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Research article

Career choice for ICT among Liberian students: A multi-criteria decision-making study using analytical hierarchy process

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ABSTRACT

Information and communication technology graduates are among the highly skilled, paid, and perceived as capable and credible professionals worldwide. This has resonated in significant growth in the number of students pursuing careers in ICT at various African institutions. These developments illustrate the importance of conducting research that will provide insights into specific influencing factors that may be associated with students' choices of careers in ICT. Such a study is particularly essential for Liberia, which is experiencing a boost in ICT-related investments. This study considers 182 Liberian students' career choices for ICT as a multi-criteria decision-making problem. The Analytical Hierarchy Process is employed to empirically study the relative significance of factors that affect students' choice of ICT. Three main themes and twelve sub-themes influencing students' career choices were identified. Pairwise comparisons revealed that even though family factors play crucial roles in influencing students' career choices, overall analysis shows that students attach great importance to extrinsic factors such as financial remuneration when making ICT career choices. Students were also reported as giving high priorities to job security and access to jobs while giving lesser importance to the prestige attached to ICT careers. The findings are highly significant to the career choice literature because they provide practical implications that may be used by organizations and entities offering IT employment and colleges enrolling IT students.

1. Introduction

Information and communications technologies (ICTs) are an integral aspect of technology development and maintenance for modern civilization, continuously dependent on the ever-changing technologies on which it is built. The ICT sector encompasses various technology-related activities vital for product development, commercial services, content design, and technical support services. The ICT industry is essential in achieving sustainable development—ICT jobs have an enormously positive social and economic impact on society, particularly in African countries. It is predicted that the technical (ICT) skills required for the digital economy will continue to rise as science, technology, engineering, and mathematics (STEM) workers remain essential components of innovation and success.

The ICT industry in Africa has seen unprecedented growth in recent years. According to several studies, the industry is increasingly

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becoming one of the most critical drivers of overall economic development in many countries across the continent, with an estimated $50 billion in annual ICT revenues. For instance, the South African ICT industry generated over $24 billion and contributed more than 7% to the country's gross domestic product (GDP) in 2009 [1]. Tunisia's ICT industry contributed 10% to the country's GDP in the same year, while it accounted for 20% of Tanzania's GDP in the same year [1].

Since the early 2000s, there has been significant growth in the number of students studying ICT at various African institutions. Governments, universities, and drivers of the ICT industry on the continent have been working together to improve the visibility and attractions of the ICT sector by enticing students to pursue ICT degrees. These initiatives include mentoring programs for high school and university students and designing strategies and activities to promote a positive image of the industry. Current estimates show that most ICT workers have either earned their degrees from a university or vocational education and training institutions in Africa. Many important factors fuel the growth and supply of skilled ICT employees on the continent, including graduate-level job prospects, a well-defined career roadmap to guide career aspirations, and an employer-friendly environment that promotes employability [2–4].

A combination of societal expectations and structural variables contributes to the attraction to the development and retention of ICT jobs [5]. These variables, coupled with many different socio-cultural factors, including perceptions about ICT adoption and its work requirements, also influence Africans' desire to study or pursue careers in ICT. For instance, access to online learning platforms, particularly mobile, for lifelong learning opportunities, expanding access to libraries' resources, enhancing regional and international knowledge sharing, teaching ICT skills for employment, and connecting to the African diaspora worldwide are some innovative delivery options offered by the ICT industry across the continent [6]. Despite these benefits for developing and expanding the ICT sector in Africa, career and study decisions are driven by personal interests, including economic and social benefits and individual belief systems acquired through specific educational or career experiences. A range of factors influences these factors, such as the expected salary, the work-life balance, and the career prospects that aspirants anticipate relishing from employment in the ICT industry [3,6]. However, these factors are under-examined in African countries compared to developed nations. The case is even worse for smaller countries like Liberia, where studies on career choice and information invisibility are far grimmer. The lack of research on career choices for the ICT profession is a phenomenon evident across the country in organizations such as banks, the Ministry of Post and Telecommunication, the Liberia Telecom Authority, and other ministerial sectors and agencies (e.g., education, health, finance, economy), research and academic institutions (e.g., university consortium), civil society organizations (e.g., consumer protection, gender advocates, ICT4D organizations) and other private sectors that create jobs for middle-class workers [7]. Expanding these service-related sectors is a substantial economic development following the end of the civil unrest in the nation. Even though agriculture is still the primary employing sector (70%), 55% of the nation's labor participation is employed in the service sector, followed by industry (8%). The service sector is experiencing growth proliferation following Liberia's Telecommunications and Information Communications Technology (ICT) Policy framework. The goal of the policy is to integrate telecommunications and ICT services into overall developmental objectives, priorities, and programs that will transform school systems, health programs, commercial, national security, and government programs, including procurement activities using ICT as the effective platform to ensure transparency, efficiency, and productivity [7]. Following the first draft of the policy in 2010, many ICT-demanding sectors continue to grow in the country. Many ICT service providers and private institutions such as universities and banks have emerged with fully backed ICT infrastructures and resources. The result of this acceleration for national sustainable development and economic growth is an increased demand for qualified ICT professionals who will work to serve the growing demand for ICT services. These demands have also urged many of the nation's universities to offer ICT and computer science courses.

Hence, these developments illustrate the importance of conducting research that will provide insights into specific influencing factors associated with students' career choices in ICT, particularly in Liberia. This study considers students' career choices as a multi-criteria decision-making (MCDM) problem. As such, the Analytical Hierarchy Process (AHP) is employed to empirically study the relative significance of factors that affect students' choice of ICT. An online AHP questionnaire was developed and sent to Liberian students comprising undergraduate and graduate students pursuing careers in the ICT field between December 1, 2021, and April 20, 2022.

