logical thinking, problem-solving and creativity.

Keywords: Technology-supported Tools, Learning/training Tools, communication/collaboration Tools, Coding/programming Tools, and Cognitive Skills.

Introduction

In the educational landscape, the integration of technology-supported tools has become a pivotal approach, hence it enhances students' learning outcomes and development of cognitive skills. The increasing emphasis on 21st century education standards highlight the necessity of integrating technology in teaching and learning processes to foster the development of these essential cognitive skills (Smith & Watson, 2020). Technology-supported tools in the education sector have transformed traditional learning environments, enabling more interactive, personalised and accessible learning experiences.

Technology-supported tools are digital devices or electronic resources that enhance teaching, learning, assessment, and skill development. These tools leverage technology to support educational processes, cognitive skill development, and the acquisition of non-cognitive skills, which have become indispensable in modern education, transforming how students learn and how teachers teach. It has also become significant in the educational landscape, particularly for enhancing cognitive skills among senior secondary school students. The integration of these digital tools into classrooms and study environments will enhance students' cognitive development, including critical thinking, problem-solving, and memory retention, among secondary school students. However, there are different types of technology-supported tools, but this work was limited to the following tools: learning/training, communication/collaboration, coding and programming tools

Learning and training tools are fundamental processes in human development, skill acquisition, and knowledge advancement, and they are essential across educational, professional and personal contexts. Learning refers to the process of acquiring new knowledge, skills, attitudes, or values, often as a result of experience, instruction, or study. It is an ongoing process that can occur in various settings, from formal education in schools and universities to informal, self-directed study and experience-based learning. Training, on the other hand, is a specific type of learning designed to develop or enhance specific skills or knowledge for a particular task, job, or activity. While training is often more structured and goal-oriented, learning can be broad and exploratory, encompassing a wide range of subjects and methods (Young & Evans, 2023).

Learning and training tools are also integral to personal growth and lifelong education, fostering adaptability, resilience and critical thinking. As individuals develop through these processes, they gain insights that enable them to handle new challenges, adapt to changes, and engage with diverse perspectives. In a rapidly changing world, where industries evolve and new technologies emerge, learning and training are vital for both individual and societal progress, bridging the gap between existing knowledge and emerging demands. The influence of learning and training, particularly technology-supported tools, has become increasingly significant in enhancing the cognitive skills of senior secondary school students. In Rivers State, where access to educational resources can be varied, technology-supported learning tools provide innovative avenues for skill acquisition and cognitive development. Moeller and Ninaus (2022) noted that the integration of digital learning tools such as interactive software, multimedia presentations and virtual simulations has the potential to enhance cognitive skills such as critical thinking, problem-solving, and memory retention tools to support active engagement, provide immediate feedback, and enable self-paced learning, all of which contribute positively to cognitive development.

The use of technology in learning fosters a student-centred environment where learners can independently explore and interact with content. This autonomy fosters a deeper understanding and retention of information, as students are more actively engaged

in the learning process than they would be in traditional lecture-based settings (Brown et al., 2021). Cognitive skills are also enhanced through the use of simulation-based learning, which allows students to practice skills in a risk-free, virtual environment, thus reinforcing knowledge through repeated, realistic applications (Nwankwo, 2023). However, Chukwu and Adewale (2022) found a strong positive correlation between learning/training technology-supported tools and the cognitive skills of senior school students. Ibe and Nwosu (2021) also revealed a strong positive correlation between learning/training tools and the cognitive skills of secondary school students. Crompton et al. (2020) found a positive relationship between learning and training tools and the cognitive skills of secondary school students.

