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Influence of students' career interests on perceived difficult concept in computer studies in Ghanaian and Nigerian secondary schools

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There have been few studies on students' difficulty in the computer studies curriculum of African senior secondary schools. This study attempts to fill this gap by investigating the concepts students find difficult in the Ghanaian and Nigerian computer science curriculum and the influence of students' career interests on these perceived difficult concepts. The study is important to the extent that our understanding of "where the shirt tights" regarding topics difficulty will guide teachers, students, secondary schools' managers, and governments in applying applicable remediating measures. The study sought to establish (a) the concepts that students perceive to be difficult in the computer studies curriculum in Ghanaian and Nigerian schools and (b) if there is a statistically significant relationship between students' career interests and perceived concept difficulty in computer studies. Anchored on cognitive constructivism theory of Piaget, a quantitative method was employed with the sample ($N = 1776$). The study reports computer basics and evolution, programme development cycle, managing computer files, Developing problem-solving skills, computer ethics and human concerns, Networking, Logic circuits, Machine language, flowcharting, Algorithm and arithmetic logic unit as perceived difficult concepts. The study also found a negative statistically significant relationship between students' career interests and perceived concept difficulty in the Ghanaian and Nigerian computer studies curriculum. Various remediating measures have been preferred.

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Introduction

The importance of formal education to societal development cannot be overstated. Various international bodies have paid specific attention to improving education across multiple races and gender. For instance, the United Nations' Sustainable Development Goal 4 is dedicated to ensuring inclusive and equitable quality education and promoting lifelong learning opportunities for all (UNESCO, 2016). The African Union also plans to improve education as part of its Agenda 2063 goals, further buttressing the importance of education. In recent times, various studies have attempted unveiling the causal factors to learning difficulties in Africa in a bid to improve the continent's educational system (see Okebukola, 2020; Awaah, Okebukola, Shabani, Raheem, Ahove, Onowugbeda & Agbanimu, 2021).

While these studies have been conducted, the drift to ICT education is increasingly becoming particularly important. Information and communication technologies (ICT) are often perceived as increasing learning in both classrooms and families, with this optimism fuelling their fast proliferation and adoption throughout developed societies (Livingstone, 2012). Over the past decades, the world has experienced unprecedented growth and expansion in information and communication technology, leading to various improvements in business, education, health, among other facets of human life. Several activities that require immense human resources have now been taken over by technology, with artificial intelligence breaking the limits of what was previously thought possible. Almost every single career now is intertwined with technology. Our increasing reliance on these information and communication technologies means understanding what they are, how they operate, how to improve them and how to use them to facilitate improvements in the human standard of living is very important. For Africa to keep up with the world's development, it is imperative to train Africa's human resources in line with modern technological requirements.

ICT education still has a long way to go to meet the increasing demand for technologically savvy human resources. Livingstone (2012) asserts that schools took longer to adapt lesson plans than install computers in the classroom. This assertion is particularly true in the African scene. One reason Livingstone (2012) posited was that convincing evidence of improved learning outcomes remains surprisingly elusive. Since then, various studies have been conducted to this effect (see Lockman et al., 2017; Awaah et al., 2021). However, multiple gaps remain in the literature. This study aims to fill one such opening, focusing on the Influence of Students' Career Interests on Perceived Difficult Concept in Computer Studies among Ghanaian and Nigerian Secondary Schools.

It is crucial to determine "difficulty" in studying a concept, topic, or subject to provide proper context for this study. Some authors have attempted to define the term "difficulty". According to Michael (2007), something is difficult when demanding a disproportionate amount of work to attain its objective. By this definition, we can extrapolate that difficult concept require excessive work on either students' or teachers' part for students to understand. The difficulty of a subject or concept is determined by the average student's capacity to comprehend it (Awaah et al., 2020). According to Buah and Akuffo (2017), some of the problems that made some topics challenging were a lack of practical instruction and a curricular overload. They further asserted that many students find topics difficult or difficult to learn due to various issues, including fear, indifference, and other erroneous perceptions.