2. Literature review

2.1. Career choice for ICT

Recent studies have found that information and computer technology graduates are among the highly skilled, highly paid, and perceived as capable and credible professionals worldwide [8]. This results from parents, teachers, career counselors, and role models' influence on students' decisions to pursue careers in ICT [9,10].

Expectations of higher status affect students' choice to seek professions in the ICT industry [11]. For example, as cited by Calitz et al. [12], a study conducted among high school students in Canada revealed that 36% were interested in pursuing a career in ICT, and 37% said that ICT occupations were innovative. In comparison, 77% believed that ICT employment would have more and better pay. Institutions have designed many initiatives to promote and encourage the adoption of a career in ICT among secondary school students [13,14]. For instance, Choudhury et al. [15] conducted a promotional campaign by establishing an IT Careers Camp to increase interest in ICT-related courses among high school students and teachers. The camp's main objective was to persuade participants that career opportunities in the ICT sector are worth exploring, that there is a wide range of career options and career tracks for ICT professionals, and that careers in ICT are creative and engaging.

Similar initiatives have been implemented across Africa. For instance, Orange Liberia, a famous telecommunication firm in the country, launched the Monrovia Meetup CS Academy from February to June 2022, where students learn to code through code

challenges [16]. The motive of the initiative is to create a mentorship learning path that teaches participants how to code using Python, conducted in three phases—basic, intermediate, and advanced. Each step presents a coding challenge the participants must complete to qualify for the next stage. In addition to the advanced stage coding challenge, participants must complete a project in recommended areas. The best three projects will receive cash prizes ranging from $1,000.00 for the first winner, $750 for the second winner, and $500 for the third winner. Similarly, according to Calitz et al. [12], IT departments at South African schools have collaborated closely with instructors, delivering IT seminars, programming training courses, IT career presentations, and other forms of educational assistance and encouragement. These departments have also spearheaded several activities, including gaming days, school IT project contests, promotional brochures, and awards for IT students who achieve high levels of success in their respective schools.

2.2. Factors influencing students' career choices

According to Akosah-Twumasi et al. [17], four significant themes influence career choice: extrinsic, intrinsic & interpersonal, and bicultural influencing factors. However, only the first three themes are considered in this paper. Extrinsic factors include financial remuneration, job security, professional prestige, and job accessibility. Intrinsic factors include personal interests, self-efficacy, outcome expectations, and professional development opportunities. Interpersonal factors include family members, teachers/educators, peers, and social responsibilities.

2.2.1. Extrinsic, intrinsic, and Interpersonal Factors

Amidst the fast-paced globalization of industries that have brought about colossal competition, the current job environment is characterized by increased fluidity and dynamism [18,19]. Thus, job seekers in today's job market are concerned with or more attached to a secured job environment. Workers' job security increases if the work environment is favorable. Other studies [see, for instance Refs. [20,21]] also find job security in the workplace contributes significantly to career decisions because it encourages the development of skills and knowledge. Thus, job security is one of the strong pillars upon which job seekers base their career decisions [22].

According to Calvin [23], remuneration is a monetary or financial advantage gained or provided to an employee or group of workers by the employer (firm) as a result of services rendered by an employee(s), commitment to the organization, or reward for employment. Many studies, such as Agarwala [24], Wüst and Leko Šimić [25], draw attention to the importance of financial remuneration in the lives of young people, especially those who exhibit high levels of individuality. For instance, compared to Croatian students, who scored 3/5, German students ranked attractive salaries as the most important aspect of their future employment opportunities (score 3.7/5) [25]. Similarly, findings of students' views of financial remuneration are reported in other countries around the globe, where students grade financial remuneration as a significant element in influencing their career choice in India, a driver of career choice among Chinese students in Canada as well as among students in Korea [24,26,27]. Thus, financial remuneration is one of the most relevant factors in students' decision-making to pursue a specific career path.

The consensus ranking of a job based on the perception of its worthiness—which includes its level of appreciation and respect—results in the development of professional prestige. On the other hand, job accessibility measures one's ability to cope with separations that may result from transportation means, road networks, congestion, and the intensity of competition [28,29]. These constructs highlight professional prestige and job accessibility as essential factors influencing career choice [17,30].

Personal interests (attributes learned from parents, friends, and schools) also influence students' career choices. They choose career environments that best fit their personalities and interests [31]. In addition, self-efficacy, which reflects an individual's capacity to produce important effects, also plays a role in career decision-making [32]. These effects further influence the prospects for expanding or refining professional knowledge and skills. Expanding these skills thus leads to the desire to seek more opportunities to enhance professional development. Therefore, opportunities for professional development can help students evaluate future career options [33]. Students also make career choices based on outcome expectancies, which reflect their expectations regarding the outcome of their career choices [34].

Personal factors such as parents/family members, teachers/educators, peers/friends, and other social responsibility attributes such as role models also help influence students' career choices. Parents are often seen as role models, and their actions encourage and support their children in making professional decisions. Other personal relations, such as career counselors and role models, are significant sources for inspiring and motivating students to set career objectives [12,20].

