Information Technology Technical Support Success Factors in Higher Education: Principal Component Analysis

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***Abstract*—The use of information and communication technologies at higher education institutions is no longer an option, but rather a need. Information Technology support is an essential factor that entails giving end users assistance with hardware and software components. Technical support for information technology has been recognized as a crucial element linked to student happiness because it helps students understand, access, and use technology efficiently. The successful implementation of IT technical support will be aided by identifying the essential success criteria that enable efficient and effective support for students and instructors. Hence the main aim of this study is to identify and rank the key success factors for the successful implementation of IT technical support at higher education institutes. 81 key success factors identified from 100 research papers were analyzed using principal component analysis. The findings led to the identification and ranking of 25 PCs. 95.35 percent of the observed variation was accounted for by the first 25 PCs with eigenvalues higher than 1. The percentages for the first 6 PCs were, in order, 11.87%, 22.21%, 30,64%, 38.25%, 45,12%, and 51.47%. This research provides useful information highlighting factors that can be used to examine areas in educational institutions that need to receive continuous and special care to generate high student satisfaction; ensure future success and gain a competitive advantage. These factors can assist the management of HEI to determine the success or failure of an institution in terms of the technical support provided to students and student satisfaction.**

Keywords*—*Information technology; technical support services; key success factors; principal component analysis; higher education institutions

I. INTRODUCTION

Information Technology technical support is an important part of the implementation and integration of technology in education [1]. Technical support is needed by students who are not familiar with information and communications technology and need to use online learning effectively [2]. Support from technical staff is not limited to infrastructure, hardware, and software issues; when academic staff is supported by technical staff are most likely to explore different online tools that will aid in multi-modal teaching [3]. Technical support is needed to assist and enhance the efficient delivery of academic content. [4]. To study, students depend on the technical team's constant and prompt reactions. [5]. Lack of technical support and advice leads to unsuccessful projects [6].

Higher education institutions all across the world were utilizing a range of measures to sustain their academic programs as the COVID-19 virus started to spread in early 2020. To avoid losing the academic year, the academics had to come up with creative ways to teach. To assist academic staff and students who were compelled to use technological tools like Moodle, Blackboard, email, and MS Teams and to help mitigate the problems experienced, there was an immediate and great need for IT technical support services[79]. According to [7] the pandemic made access to technical support services at all higher education institutions an even bigger problem. Email, Microsoft Teams, WhatsApp, and several other online channels were used to deliver technical support services. Students required technical support and advice to enable them to understand how this new technology will benefit them [5].

Technical support has been cited by numerous researchers [84,85,86,87] as a crucial success component that is linked to student contentment. Reference[87] cited technical support as a key element that influenced distant learners' satisfaction with their courses at Malaysian universities. According to studies [84, 85, 86], students who received technical support felt more at ease and inspired to use the e-learning systems. To create a successful IT technical support services satisfaction model and reduce the risk of failure, key success factors (KSFs) must be recognized [8, 9]. It is crucial to emphasize that KSFs will evolve as both the environment and users' perceptions of them do. To attain or sustain optimum benefit, identified KSFs will need to be continually assessed [9]. The most important success variables ought to be small, manageable, and measurable [10].

Principal component analysis (PCA), according to Hanci and Cebeci [12], is a multidimensional statistical technique that can split similar relevant variables into a cluster of fewer key determinants as principle components (PCs). It helps draw attention to differences and spot patterns that may be concealed in a dataset [11]. The PCA method, a mathematical methodology based on eigenanalysis, calculates the eigenvalues and equivalent eigenvectors of a square symmetric matrix using sums of squares and cross-products [13]. The author in [81] used PCA to reduce the number of

evaluation criteria for learner support services provided to undergraduate students at remote education centres. The PCA method was used by Reference[82] to identify the service quality indicators among Ghanaian graduates of a higher education institution. PCA was utilized in the study [83] to identify the aspects of service quality at a Kenyan university. The main objective of this study is to use the PCA method to identify the key success factors for IT technical support services in higher education institutions. The following section of this paper is organized as follows: Section 2 related works; Section 3 materials and methods; Section 4 the results and discussion and Section 5 conclusion.