The rationale for the study

Despite the growth in the literature on students' difficulties, studies relative to the African region and its students remains relatively sparse. This scarcity is particularly witnessed in studies concerning students' career interests. This scarcity precludes university managers from implementing policies that enhance students' understanding. Therefore, this study is conducted to investigate the effect of students' career interests on their perception of difficult concepts in the Ghanaian and Nigerian computer studies curriculum. The study is further necessitated by the work of (Okebukola et al., 2020) that, there are a teacher capacity deficit for delivering online education, poor internet service, an erratic power supply, and severe inadequacies in infrastructure for open and distance education in the two countries. Similar claims are made by Okebukola et al. (2020).

Exploring the topic of difficulties in Africa seems overly researched from a single country perspective. This makes it difficult to establish whether perceived concept difficulties are limited to one country or generalised to others. This direction of our study departs from the single country perspective, giving it a broader generalisability, making it original and different from previous studies. The research niche of this study is discovering difficulties that students studying computer science face within Ghana and Nigerian secondary schools. In a bid to fill this gap, the study sought to establish (a) the concepts that students perceive to be difficult in the computer studies curriculum in Ghanaian and Nigerian schools (b) if there is a statistically significant relationship between future career interest and perceived concept difficulty in the study of computer studies in Ghanaian and Nigerian secondary schools.

The questions which the study sought answers to were:

(a) What concepts do students perceive to be difficult in the computer studies curriculum in Ghanaian and Nigerian secondary schools?
(b) Is there a statistically significant relationship between future career interest and perceived concept difficulty in studying computer studies in Ghanaian and Nigerian secondary schools?

Theoretical underpinnings

The cognitive constructivism theory of Piaget is appropriate for this research. Piaget's cognitive constructivist theory, first proposed in 1973, posits that children go through four phases in their development. These stages are thought to reflect changes in children's cognitive abilities. He highlighted the need for a holistic approach to learning, in which a child builds understanding through investigating and experiencing their surroundings. Piaget's theory was later refined in 1985 to describe how new information is shaped to fit with a learner's existing knowledge and how existing knowledge is transformed to accommodate further information. These activities centred around three concepts, assimilation, accommodation and equilibration.

Assimilation occurs when a learner perceives new objects or events in terms of existing schedules or operations; accommodation occurs when an existing scheme or operation is modified to account for a new experience; and equilibration, which encompasses both assimilation and accommodation, is the primary developmental process. Piaget's theory focuses on the country (environment) as a variable, based on his assumption that a child builds understanding through exploring and experiencing their surroundings.

This theory has been found appropriate for this study as it discusses the influence of students' environments on their understanding. For this study, the students' environment is defined as the physical, psychological, and social aspects that affect their well-being and general academic life. Various studies have studied the influence of students' environment on their understanding of multiple concepts under various jurisdictions (see Awaah et al., 2020; Prescott et al., 2013). Awaah et al. (2020)

studied the influence of students' gender and career interests on students perceived difficult concepts in the public administration curriculum. Prescott et al. (2013) also considered the effect of a relatively new entrant into the student environment, Facebook. This study considers two other aspects of the students' environment, their teachers' qualifications and students' career interests.

Related literature: students' perceived difficulties

Various studies have been conducted on students' perceived difficulties in various disciplines and jurisdictions (see Awaah et al., 2021; Torppa et al., 2020). Some of these studies are used to provide empirical backing to this study. Qian and Lehman (2017) conducted a literature study on broad definitions of misconceptions and research on students' misunderstandings and other challenges in beginning programming. They dug deeper into the components that led to the problems. According to their research, students had numerous misconceptions and other syntactic, conceptual, and strategic knowledge issues. Students' challenges are caused by various reasons, including foreign syntax, natural language, math expertise, faulty mental models, a lack of methods, programming environments, and the knowledge and training of teachers. Many origins of students' challenges, on the other hand, are linked to their past knowledge. Grover and Basu (2017) also discovered that students are often unaware of the usage of variables and have misunderstandings about them. Other parts of beginning programming that they struggle with include how loops function and Boolean operators work. These findings highlight the need for a pedagogy that blends popular constructionist activities with those that focus on conceptual learning and enhanced professional development to help instructors understand these core ideas conceptually.