Many scholars have discussed these twelve career influencing factors in detail [see Refs. [12,17,24–27,31]. However, no such career study has been conducted in Liberia. Therefore, we contribute to this gap by conducting empirical research considering multi-criteria decision-making (MCDM) factors. An analytical hierarchy process (AHP) questionnaire was developed to understand the key factors that influence the career choices of Liberia students. AHP is a robust MDCM method developed by Saaty [35] to derive ratio scales from paired comparisons. The mathematical nature, methodological convenience, and the flexibility of obtaining input data in a hierarchical structure make AHP a flexible MCDM tool with widespread adoption and use in various research fields [36], including decision-making in career studies [37–40]. According to AHP, several steps are necessary to determine whether a criterion should be prioritized. These steps are outlined in the methodology section.

3. Methodology

3.1. Study point and data collection

3.1.1. Location

This research draws its participants and analysis from Liberia. Liberia is heading from a post-conflict society to a developing country with long-term growth ambitions and growing investments in infrastructure and natural resource use. The country is currently recovering from the shackles of the 14-year civil unrest. There are signs that the energy, mining, ICT, and transport sectors are growing with progressive investment and political engagement supporting long-term goals. Although ICT is still at a nascent stage in the country, it has excellent growth potential. Liberia has four million cell phone connections as of January 2020, representing 83% of the country's population, while mobile phone connections increased by 32% between 2019 and 2020. In addition, there are developmental strategies and plans for digitizing registration and obtaining various services, including national ID cards, driving licenses, passports, residence, and work permits.

3.1.2. Data collection

Due to covid-19 restrictions and the inability of the researchers to travel for in-person interviews, an online questionnaire was built using the Microsoft Forms platform with AHP pairwise comparison mechanism embedded. The questionnaire was pilot tested on ($n = 10$) participants from the Organization of African Academic Doctors (OAAD) who were not part of the research team. The pilot contained 15 questions. Modifications such as the cities and provinces of respondents were suggested as irrelevant to the AHP survey. In addition, modifications were suggested to allow the questionnaire to be filled out within a short period. The link to the questionnaire was then distributed to participants across various social media platforms—Facebook, WeChat, WhatsApp, Instagram, Messenger, Telegram, etc. This method was appropriate because it was the quickest way to reach the targeted respondents while observing rules on social distancing. To enhance the quality of the research data, respondents were targeted based on their status as undergraduate, master, or PhD students who were willing and available to fill out the questionnaire. The undergraduate category included students pursuing their bachelor's degrees, while the graduate category included both master's and PhD students currently pursuing graduate degrees. Due to the incapacity of universities to offer graduate ICT courses, coupled with the limited number of participants in this category, the survey was extended to participants pursuing their degrees (either at home or abroad) as part of the graduate category.

A survey deadline was set, and multiple submissions were disallowed to prevent data fluctuation and interruptions during analysis. English was used as the only language for the survey. The average time spent filling out the questionnaire was between 4 and 8 min, and the statistical population of the survey included a total of 182 participants.

Microsoft Excel 2016 was used for capturing, cleaning, coding, and visualizing data. The coded data were exported to SPSS version 26 software for descriptive statistics analysis, followed by a cross-tabulation to compare frequencies of different variables. Reliability analysis using Cronbach's Alpha was conducted on all factors in the pilot, where an α-value of 0.885 was considered statistically significant.

Table 1
The twelve career choice-influencing factors considered in this study.

Factors	Names of Sub-factor or Criteria	Details or explanation
Extrinsic Factors (EF)	C1 Financial remuneration	Financial remuneration includes all cash or cash equivalents given to employees in exchange for their work or services. It is typically included as part of a total remuneration or compensation package, which consists of both financial and non-financial compensation
	C2 Job security	Job security is the assurance that one can continue to work at their current job for as long as they so desire
	C3 Professional prestige	The public's impression of an individual's social status concerning their professional position affects their prestige.
	C4 Job accessibility	Job accessibility indicates a worker's ability to overcome the barriers caused by transportation, road network, traffic congestion, and competition among workers for available jobs.
Intrinsic Factors (IF)	C5 Outcome expectations	The idea of outcome expectation refers to beliefs about the results that an accomplishment will have in the long run.
	C6 Self-efficacy	self-efficacy entails an individual's ideas of their capacity to complete a specific job.
	C7 Personal interests	Personal interest is a measure of a student's motivation toward the profession they choose
	C8 Professional development	Opportunities for professional growth are situations where one may improve or hone one's existing professional knowledge or abilities.
Interpersonal Factors (PF)	C9 Social responsibilities	Social responsibility entails an individual's acceptance of the need to act morally and with awareness of social, cultural, civic, and environmental concerns.
	C10 Family members	Parents have a tremendous impact on their children's professional decisions because of the myriad of methods through which they exert this influence, including through direct inheritance and the condition of apprenticeship or role model.
	C11 Peers/friends	Peers affect each other's career choices by influencing their values and character. It affects their decision-making abilities, especially when choosing a degree or career.
	C12 Teachers/educators	The teaching, motivations, and experiences shared by Teachers can also help learners to think about their futures and find their career paths.

3.2. Ethical considerations

An ethical clearance to conduct the study was granted by the Ethics Committee Board of Zhejiang Sci-Tech University (ZSTU-SEM202305). Beneath the heading of the questionnaire was detailed information explaining the purpose of the study. All the participants were fully informed about the aim of the study and how the data was used and stored. Consent was obtained from all participants for participating in the questionnaire including understanding their rights to withdraw at any point and that no participant will be mentioned by name.