Communication and collaboration tools are another technology-supported tool in education that plays a crucial role in shaping the cognitive skills of senior secondary school students. Technology has transformed the traditional classroom by enabling real-time interactions, collective problem-solving, and resource-sharing through tools such as educational apps, collaborative platforms (like Google Workspace and Microsoft Teams), and social learning networks. Technology-supported communication and collaboration tools help to engage students in cognitive tasks more interactively and dynamically. Through collaborative platforms, students can participate in discussions and provide peer feedback, fostering critical thinking and active engagement. The use of digital tools to share insights, debate viewpoints, and refine solutions encourages students to delve deeper into content, enhancing comprehension and analysis (Harper & Whitman, 2023). By utilising digital tools for collaborative learning, students practice skills such as critical thinking, problem-solving, and creativity. Group work on digital platforms challenges them to assess information, structure their arguments and analyse the perspectives of others. When students communicate and collaborate on tasks like simulations, they learn to apply theoretical knowledge to real-life scenarios, which strengthens their evaluative and analytical skills. Technology tools support varied communication channels such as text-based, audio, or video, which allows students to become more proficient in expressing their ideas across different formats. This flexibility in communication not only enhances verbal and written skills but also fosters an appreciation for clarity, brevity and effective articulation, all of which contribute to overall cognitive development (Kim & Park, 2023).

Collaborative digital tools provide students with opportunities to build social connections and learn from diverse perspectives, enhancing empathy, adaptability and teamwork. These social interactions contribute to social cognition, an essential component of cognitive skill development. Communication and collaboration in a technology-driven setting promote metacognitive skills, awareness and regulation of one's thought processes. As students participate in shared projects, they become more conscious of their learning strategies, assessing how well they understand the material and identifying areas for improvement. Technology platforms that allow students to track their progress and reflect on their learning outcomes (like digital portfolios and

collaborative mind mapping) support the growth of metacognitive abilities, which are crucial for lifelong learning (Ogunleye & James, 2020).

Collaborative digital tools help reinforce memory retention by encouraging repetition and active engagement with information. For instance, students might use collaborative flashcard applications, engage in group quizzes, or revisit notes and comments from classmates. This repeated exposure to material, combined with active discussions, enhances encoding and retrieval processes. Whenever students process information in various formats, the cognitive processing is further strengthened. Collaboration via technology provides an environment where students can brainstorm ideas, share creative solutions and constructively critique each other's work, encouraging innovative thinking. Digital tools like online whiteboards, video presentations and project-based platforms allow students to experiment and visualize concepts in novel ways, which fosters both individual creativity and collaborative innovation. The freedom to explore different modes of expression, combined with feedback from peers, fosters divergent thinking —a key cognitive skill essential for creative problem-solving. Furthermore, Nwachukwu (2021) found a strong correlation between communication, collaboration tools and cognitive skills among students. Oliver and Sharma (2023) revealed a positive relationship between communication, collaboration and cognitive skills of students, which is consistent with the present study.

Another important variable considered is the use of coding and programming tools. Coding and programming require students to approach problems systematically, breaking them down into smaller, manageable steps (decomposition) and applying logic to construct solutions. This process nurtures analytical thinking, as students need to recognize patterns, identify errors, and use logical structures (e.g., loops, conditionals) to solve problems. As students improve in these skills, they gain the ability to apply similar logical frameworks to complex, real-world problems. Programming is inherently problem-based, involving tasks that challenge students to find solutions to specific issues. Whether they are writing algorithms to automate a task or debugging a piece of code, students develop resilience and adaptability, key traits in cognitive growth. Coding encourages an iterative approach to problem-solving: students attempt a solution, test it, receive feedback (often through errors), and refine their approach. This cycle promotes cognitive flexibility, enabling students to think critically and view problems from multiple angles (Kalelioglu & Gülbahar, 2020).

Coding and programming tools require students to retain syntax, functions, and structures and to recall them as needed. This process enhances both working memory and long-term memory, as students repeatedly use and reinforce their knowledge of programming languages and coding concepts. The practice of holding information in mind while coding also exercises cognitive processing speed and efficiency, as students learn to think and respond quickly within the programming environment. Programming requires students to monitor and evaluate their thinking processes, which fosters metacognitive skills. When coding, students often need to plan, set goals and assess the effectiveness of their approach. This self-reflection and awareness enable students to

recognize when they need to try a new strategy, make adjustments, or seek additional resources, which are essential skills for independent learning and cognitive self-regulation. Coding involves a significant amount of trial and error, which teaches students the importance of persistence. This persistence in overcoming challenges can translate to better cognitive and emotional resilience in other areas of academic and personal life, reinforcing the idea that skills and intelligence can be developed through effort. Okoye and Adamu (2022) found a strong positive correlation between coding, programming tools and cognitive skills of senior secondary school students. Liu et al. (2022) also revealed a strong positive relationship between coding tools and the cognitive skills of senior secondary school