Students' career interests and perceived difficulties

Even though scant literature exists on the relationships between future career interest on student difficulty in computer studies, various studies have been conducted regarding these variables and students' understanding.

Students' career interests have been shown to impact their understanding directly. In determining the influence of gender and career interests on African university students perceived difficulties in the study of Public Administration, Awaah et al. (2020) established that students interested in pursuing a career in public administration were more likely to grasp the principles presented than students who had no interest in pursuing a career in public administration. Negru-Subtirica and Pop (2016) had similar findings. Negru-Subtirica and Pop (2016) looked at the long-term relationships between job flexibility and adolescent academic success. They highlighted that teenager spend more time in school and lifelong career development. As a result, teenagers typically began focusing on their professions long before working. Negru-Subtirica and Pop (2016) demonstrated that adolescents with a clear future focus already involved in job preparation practices did well in school and vice versa. Strong academic achievement reinforced adolescents' optimistic views about their future profession. Oliveira et al. (2017) found comparable results after looking at Portuguese youngsters' job preparedness and school accomplishment, with a special focus on longitudinal trend articulations.

After computing different statistical measures and procedures, the Oliveira et al. (2017) study revealed a favourable and statistically significant relationship between career exploratory outcome expectations and academic success average trends. Educational achievement quadratic trends were inversely connected with career planning and self-efficacy expectations. Matsum (2018) also found that students' interests statistically impacted their economic accomplishment at Sman 1 Sambas. Similarly, in the case of big, general education classes, Kalaf-Hughes (2019) stated that student participation with course material may be based on their interest in the subject area.

Further, Hazari et al. (2017) discovered that students who experience a quorum of peers' interest in high school biology, chemistry, and physics classes are more likely to pick STEM (science, technology, engineering, and mathematics) related career ambitions and course performance. They, however, discovered that interest quorums had lesser beneficial benefits on course performance in various circumstances, with no negative consequences across the board.

Methodology

A quantitative research design was adopted to collect data for this study. In doing so, the difficult concept in the computer studies questionnaire (DCCSQ) was designed and administered.

Participants

Two West African countries, Ghana and Nigeria, were selected for the study. This was based on certain considerations. Both countries are anglophones hence comparable in terms of language to investigate the primary goal of the study—topics/concepts that students find difficult to learn. It would have been a limitation if the countries selected did not use the same language to deliver their computer science syllabus. Also, both countries share very similar curriculum based on the West African Senior School Certificate Examination (WASSCE) administered by the West African Examination Council (WAEC). This allowed for the generation of a large enough sample frame to enable the researchers to generalise the study's findings. This reduced the possibility of committing a type 1 error.

The participants in this study were 1776 students from secondary schools in Ghana and Nigeria, from an initial administration of 2000 questionnaires. The secondary schools were selected on one criterion; that they have taught the subject for 7 years. All the schools met the criterion.

Instrumentation and data collection

The difficult concept in computer studies questionnaire (DCCSQ) was used to collect quantitative data for the study. It had five sections. The respondents' demographic data was provided in Section A of the questionnaire, which consisted of nine items (respondents' names were not collected to ensure anonymity). Section B had 18 selected topics drawn from all secondary schools in Ghana and Nigeria based on the WAEC syllabus. The section had a three-point rating scale of very difficult, moderately difficult, and not difficult. Since the research was not interested in easy concepts, "not very difficult" was not stated on the Likert scale.

Further, since indifferent participants would not aid the researchers in detecting challenging concepts in computer studies, "neutral" was also not included on the Likert scale. Based on its previous use in relevant investigations, this 3-point Likert scale was judged to be acceptable for our study (see Awaah et al., 2020). Etobro and Fabinu (2017) used a 4-point Likert scale to investigate students' perceptions of difficult concepts in biology in senior secondary schools in Lagos State; however, due to the cumbersome nature of that scale in assessing difficulty, they collapsed very difficult and difficult into the difficult category, and averagely difficult and not difficult into the not difficult category for ease of interpretation. The researchers also collapsed moderately difficult and very difficult into one category whilst analysing and presenting the data.