3.3. The AHP model

AHP, developed by Professor Thomas L. Saaty in the 1970s, is a powerful MCDM tool [41]. Hierarchical decision-making criteria or objectives characterize MCDM problems. They are based on criteria or sub-criteria that significantly impact decision-making. When applied to MCDM problems, AHP ensures that psychological attributes are transformed into mathematical reasoning with relative importance using hierarchical structures [42], using pairwise comparisons to generate criteria and alternatives that guide the evaluation of the required objective. Thus, the relative importance of or weightage assigned to each criterion is evaluated and scored for comparison at each level, thus achieving a fair comparison.

With these advantages, AHP is being utilized in this research to quantitatively examine the relative importance of several variables impacting students' career choices in the ICT industry in Liberia. As explained in the literature review section, all career choice-influencing criteria and the sub-criteria for this study were sourced from existing career studies (see Table 1). Pairwise

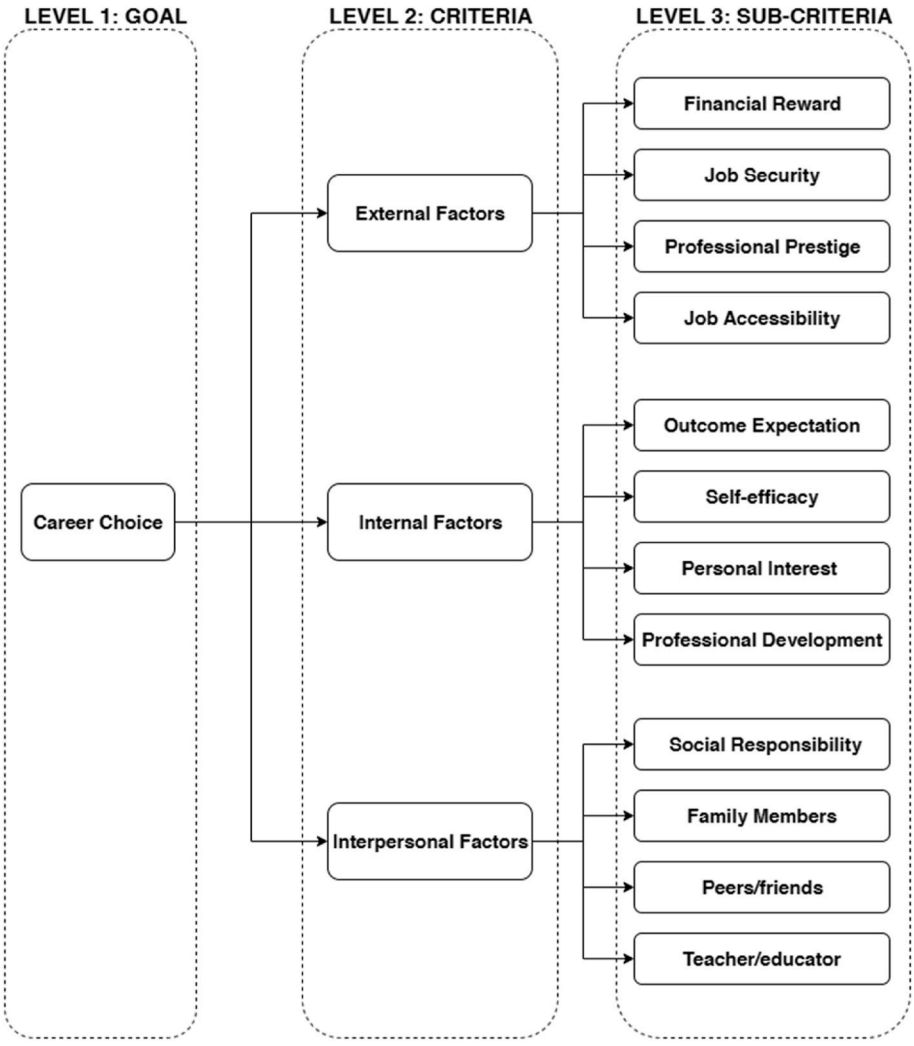

Fig. 1. A structured hierarchy of career choice. The hierarchy describes the goal in the first level, three criteria in the second level, and 12 sub-criteria or alternatives in the third level.

comparisons were made between the individual level of the hierarchy displayed in Fig. 1. These comparisons are then fed from the questionnaire into the AHP model developed in Microsoft Excel. Below are the steps followed in the AHP analysis.

Step 1. Since in AHP analysis, the pairwise comparison matrix only requires one value. Therefore, the results of each of the participant's pairwise comparisons have been consolidated into a single value. These aggregated pairwise comparisons are generated using the geometric mean method [43–45] from the judgments of 182 students. As seen in Equation (1), using the geometric mean is a widely used method in AHP analysis.

$$\mu_{ij} = \sqrt[n]{a_{ij1}a_{ij2}\ldots a_{ijn}} \tag{1}$$

where:

μ_{ij} = geometry mean row-*i* column-*j*

n = number of expert (participant)

Step 2. From Table 2, the weight of importance with respect to the nth criteria is indicated as w_n. Thus, the relative importance between the ith and jth criteria can be given by $a_{ij} = w_i/w_j$ [42].

Taking the weight of importance of each nth factor (criteria), Saaty's scale (Table 3) was used to compare these criteria on the same hierarchical level. If decision criteria have rank values listed in column 1 of Table 3, the rating values are considered; otherwise, the reciprocal values in column 2 of Table 3 are considered. Thus, a pairwise comparison of matrix A is achieved (Equation (2)).