Furthermore, cognitive skills are foundational abilities that underpin students' capacity to process information, understand complex concepts, and make informed decisions, all of which are essential for academic success. Cognitive skills are mental processes that enable individuals to learn, remember and solve problems. For secondary school students, these skills are essential as they underpin academic performance, social interactions and future success. As students progress through secondary education, they encounter increasingly complex material, making the development and strengthening of these cognitive skills vital for academic achievement and overall intellectual growth. One key cognitive skill for secondary students is attention, which is crucial for maintaining focus on tasks and filtering out distractions. Sustained attention allows students to engage with lengthy assignments, listen attentively to instructions, and absorb new information presented in the classroom. Adequate attention is linked to academic success, as it enhances the ability to comprehend and retain material in subjects that require sustained focus, such as mathematics and science (Al-Harthy, 2023).

Statement of the Problem

In today's digital age, technology is no longer merely a supplementary tool but an integral part of the learning process that can foster critical cognitive skills. However, despite the rapid adoption of technology in education globally, many schools in Rivers State face challenges in effectively utilising technology-supported tools to improve students' cognitive abilities. The gap between the potential benefits of technology integration and the actual practices observed in classrooms raises questions about the efficacy of technology-supported tools in promoting cognitive skill development among senior secondary school students. Wordu and Wodi (2021) found that students in senior secondary schools in Rivers State utilise Information and Communication Technologies (ICT) infrastructure to a high extent, and it positively impacts their academic performance. This also suggests that ICT can enhance cognitive skills among students. Deebom and Zite (2020) assessed the technical skills acquired by students of technology education in Rivers State and found that students lacked adequate skills for employment generation. This indicates a gap in the effective integration of technology into the curriculum, which may limit the development of essential cognitive and practical skills. These divergent findings highlight the complexity of integrating technology in education

within Rivers State. Factors such as the availability of technological resources, the quality of implementation strategies, and the proficiency of educators play critical roles in determining the effectiveness of technology in enhancing students' cognitive skills. Therefore, this study aims to assess the effectiveness of technology-supported tools as a correlate of cognitive skills among senior secondary school students in Rivers State. By identifying the key factors that contribute to successful or limited outcomes, the research seeks to provide.

Purpose of the Study

1. Examine the relationship between learning/training tools and the cognitive skills of senior secondary school students in Rivers State.
2. Examine the relationship between communication/collaboration tools and the cognitive skills of senior secondary school students in Rivers State.
3. Examine the relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State

Research Questions

1. What is the relationship between learning/training tools and the cognitive skills of senior secondary school students in Rivers State?
2. What is the relationship between communication/collaboration tools and the cognitive skills of senior secondary school students in Rivers State?
3. What is the relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State?

Methodology

The study adopted a correlational research design. Chikwe (2020) noted that correlation research design helps to determine the extent or degree of relationship existing between two or more variables and uses such relationship in making future predictions. It seeks to determine the relationship between two variables, as well as the magnitude and direction of this relationship. The population of the study comprises 63,486 SS1 in Rivers State. The sample size consisted of 400 SS1 students. The stratified sampling technique was employed to select eight public senior secondary schools in Rivers State. The random sampling technique was then used to select 50 senior secondary school students from each of these schools, resulting in a total of 400 students in senior secondary school (SSS1) for the study. Self-designed instruments titled ‘’Technology-Supported Tools and Cognitive Skills’’ (TSTCS) was used for data collection. The instrument was validated by two experts in Measurement and evaluation from the Department of Educational Foundations at Rivers State University. The reliability of the instrument was established using Cronbach's Alpha for a measure of internal consistency, which yielded a reliability coefficient of 0.85. Pearson Product-Moment Correlation was used to answer research questions and test the null hypotheses at the 0.05 level of significance.

Results

Research Question One: What is the relationship between learning/training tools and the cognitive skills of senior secondary school students in Rivers State?

Hypothesis One: There is no significant relationship between learning/training tools and cognitive skills of senior secondary school students in Rivers State

Table 1: Pearson's Product-Moment Correlation of Learning/Training tools and Students' Cognitive Skills of senior secondary school students in Rivers State.