Apart from the earlier works' use of 3-point Likert scales, researchers have also demonstrated that 3-point Likert scales are enough for investigations, depending on the purpose of such

studies. For example, Matell and Jacoby (1971) suggest that because the reliability and validity vectors appear independent of the rating format, it may be advantageous to allow a subject to choose the rating format that best matches his needs. In a study of preference utilising rating scales with 2, 3, 5, 7, and 9 categories, Bendig (1954) discovered that rater dependability remained consistent from five to nine groupings but was significantly lower at two and slightly higher at three. This influenced our decision to utilise a three-point Likert scale.

Section C sought to know from the respondents the factors influencing their perception of the difficulty of the topics. This section had a listing of reasons for the challenges, derived from a pilot study and placed on a four-point rating scale of: strongly agree (SA), Agree (A), disagree (D), and strongly disagree (SD). Section E sought students' suggestions for improvement in studying computer studies. Because the researchers were not interested in impartial answers, a 4-point scale was used again. The 4-point scale employed in this investigation was considered suitable and has been utilised in other studies (see, Awaah et al., 2021). In addition, according to Garland (1991), Likert scales lacking the neutral component aid research in various ways. He claims that eliminating the mid-point ('neither… nor,' uncertain, etc.) category from Likert scales can reduce social desirability bias, which arises from respondents' desires to please the interviewer, appear helpful, or not be seen as giving what they perceive to be a socially unacceptable answer.

DCCSQ was validated by 13 experts in computer studies and education management. Upon endorsement of validity, the test-retest reliability coefficient of the instrument after two weeks of administration among Action senior high school showed an acceptable coefficient (0.79).

Procedure

The participants were granted anonymity, and they were told the result of the questionnaires would not influence their annual appraisal form in any way. They were also informed that the study's primary goal was to help improve the school's assessment practices and, consequently, enhance teaching and learning quality. After seeking permission from school authorities to conduct the study (secondary school management in some cases and teachers in others), the research team ensured a friendly atmosphere wherein the respondents felt relaxed and ready to participate (this was achieved with the help of the school principals and teachers). The information that was not readily available to the respondents (such as teacher's qualification and student's career choice) was provided generally. The last stage of the quantitative data-gathering exercise was to ensure that all participants signed the attestation report on the questionnaire, which conveyed liberty of participation and readiness to do so under the authority of the school.

Ethical considerations

Participation in the study was completely voluntary, and there was no danger to the participants. Specific ethical concerns were applied to the current investigation. Before the questionnaires were given out, the school's management or the subject teachers sought the secondary school's consent. Both steps were designed to reassure participants and school officials that their participation in the study was entirely voluntary. They might leave at any time and for any reason. Participants were also made aware of the study's goals and were told that their replies would be kept confidential and utilised exclusively for research reasons. Apart from the afore stated, respondents were neither physically nor mentally injured or maltreated throughout the research.

Table 1 Level of difficulty in the study of computer studies in African secondary schools.

Variable	Not difficult		Moderately difficult		Very difficult	
	n	%	*n*	%	*n*	%
Computer fundamentals and evolution	461	39.2	483	41.1	232	19.7
Components of a computer system	851	72.4	234	19.9	91	7.7
Programme development cycle	345	29.3	538	45.7	293	24.9
Basic computer operations	710	60.4	350	29.8	116	9.9
Computer applications	685	58.2	337	28.7	154	13.1
Managing computer files	518	44.0	460	39.1	198	16.8
Developing problem solving skills	355	30.2	460	39.1	361	30.7
Computer ethics and human issues	446	37.9	475	40.4	255	21.7
Networking	511	43.5	380	32.3	285	24.2
Logic circuit	458	38.9	407	34.6	311	26.4
Machine language	410	34.9	455	38.7	311	26.4
Flowcharting	280	23.8	474	40.3	422	35.9
Algorithm	301	25.6	479	40.7	396	33.7
Basic programming	727	61.8	274	23.3	175	14.9
Operating system	770	65.5	289	24.6	117	9.9
Telecommunication	702	59.7	321	27.3	153	13.0
Arithmetic logic unit	537	45.7	415	35.3	224	19.0
Binary numbers	791	67.3	230	19.6	155	13.2

$N = 1176$.