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & a_{ij} & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{bmatrix} \quad where\ i,j = 1,\ldots n \tag{2}$$

Step 3. Using equations (3) and (4), a normalized pairwise comparison matrix is obtained by dividing each element by its column total in the pairwise comparison matrix.

$$X_{ij}^{*} = \frac{a_{ij}}{\sum_{i=1}^{n} a_{ij}} \; for\ all\ j = 1, 2, \ldots, n \tag{3}$$

$$X = \begin{bmatrix} X_{11} & X_{12} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ X_{n1} & X_{n2} & \cdots & X_{nn} \end{bmatrix} \tag{4}$$

where

X_{ij}^{*} = the value of the division of the ith row jth column with a total value of jth column; and

$\sum_{i=1}^{n} a_{ij}$ = total value of all pairwise comparisons of column j

Step 4. To obtain the weighted matrix, the average of the row elements in the normalized matrix is computed (see equations (5) and (6)). In the weighted matrix, the elements show the relative weights of the different criteria compared to each other. A higher value indicates a higher level of preference for each criterion.

$$W_i = \frac{\sum_{j=1}^{n} X_{ij}}{n} = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ \vdots \\ W_n \end{bmatrix} \; for\ all\ i = 1, 2, \ldots, n \tag{5}$$

Table 2
Pairwise comparison matrix.

	A_1	A_2	A_j	A_n
A_1	w_1/w_1	w_1/w_2	w_1/w_j	w_1/w_n
A_2	w_2/w_1	w_2/w_2	w_2/w_j	w_2/w_n
A_i	w_i/w_1	w_i/w_2	w_i/w_j	w_i/w_n
A_n	w_n/w_1	w_n/w_2	w_n/w_j	w_3/w_n

Table 3
Saaty's AHP and fuzzy pairwise comparing scale.

AHP Rating	Inverse	Linguistic Scale
1	1	Equally important (EI)
2	1/2	Intermediate value (IV)
3	1/3	Moderately important
4	1/4	Intermediate value (IV)
5	1/5	Strongly more important (SMI)
6	1/6	Intermediate value (IV)
7	1/7	Very strongly important (VSI)
8	1/8	Intermediate value (IV)
9	1/9	Extremely more important (EMI)

$$W = \begin{bmatrix} W_1 \\ W_2 \\ \vdots \\ \vdots \\ W_n \end{bmatrix} \tag{6}$$

Step 5. As a result of the possibility of various inconsistencies in respondents' views, a consistency analysis of all preferences expressed by the participants is performed. The consistency vector was obtained by summing the column element of the pairwise comparison of the matrix (C) multiplied by the appropriate weight (W_i) (see equation (7)).

$$Cv_1 = [C_{1i} + C_{2i} \ldots C_{ni}] \times W_i \tag{7}$$

where $i = 1, 2, \ldots n$.

$$Consistency\ Vector \quad Cv = \begin{bmatrix} Cv_1 \\ Cv_2 \\ \bullet \\ Cv_i \\ \bullet \\ Cv_n \end{bmatrix} \tag{8}$$

Step 6. Summing all elements of the consistency vector (Cv) in equation (8), a principal eigenvalue (λ_{max}) is obtained using equation (9).

$$\lambda_{max} = \sum_{i=1}^{n} Cv_i \tag{9}$$

Step 7. The Consistency Index (CI) (see equation (10)), is used to determine the degree to which respondents' perspectives are consistent with one another. CI represented as the difference between the lowest eigenvalues and the size of the comparison matrix (n), reflects the variation of respondents' views from consistency. In order to determine the Random Consistency Index, a comparison is made between the values computed based on the random index formulated by Saaty (Table 4). This index is dependent upon the number of criteria used.

$$CI = \frac{\lambda_{max} - n}{n - 1}, \tag{10}$$

Table 4
Radom index values.

Matrix	1	2	3	4	5	6	7	8	9	10	11	12
Random index (RI)	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.58

Step 8. Lastly, using equation (11), the consistency ratio between the CI and the RI is calculated.

$$CR = \frac{CI}{RI} \tag{11}$$

In order to proceed with the AHP analysis, a consistency ratio of 0.10 or below must be achieved. Otherwise, a rerun of the pairwise comparison is required [35].

4. Result and discussion

4.1. Survey results

As mentioned in section 3.1.2, an online questionnaire was built using the Microsoft Forms platform with AHP pairwise comparison mechanism embedded and distributed to participants across various social media platforms. To enhance the quality of the research data, respondents were targeted based on their status, either as undergraduate students or graduate students who were willing and available to fill out the questionnaire. As shown in Fig. 2, the survey tally reported a total of 182 participants—111 (60.98%) were undergraduate students, 59 (32.41%) were master's degree students, and 12 (6.59%) were PhD students.

In addition, the gender distribution of the survey result showed an imbalance between males 110 (60.4%) and females 72 (39.6%). Even though the female score is lower than males [46], this figure is still significantly encouraging. It shows improvement in the fight for gender equality in STEM courses in universities across Sub-Saharan Africa [47–49]. The fight against gender inequality in schools across Liberia has born significant fruit, predominantly due to the efforts of former President Ellen John-Sirleaf, who was Africa's first female head of state and a strong promoter of women empowerment. During her tenure as president of the nation, she mandated the Ministry of Education (MoE) to enforce the implementation of the National Policy on Girls' Education. This policy aims to consolidate national and international laws that promote girls' education and advance priorities to accelerate progress toward improving girls' education [50]. Other features of the survey are presented in Tables 5 and 6.