		Learning/Training	Cognitive Skill
Learning/Training	Pearson Correlation	1	.835**
	Sig. (2-tailed)		.000
	N	400	400
Cognitive Skill	Pearson Correlation	.835**	1
	Sig. (2-tailed)	.000	
	N	400	400

* Significant at 0.05 (2-tailed) *

Table 1 presents Pearson's product-moment correlation between learning/training tools and cognitive skills of senior secondary school students in Rivers State. The result revealed an r-value of .835 with its corresponding p-value of .000 < 0.05 level of significance. This indicates a strong positive relationship between learning and training tools and the cognitive skills of senior secondary school students in Rivers State. Again, since the p-value is less than the chosen level of significance, the null hypothesis is rejected. This therefore indicates a significant relationship between learning and training tools and the cognitive skills of senior secondary school students in Rivers State. This result also indicates that as the learning and training of students increase, there tends to be a corresponding increase in the cognitive skills of senior secondary school students in Rivers State.

Research Question Two: What is the relationship between communication/collaboration tools and the cognitive skills of senior secondary school students in Rivers State?

Hypothesis Two: There is no significant relationship between communication/collaboration tools and cognitive skills of senior secondary school students in Rivers State

Table 2: Pearson's Product-Moment Correlation of Communication/Collaboration tools and Students' Cognitive Skills of senior secondary school students in Rivers State.

		Communication /Collaboration	Cognitive Skill
Communication /Collaboration	Pearson Correlation	1	.820**
	Sig. (2-tailed)		.000
	N	400	400
Cognitive Skill	Pearson Correlation	.820**	1
	Sig. (2-tailed)	.000	
	N	400	400

* Significant at 0.05 (2-tailed) *

Table 2 presents Pearson's Product-Moment Correlation of communication/collaboration tools and cognitive skills of senior secondary school students in Rivers State. The result revealed an r-value of .820 with its corresponding p-value of .000 < 0.05 level of significance. This indicates a strong positive relationship between communication and collaboration tools and the cognitive skills of senior secondary school students in Rivers State. Again, since the p-value is less than the chosen level of significance, the null hypothesis is rejected. This therefore suggests a significant relationship between communication and collaboration tools and the cognitive skills of senior secondary school students in Rivers State. This result also indicates that as communication and collaboration among students increase, there tends to be a corresponding increase in the cognitive skills of senior secondary school students in Rivers State.

Research Question Three: What is the relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State?
Hypothesis Three: There is no significant relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State

Table 3: Pearson's Product-Moment Correlation of Coding/Programming tools and Students' Cognitive Skills of senior secondary school students in Rivers State.

		Coding/ Programming	Cognitive Skill
Coding/Programming	Pearson Correlation	1	.810**
	Sig. (2-tailed)		.000
	N	400	400
Cognitive Skill	Pearson Correlation	.810**	1
	Sig. (2-tailed)	.000	
	N	400	400

* Significant at 0.05 (2-tailed) *

Table 3 presents Pearson's Product-Moment Correlation of coding/programming tools and cognitive skills of senior secondary school students in Rivers State. The result revealed an r-value of .810 with its corresponding p-value of .000 < 0.05 level of

significance. This indicates a strong positive relationship between coding and programming tools and the cognitive skills of senior secondary school students in Rivers State. Again, since the p-value is less than the chosen level of significance, the null hypothesis is rejected. This therefore indicates a significant relationship between coding and programming tools and the cognitive skills of senior secondary school students in Rivers State. This result also indicates that as the coding and programming skills of students increase, there tends to be a corresponding increase in the cognitive skills of senior secondary school students in Rivers State.