Data analysis and findings

After a preliminary raw analysis of the three-point scale of not difficult, moderately difficult, and extremely difficult, IBM-SPSS Version 23 was used to evaluate the data obtained by the questionnaires. Not difficult was given a score of 1, moderately difficult was given a score of 2, and very difficult was given a value of 3 throughout the data coding procedure. After that, a difficulty score ranging from 1 to 3 was assigned to each respondent.

Table 1 shows students' perceptions regarding the difficulty level of 18 topics in the Ghanaian and Nigerian computer science curriculum. Regarding computer basics and evolution, 60.8% thought it quite difficult, while 72.4% thought computer system components were fairly easy to understand. 70.6% of respondents thought the programme development cycle was somewhat difficult, but 60.4% thought basic computer functions were not difficult. With computer applications, 58.2% reported it was not difficult, whilst managing computer files was rated as fairly difficult by 55.9% of respondents. "Developing problem-solving skills" was rated fairly difficult by 69.8% of respondents, whilst 62.1% thought computer ethics and human concerns were difficult.

Networking was rated as fairly difficult by 56.5% of respondents, just as Logic circuits were deemed fairly difficult by 61% of respondents. Machine language was considered rather difficult by 65.1% of respondents, while 76.2% thought flowcharting was difficult. "Algorithm" was rated as difficult by 74.4% of respondents, with 61.8% of those polled thinking that Basic programming was not difficult. Regarding operating systems, 65.5% stated it was not difficult, whilst 59.7% thought telecommunication was not difficult. Finally, 54.3% thought the arithmetic logic unit was difficult, whilst 67.3% thought binary number was not difficult (see Table 1).

Research objective two addresses the statistically significant relationship between career interest and perceived concept difficulty in computer studies in African senior secondary schools (see Table 2).

Table 2 Pearson correlation on the relationship between students' career interests and perceived concept difficulty in the study of computer science in Ghanaian and Nigerian Secondary schools.

		Total difficulty scores	Students' career interests
Total difficult scores	Pearson correlation	1	−0.238**
	Sig. (2-tailed)		0.000
	N	1176	1176
Students' career interests	Pearson Correlation	−0.238**	1
	Sig. (2-tailed)	0.000	
	N	1176	1176

**Correlation is significant at the 0.05 level (2-tailed).

Table 2 found a significant relationship between students' career interests and perceived concept difficulty at *p*-value 0.000 given the significance level of $p < 0.05$. The correlation coefficient of −0.238 shows that the strength of the relationship is slight or weak. The correlation coefficient further indicated a negative relationship between students' career interests and perceived concept difficulty. This finding implies that as a students' interests in an ICT related career increased, their perceived difficult of concepts decreased.

Discussion of results

Research question 1. The study investigated concepts students perceived difficult in the Ghanaian and Nigerian computer science curriculum. The study found computer basics and evolution, programme development cycle, managing computer files, Developing problem-solving skills, computer ethics and human concerns, Networking, Logic circuits, Machine language, flowcharting, Algorithm and arithmetic logic unit as perceived difficult concepts amongst students.

These perceived difficulties may result from the impractical nature of these concepts as most African secondary schools are not equipped with the right tools and teachers with the required qualification for effective teaching and learning. The absence of these tools and skills makes the concepts look overly abstract and complex resulting in students' misconceptions of difficulty. This assertion is reflective in the findings of Qian and Lehman (2017). Qian and Lehman (2017) found that students exhibited various misunderstandings and other syntactic, conceptual, and strategic knowledge issues. They attributed these difficulties to the unfamiliarity of syntax, natural language, math knowledge, inaccurate mental models, lack of strategies, programming environments, and teachers' knowledge and instruction. Grover and Basu (2017) also support this assertion. Their research showed that students are often unaware of variables and misunderstand them.

Research question 2. The second research question sought to establish the relationship between students' career interests and perceived concept difficulty at a *P*-value of 0.000 given the significance level of $P < 0.05$. The correlation coefficient of 0.238 showed that the strength of the relationship is weak. The correlation coefficient further indicated a negative relationship between students' career interests and perceived concept difficulty. This finding implies that as a students' interests in an ICT related career increased, their perceived difficult of concepts decreased.