4.2. Result of the AHP

From Fig. 1, the career choice for ICT amongst Liberian students is considered a multi-criteria decision problem to be computed on three levels. The goal (level 1) is to determine the factors influencing students' choice of ICT. Through a literary survey, three main themes contributing to the goal were identified (level 2). Each theme was further divided into four sub-themes. Level 3 presents the 12 sub-factors that cut across the three themes identified in level 2. These sub-factors influence the increase in students enrolling in ICT courses. Thus, this section presents the results obtained from the AHP analysis of the 182 respondents. We first determined the weights of both factors and sub-factors and then obtained the global weight by multiplying the factor and sub-factor weights.

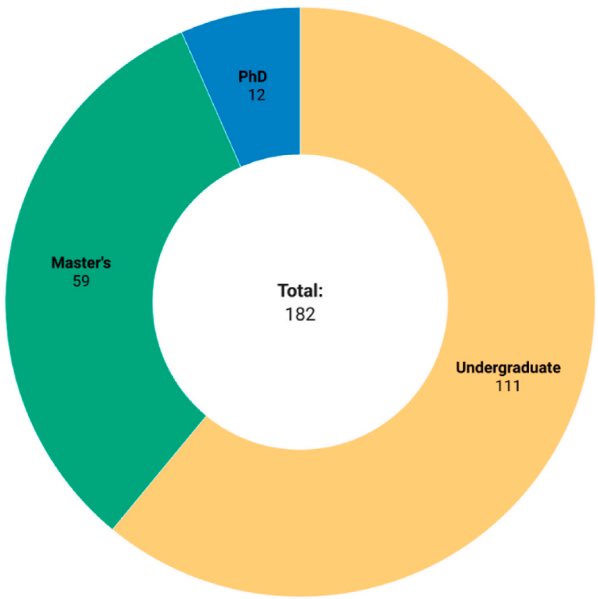

Fig. 2. Survey respondents by category.

Table 5
Summary of respondents' demographics.

Variable	Category	Frequency	Percent (%)
Gender	Male	110	60.4
	Female	72	39.6
Marital Status	Single	153	84.1
	Married	25	13.7
	Engaged	4	2.2
Age	18–25	86	47.3
	26–33	80	44.0
	34–41	16	8.8
	>41	0	0.0
Education Level	Undergraduate	111	61.0
	Master's	59	32.4
	PhD	12	6.6
Employment	Employed	8	4.4
	Unemployed	174	95.6
Religion	Christianity	152	83.5
	Islam	25	13.7
	Traditional African Religion	5	2.7

4.2.1. Results from the three themes

The questionnaire was divided into three sections. The first section captured respondents' demographic information. The second section presented an AHP pairwise comparison of the three factors—Extrinsic Factors (EF), Intrinsic Factors (IF), and Interpersonal Factors (PF). These three factors or themes formed the basis of the level 2 analysis. Table 6 displays the aggregated pairwise comparison of all 182 respondents for criteria in level 2, along with their weights and ranks. The analysis of responses was found to be consistent (CR = 0.05). Results displayed in Table 7 entail that Extrinsic Factors (EF), with a score of 0.633 and rank of 1, is regarded by Liberian students as the primary influencer amongst factors in Level 2 impacting their choice of pursuing careers in the ICT sector. It was followed by Intrinsic Factors (IF), with a score of 0.260. Interpersonal Factors (PF) received the lowest rank, with a score of 0.106. The variations in these scores are significantly interesting as they align with a similar career choice study by Abe and Chikoko [51] and Akosah-Twumasi et al. [17]. For instance, the participants in Abe and Chikoko [51] study reported interpersonal influences on their decisions to study STEM. However, when individually asked to describe their families' influences, they reported varying degrees of influence from their families on their decision-making. Some students noted in their reflections that their families did not have any role in their choice to major in a STEM field.

In the third and final section of the questionnaire, respondents were further asked to perform a pairwise comparison of the 12 sub-factors identified from the literature (level 3). The 12 sub-factors are presented in Table 1. The resulting pairwise comparisons are presented based on themes.

4.2.2. Results from the 12 sub-factors

Pairwise comparisons amongst sub-factors of the Extrinsic group (Table 8) reveal students attach great importance to Financial Remuneration (C1) with a score of 0.461 when making ICT career choices. Financial remuneration is a hot topic among students when laying out career objectives. This is particularly important because sectors with low salary offerings tend to demotivate students [24, 52]. It was followed by Job Security (C2), Job Accessibility (C4), and Professional Prestige (C3) with scores of 0.399, 0.093, and 0.046, respectively. Thus, the order of importance for all sub-factors in the Extrinsic group can be summarized as C1>C2>C4>C3.

Respondents' grading of sub-factors in the Intrinsic group reveals equal scores (0.389) allotted to both Personal Interest (C7) and Professional Development (C8). Scores of Outcome Expectation (C5) and Self-efficacy (C6) indicated very minimum influence on participants' choices of ICT courses. The score particularly allotted to Personal Interest (C7) reflects how interest plays a critical part in inspiring individuals to accomplish the activities they like. A student with a solid and inspiring passion for a course is encouraged to complete it [31]. Thus, the order of importance for all sub-factors in the Intrinsic group can be summarized as C8═C7>C5>C6 (see Table 7 Intrinsic Sub-factors).