Discussion of Findings

Table 1 shows a strong positive relationship between learning and training tools and the cognitive skills of senior secondary school students in Rivers State. The results of research question one showed that learning and training tools relate to the cognitive skills of senior secondary school students in Rivers State, while the results of the corresponding hypothesis indicated a significant positive relationship between learning and training tools and the cognitive skills of senior secondary school students in Rivers State. This result could be because learning and training programs expose students to consistent and systematic content delivery, which helps them retain information more effectively and deepen their understanding of complex concepts. The findings of the study are in agreement with those of Ibe and Nwosu (2021), who also found a strong positive correlation between learning/training tools and the cognitive skills of secondary school students. This result could likely be attributed to the fact that learning and training often involve tackling challenges or solving problems. These experiences help students strengthen cognitive skills, as they must analyse situations, hypothesise solutions, and apply logic and creativity. Crompton et al. (2020) found a positive relationship between learning and training tools and the cognitive skills of secondary school students. This result could be because interactive and supportive learning and training sessions can build students' confidence, motivating them to take on more challenging tasks. As students become more comfortable with their skills and knowledge, their cognitive capacity also expands. Confidence fosters cognitive resilience, enabling students to tackle complex problems with confidence.

Table 2 shows a strong positive relationship between communication and collaboration tools and the cognitive skills of senior secondary school students in Rivers State. The results of research question two showed that communication and collaboration tools relate to the cognitive skills of senior secondary school students in Rivers State, while the corresponding hypothesis indicated a significant positive relationship between communication and collaboration and the cognitive skills of senior secondary school students in Rivers State. This result could likely be since communication and collaboration tools often involve real-time discussions that challenge students to think critically, articulate their ideas, and solve problems together. This interactive problem-solving strengthens cognitive skills by requiring students to analyse information, evaluate multiple perspectives, and develop creative solutions.

This finding aligns with the study by Nwachukwu (2021), which found a strong correlation between communication, collaboration tools, and cognitive skills among students. This is probably because collaborative and communication tools expose students to varying perspectives and ways of thinking, encouraging them to consider alternative solutions and viewpoints. Oliver and Sharma (2023) also found a significant relationship between communication, collaboration tools and cognitive skills among students, which is consistent with the present study.

Table 3 showed a strong positive relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State. The results of research question three show that coding/programming is related to the cognitive skills of senior secondary school students in Rivers State. The corresponding hypothesis results indicate a significant positive relationship between coding/programming tools and the cognitive skills of senior secondary school students in Rivers State. This is probably because coding and programming require students to break down complex problems into smaller, manageable steps. This practice builds logical thinking and strengthens problem-solving skills, as students learn to identify patterns, construct algorithms, and debug errors. These skills are fundamental to cognitive development, helping students approach challenges methodically and develop critical thinking.

This study aligns with the findings of Okoye and Adamu (2022), who discovered a strong positive correlation between coding, programming tools, and cognitive skills in senior secondary school students. This result is likely since coding and programming promote cognitive flexibility, as students adapt to varying coding challenges and adjust their problem-solving approaches accordingly. Liu et al. (2022) supported that there is a strong positive relationship between coding tools and cognitive skills of senior secondary school students, which is consistent with the present study.

Conclusion

The study concludes that the integration of technology-supported tools, such as learning and training, communication and collaboration, and coding and programming tools, correlates with the cognitive skills of senior secondary school students in Rivers State. These technology-enhanced skills in the educational framework can significantly improve students' logical reasoning and independent learning, making them better prepared for future academic and professional challenges. The study also highlights the importance of integrating technology-supported skills, such as learning and training, communication and collaboration, and coding and programming tools, into the educational system to enhance the cognitive skills of students in Rivers State.

Recommendations

1. Schools in Rivers State should adopt technology-supported adaptive learning platforms that cater to individual learning styles and paces. Platforms that offer personalised assessments and feedback can help students build cognitive skills effectively by enabling them to focus on areas that need improvement. Regular

teacher-led training sessions on how to use these platforms would further enhance students' engagement and optimize the tools' benefits.

2. Schools should integrate collaborative platforms, such as discussion forums and shared digital workspaces, to promote group work and peer-to-peer learning. These tools enhance students' cognitive skills by encouraging them to communicate effectively, exchange ideas, and solve problems collectively, simulating real-world scenarios and preparing them for future collaborative work environments
3. Schools should incorporate coding and programming courses that emphasise logical thinking, problem-solving, and creativity. Using platforms that allow students to create projects and practice coding will improve their computational thinking and cognitive skills. To maximise the impact, coding classes should be aligned with students' core curriculum topics to illustrate practical applications and reinforce understanding across subjects.

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