Our finding is consistent with previous studies. According to Hanna et al. (2016), studying science at school, willingness to improve people's health, and desire to serve in healthcare were the most common reasons for choosing the pharmacy profession. Similarly, in a study conducted in Pakistan, working in the pharmaceutical industry field was the highest preferred career choice followed by clinical and hospital pharmacy, which was in line with the finding of this study.

Our findings and supporting literature are testament that future career choice influences student understanding in computer studies education. Arguably, a student who has a future career interest in computer studies will take keen attention and work extra hard to excel in the subject to fulfil future career ambition. These findings are further reflected in the work of Awaah et al. (2020). While the work of (Awaah et al., 2020) was in public administration, similar findings were reported in Portugal (Oliveira et al., 2017)

Negru-Subtirica and Pop (2016) highlighted that teenager spend more time in school and lifelong career development resulting in teenagers focusing on their professions long before working. As such, they were more likely to understand concepts that fell in line with the career path they had chosen. This improved achievement which reinforced their optimistic views about their future profession. Matsum (2018) also found that students' interests statistically impacted their economic accomplishment. Similarly, in the case of big, general education classes, Kalaf-Hughes (2019) stated that student participation with course material may be based on their interest in the subject area.

Further, Hazari et al. (2017) also found that students who experience a quorum of peers' interest in high school biology, chemistry, and physics classes are more likely to pick STEM (science, technology, engineering, and mathematics) related career ambitions and course performance.

Conclusion

Using 1776 secondary school students from Ghana and Nigeria, this quantitative survey investigated the topics in the computer studies curriculum that students perceived as difficult and the relationship between students' career interests and the perceived difficulty. The study found that students perceived computer basics and evolution, programme development cycle, managing computer files, developing problem-solving skills, computer ethics and human concerns, networking, logic circuits, machine language, flowcharting, algorithm and arithmetic logic unit as difficult concepts. Further, a statistically significant relationship was found between students' career interests and the perceived concept difficulty. The following suggestions are implicit in this study; diverse factors affect student understanding of different concepts in computer studies. This necessitates teachers of computer studies to figure out such factors to enhance teaching and learning. Students' environment is a key pointer for their understanding of concepts. Computer studies teachers should ensure teaching methods are in sync with student environs to foster understanding of concepts in computer studies. Various stakeholders such as the government, parents and teachers should promote students' interests in computer studies to improve students' understanding.

Other studies should focus on other parts of the students' environment and how they affect their perceived concept

difficulties. Other studies should also focus on determining the actual concepts that students find difficult and not only what they perceived to be difficult.

Data availability

The data supporting the study's findings are available upon request from the corresponding author (OGA).