In the Interpersonal group, a comparison of sub-factors reveals that Family Members (C10), with a score of 0.558, play a significant role in students' ICT career decision-making. In Liberia, parents have a tremendous impact on their children's professional decisions. They employ a myriad of methods through which they exert this influence, including through direct inheritance and the condition of apprenticeship or role model. Influences from peers/friends affect a student's career choices by influencing their values and character. As reported in this study with a score of 0.268, peers' influences thus affect a student's decision-making ability, especially when choosing a degree or career. On the other hand, teachers' and educators' teachings, motivations, and experiences can also help learners think about their futures and find their career paths. This sub-factor was reported as the third-ranked factor influencing respondents' ICT career choices, with a score of 0.133. Furthermore, Social responsibility (C9), with the least score of 0.042, did not appear as a pressing factor that would influence students' ICT career choices. Thus, the order of importance for all sub-factors in the Interpersonal group can be summarized as C10 > C11 > C12 > C9 (see Table 7 Interpersonal Sub-factors).

Table 6
Breakdown of responses between undergraduate, master's, and PhD participants.

Level 2 factors vs educational level responses		EI	MI	SMI	VSI	EMI
Extrinsic Factors	Undergraduate	12	8	46	17	28
	Master's	4	13	9	12	21
	PhD	0	0	0	4	8
Intrinsic Factors	Undergraduate	8	8	32	34	29
	Master's	0	21	0	26	12
	PhD	0	0	0	8	4
Interpersonal Factors	Undergraduate	12	20	34	29	16
	Master's	0	0	18	21	20
	PhD	0	0	8	0	4
Extrinsic sub-group vs educational level responses		**EI**	**MI**	**SMI**	**VSI**	**EMI**
Financial reward	Undergraduate	4	16	36	21	34
	Master's	4	5	14	12	24
	PhD	4	0	0	4	4
Job security	Undergraduate	16	4	29	21	41
	Master's	14	12	0	21	12
	PhD	0	0	8	0	4
Professional prestige	Undergraduate	12	16	32	22	29
	Master's	5	4	12	13	25
	PhD	0	0	0	8	4
Job accessibility	Undergraduate	12	16	28	12	43
	Master's	5	5	4	24	21
	PhD	0	0	4	4	4
Intrinsic sub-group vs educational level responses		**EI**	**MI**	**SMI**	**VSI**	**EMI**
Outcome expectation	Undergraduate	8	8	28	26	41
	Graduate	5	0	26	12	16
	PhD	4	4	4	0	0
Self-efficacy	Undergraduate	12	8	28	35	28
	Graduate	13	0	29	5	12
	PhD	0	4	4	0	4
Personal interest	Undergraduate	8	12	28	22	41
	Graduate	5	4	21	12	17
	PhD	0	0	4	8	0
Professional development	Undergraduate	4	12	28	12	55
	Graduate	0	9	9	21	20
	PhD	0	0	0	0	12
Interpersonal sub-group vs educational level responses		**EI**	**MI**	**SMI**	**VSI**	**EMI**
Social responsibility	Undergraduate	12	8	46	20	25
	Graduate	8	22	12	4	13
	PhD	4	4	4	0	0
Family member	Undergraduate	12	12	54	21	12
	Graduate	12	9	25	5	8
	PhD	4	4	4	0	0
Peers/friends	Undergraduate	16	37	24	13	21
	Graduate	8	26	13	8	4
	PhD	4	8	0	0	0
Teachers/educators	Undergraduate	20	12	33	38	8
	Graduate	4	9	13	28	5
	PhD	0	8	0	0	4

Note: EI = equally important, MI = moderately important, SMI = strongly more important, VSI = very strongly important, EMI = extremely more important.

Table 7
AHP pairwise comparison of three criteria of Level 2.

	EF	IF	PF	Weights	Rank
EF	1.000	3.000	5.000	0.633	1
IF	0.333	1.000	3.000	0.260	2
PF	0.200	0.333	1.000	0.106	3
CR = 0.05		$\lambda_{max} = 3.05$		CI = 0.02	

Table 8
Pairwise comparison of all twelve sub-factors.

Extrinsic Sub-factors						
	C1	**C2**	**C3**	**C4**	**Weights**	**Rank**
C1	1.000	1.000	9.000	7.000	0.461	1
C2	1.000	1.000	7.000	5.000	0.399	2
C3	0.111	0.143	1.000	0.333	0.046	4
C4	0.143	0.200	3.000	1.000	0.093	3
CR = 0.05		λ_{max} = 4.15			CI = 0.05	
Intrinsic Sub-factors						
	C5	**C6**	**C7**	**C8**	**Weights**	**Rank**
C5	1.000	3.000	0.333	0.333	0.153	2
C6	0.333	1.000	0.200	0.200	0.069	3
C7	3.000	5.000	1.000	1.000	0.389	1
C8	3.000	5.000	1.000	1.000	0.389	1
CR = 0.02		λ_{max} = 4.05			CI = 0.02	
Interpersonal Sub-factors						
	C9	**C10**	**C11**	**C12**	**Weights**	**Rank**
C9	1.000	0.111	0.143	0.200	0.042	4
C10	9.000	1.000	3.000	5.000	0.558	1
C11	7.000	0.333	1.000	3.000	0.268	2
C12	5.000	0.200	0.333	1.000	0.133	3
CR = 0.09		λ_{max} = 4.3			CI = 0.09	

Table 9
Global weights and ranks for factors and sub-factors.