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References

Awaah F, Arkorful H, Foli J, Darteh DO, Yeboah S (2021) Previous knowledge and difficulties in the study of public administration among undergraduates in African universities. SN Soc Sci 1(4):1–22.
Awaah F, Okebukola PA, Ebisin A, Agbanimu D, Peter EO, Ajayi OA, Lawal R (2020) Influence of gender and career interest on African university students perceived difficult concepts in the study of public administration. Teach Public Adm 39(2):227–245.
Awaah F, Okebukola P, Alfa AA, Anagba K, Arkorful H (2021) Developing public administration education by focusing on difficult key concepts: the case of Nigeria and Ghana. Soc Sci Humanit Open 4(1):100136.
Awaah F, Okebukola P, Shabani J, Raheem K, Ahove M, Onowugbeda F, Agbanimu D (2021) Will cultural teaching methods influence student understanding of politics and bureaucracy in the public administration curriculum of African countries within the COVID-19? Teach Public Adm 01447394211058167.
Bendig AW (1954) Reliability and the number of rating-scale categories. J Appl Psychol 38(1):38.
Buah E, Akuffo AF (2017) The science topics perceived difficult by junior high school students at Techiman north district: effects on the teaching and learning of science. Imperial J Interdiscipl Res 3(1):503–509.
Etobro AB, Fabinu OE (2017) Students' perceptions of difficult concepts in biology in senior secondary schools in Lagos State Global J Educ Res 16(2):139–147.
Garland R (1991) The mid-point on a rating scale: is it desirable. Mark Bull 2(1):66–70.
Grover S, Basu S (2017) Measuring student learning in introductory block-based programming: examining misconceptions of loops, variables, and Boolean logic. In: Proceedings of the 2017 ACM SIGCSE technical symposium on computer science education. pp. 267–272.
Hanna LA, Askin F, Hall M (2016) First-year pharmacy students' views on their chosen professional career. Am J Pharm Educ 80(9):9.
Hazari Z, Potvin G, Cribbs JD, Godwin A, Scott TD, Klotz L (2017) Interest in STEM is contagious for students in biology, chemistry, and physics classes. Sci Adv 3(8):e1700046.
Matell M. S, Jacoby J (1971) Is there an optimal number of alternatives for Likert scale items? Study I: Reliability and validity. Educational and psychological measurement 31(3):657–674.
Kalaf-Hughes N (2019) Reaching students with low interest: subject matter interest and perceptions of open educational resources in an introductory American Government Course. J Political Sci Educ 28:1–27.
Kalimullin AM (2014) Improvement of teachers' qualification at Kazan Federal University. World Appl Sci J 30(4):447–450.
Livingstone S (2012) Critical reflections on the benefits of ICT in education. Oxford Rev Educ 38(1):9–24.
Lockman K, Haines ST, McPherson ML (2017) Improved learning outcomes after flipping a therapeutics module: results of a controlled trial. Acad Med 92(12):1786–1793.
Matsum J (2018) Learning outcomes viewed from a learning process through an ICT-Based Learning Group. In: International Conference on Teacher Training and Education 2018 (ICTTE 2018). Atlantis Press, pp. 230–232.
Michael J (2007) What makes physiology hard for students to learn? Results of a faculty survey. Adv Physiol Educ 31(1):34–40.
Negru-Subtirica O, Pop EI (2016) Longitudinal links between career adaptability and academic achievement in adolescence. J Vocat Behav 93:163–170.
Okebukola PA, Oladejo A, Onowugbeda F, Awaah F, Ademola I, Odekeye T, Ajayi OA (2020) Investigating chemical safety awareness and practices in Nigerian Schools. J Chem Educ 98(1):105–112.
Okebukola PA, Suwadu B, Oladejo A, Nyandwi R, Ademola I, Okorie H, Awaah F (2020) Delivering high school chemistry during COVID-19 lockdown: voices from Africa. J Chem Educ 97(9):3285–3289.
Okebukola PA (2020) Breaking barriers to learning: the culture-techno-contextual approach (CTCA). Sterling Publishers, Slough, UK and Delhi, India.
Oliveira ÍM, Taveira MDC, Porfeli EJ (2017) Career preparedness and school achievement of Portuguese children: longitudinal trend articulations. Front Psychol 8:618.
Prescott J, Wilson S, Becket G (2013) Facebook use in the learning environment: do students want this? Learn Media Technol 38(3):345–350.
Qian Y, Lehman J (2017) Students' misconceptions and other difficulties in introductory programming: a literature review. ACM Trans Comput Educ (TOCE) 18(1):124.
Torppa M, Vasalampi K, Eklund K, Sulkunen S, Niemi P (2020) Reading comprehension difficulty is often distinct from difficulty in reading fluency and accompanied with problems in motivation and school well-being. Educ Psychol 40(1):62–81.
UNESCO (2016) Sustainable Development Goal 4 (SDG 4) https://sdg4education2030.org/the-goal.

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Competing interests

The authors declare no competing interests.

Ethical approval

The survey questionnaire and method were reviewed the authors' university, education districts and school authorities, which determined that the study met the standards for exempt status.

Informed consent

The participant was guided on a consent form that was distributed to all the students before the commencement of the study. Before this step prior consent and approval was given by school authorities and the department of science and technology education of the Lagos State university, Ojo, Lagos, Nigeria. Thereafter, informed consent was filled by each participant prior to reading the survey instrument.

Additional information

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