Factors	Factor Level Weight	Rank	Sub-factors	Sub-factors Level weight	Rank	Global Weight	Global Rank
Extrinsic Factors (EF)	0.633	1	C1 Financial reward	0.461	1	0.292	1
			C2 Job security	0.399	2	0.253	2
			C3 Professional prestige	0.046	4	0.029	8
			C4 Job accessibility	0.093	3	0.059	6
Intrinsic Factors (IF)	0.260	2	C5 Outcome expectations	0.153	2	0.040	7
			C6 Self-efficacy	0.069	3	0.018	10
			C7 Personal interests	0.389	1	0.101	3
			C8 Professional development	0.389	1	0.101	3
Interpersonal Factors (PF)	0.106	3	C9 Social responsibilities	0.042	4	0.004	12
			C10 Family members	0.558	1	0.059	5
			C11 Peers/friends	0.268	2	0.028	9
			C12 Teachers/educators	0.133	3	0.014	11

4.2.3. Global weights computation

Results for global weights for all sub-factors are presented in Table 9. The global weight column for the sub-factors was computed by multiplying the sub-factors' level weights by the weights obtained in the factor level weights column. Furthermore, values of the global rank column were derived by invoking the RANK function on global weights using Microsoft Excel.

Based on the sub-factor results from the combined sub-factors group, the two outstanding sub-factors which influence students' choices for ICT were Financial Remuneration (C1) and Job Security (C2) from the Extrinsic sub-factors group with rank and score (1st, 29.2%, & 2nd, 25.3%) respectively. Globally, the scores for Job Accessibility (C4) and Professional Prestige (C3) were relatively lower (6th, 5.9% & 8th, 2.9%, respectively) even though they come from the best-performing sub-group.

Interestingly, though Personal interests (C7) and Professional development (C8) were ranked first in the sub-group of Intrinsic factors, their ranks were reduced to third in the global ranking (10.1%) each. Outcome expectations (C5) globally maintained a good score (7th, 4%). This result highlights that students have higher expectations regarding their future outcomes and achievements when deciding on career choices in the field of ICT. Self-efficacy (C6) received one of the lowest ranks (10th, 1.8%) from the Intrinsic sub-factors group. A possible explanation could be that when a student is offered attractive financial rewards on a secured job, they worry less about their capacity to effectively complete any assigned task.

Family members (C10) of the Interpersonal sub-factors groups were still significant influencers in students' career choice decision-making. Though the group received the lowest scores, the sub-factor still scored (5th, 5.9%) preference rate. Even though a student's ideas and character are influenced by their peers, which also impact their ability to make decisions, particularly in selecting a college major or job path, the global ranking from the survey result reveals that it minimally impacts students' career choices to the degrees of other factors listed above. Global analysis of the factors also highlights that teachers' teachings, motivations, and experiences also play

a minimum influence on learners' decisions on their career paths compared to Financial remuneration or Family influence. Social responsibility scored the lowest (12th, 0.4%). This finding is interesting because it reveals that more is to be done to educate students and communities to develop the need to act morally with awareness of social, cultural, civic, and environmental concerns.

5. Conclusion

This research uses AHP to better understand the relative impact of three main themes (Extrinsic, Intrinsic, and Interpersonal) that affect students' choices of ICT. The research further explored the influence of four sub-factors of each of these themes.

According to the research findings, even though at the individual group level, family factors appear to be the most important career influencing factor, students' views on whether to pursue IT careers seem to be heavily influenced by the future financial earnings they will receive, such as stipends, salaries, and other non-financial compensation packages. In contrast, Job accessibility and the prestige associated with ICT jobs did not significantly impact students' career choices in ICT. However, regardless of them being ranked 6th and 8th, respectively, the Extrinsic group was regarded by students as the main factor influencing their ICT choices.

Additionally, students' interests (C7), their professional development (C8), and the influence of family members (C10) were rated as significant influencing factors affecting their decision to study ICT. Respondents also indicated that their chosen career's expected future outcomes and achievements were crucial factors to be considered when deciding on their career path.

These results give practical implications that may be used by organizations and entities such as the Post and Telecommunication, various network services providers offering IT employment, and universities and colleges enrolling IT students across Liberia. Although the IT students studying in different countries may differ in study methodology and career prospects, the findings are also highly practical for any country, especially those regarded as developing countries.

Each theme and its sub-factors reported different priority weightings. However, the minor variations in these weights indicate that IT companies, universities, and departments recruiting IT workers may use a mix of these themes based on their relevance to the specific entity.

As can be seen from the presentation of the findings, the AHP approach is suitable for use in such a multi-criteria decision-making study. Its robustness was further intensified by the relevance of the decision variables and the consistency of the results. Consequently, substantial insights into several specialized career choice issues intriguing to students studying information and communication technology-related courses were discovered. These insights may be helpful from the perspective of recruiting strategy in aiding IT stakeholders in focusing their attention and recruitment efforts on the areas of impact with the most substantial potential. They could also boost the number of accessible choices and different enticing career paths in the ICT industry.

Lastly, findings from this study have significantly contributed to the career choice literature. This study has innovatively transformed qualitative career choice perceptions into a quantitative hierarchical analysis, which is found lacking in many career choice studies.

This study has some limitations. The study reveals essential information on the career choices of ICT students in Liberia; however, the sample size used was insufficient. Future researchers should consider using large sample sizes to draw a more generalized conclusion. Additionally, this study does not include a comparison analysis. Future studies are encouraged to consider incorporating other methods for more comparative analysis. Lastly, future studies should explain each factor more clearly to enable survey participants to provide better responses.

Author contributions

D. Z. Sumo, Z. Lei, P.D. Sumo: conceived and designed the experiments, performed the experiments, analyzed and interpreted the data, wrote the paper. **Z. Lei:** editing, supervision, validation.

All authors approved the final manuscript.

Data availability statement

The data that has been used is confidential.

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Additional information

No additional information is available for this paper.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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