II. Related Works

Technical aid some of the services offered to students and academics to lessen the workload of the instructor and improve student performance include having the knowledge and abilities to assist students and instructors with technical issues, providing support using online tools (WhatsApp), being able to resolve issues quickly and effectively, understanding the specific needs of students, and being available 24/7. Over the years, numerous research measuring the service quality of HEIs were carried out utilizing the Service Quality (SERVQUAL) 5 dimensions technique (tangibility, reliability, responsiveness, empathy, and assurance). The author in [14] discovered that the institution in Thailand did not live up to the expectations of the 350 study participants. Perceptions received lower scores than anticipated. This suggests that significant service enhancements are required to improve service quality. Similarly, in [15], they determined that it was important to assess the level of service at a university in Ghana, particularly from the perspective of the students, given the growing demand for investment in the management and administrative areas of HEIs. Data was gathered and examined by 384 students. The study's findings indicated that most students were happy with the services provided by the institution to the point where they would suggest it to others. Contrary to the other four dimensions, the tangibility dimension was performing well in terms of its services. The author in [16] at Valley View University in Ghana surveyed 100 students to gauge their satisfaction with the services provided. The findings demonstrated that the university's assurance, tangibility, and responsiveness services were satisfied; however, the empathy dimension was only moderately satisfied. A Tanzanian university's service quality and student happiness were the subjects of the study described in [17]. The findings indicated that the reliability dimension was the most favourable aspect of the study, while the other dimensions obtained low scores, indicating that the services provided to the students were unsatisfactory.

The author in [18] sought to investigate how service quality was implemented at an Indonesian university. We conducted interviews, observations, and document analyses. The outcomes demonstrated that the university's implementation of service quality was of poor quality. The SERVQUAL instrument was used in the study [19] to compare literature reviews and assess service quality in HEIs. The outcomes of the literature review were triangulated, and they were evaluated for certain quality aspects that would be typical of public HEIs and might need to be improved. In terms of the services being provided, the perception of the students was lower than expected. The study by [20] looked at how the five service quality factors impacted Indonesian university students' satisfaction. The sample group included 125 students. The sampling process was straightforward and random. According to the findings, tangibility, dependability, and responsiveness had a good impact, whereas empathy scored reasonably, and assurance had no impact.

The study in [21] assessed the level of services offered at Albanian HEIs. According to the study's findings, none of the services provided to students satisfied them, as evidenced by the fact that all five SERVQUAL dimensions obtained low scores. The reliability factor received the most negative evaluations from students who thought that staff members were unwilling to help them with issues, failed to notify students in advance of schedule changes, and did not give them the necessary support. A study [22] looked at the relationship between student happiness and the caliber of services provided to Sri Lankan students in private foreign HEIs. The key SERVQUAL dimensions that were most important in determining student satisfaction were looked at. The results of the study demonstrated a significant link between student happiness and service quality. In this study, the qualities of assurance and responsiveness had a substantial contribution to student happiness. This research will fill a gap since no earlier studies have concentrated especially on the technical support services offered to students at HEIs.

III. Materials and Methods

The techniques for data extraction and dimensionality reduction are thoroughly explained in this section. To obtain the pertinent data, this investigation used the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) technique recommended by [23]. One of the finest techniques for helping researchers do systematic reviews and meta-analyses correctly and review a structure like a road map is PRISMA. This approach is well-liked in systematics literature and has been widely applied in a variety of research [24-28, 80]. The scientific literature that can be obtained using a structured approach that is based on objectives that are set so that different authors can utilize them can be summarized and analyzed by the researcher in a systematic review, which provides significant evidence [29].

All published studies reporting on IT technical support services were found through a search of the literature. Identification of pertinent research, screening, and selection of those studies, eligibility, and inclusion stages were all completed following the PRISMA methodology.

1) Identification: Scientific articles are chosen relating to IT technical support service key success factors in higher education institutions published in scholarly journals listed on the SCOPUS database (368) and ScienceDirect (749). Databases were searched by using the keywords “key success factors”, “IT technical support services”, “higher education”, limited to years greater than 1985 and less than 2022, limited to “journals”, limited to “computer science” subject area and limited to the “English” language. The Next step of the

PRISMA method is to remove duplicate articles.

2) Screening: A review of articles relevant to IT Technical Support Service Key Success Factors in Higher Education, the articles were screened by analyzing the title and abstract. The articles were put into the Mendeley citation management software. From a total of 1,117 articles 303 duplicate articles were removed. Finally, 814 articles remain.

3) Eligibility: Eligible criteria are needed to select appropriate articles [30], therefore articles are filtered based on inclusion and exclusion criteria as shown in Table 1.

TABLE I. INCLUSION AND EXCLUSION CRITERIA

Criteria	
Exclusion Criteria	
EC1	Papers in which only abstract is available.
EC2	Duplicate records.
EC3	Review and survey papers.
EC4	Papers not written in the English language.
EC5	Papers not relevant to IT technical support services.
EC6	Papers not applying PCA or Factor Analysis or SERVQUAL dimensions.
EC7	Papers not reporting sample size.
Inclusion Criteria	
IC1	Articles published in English.
IC2	Papers in Computer Science subject area only.
IC3	Papers relating to IT technical support service key success factors in higher education.
IC4	Journal papers only.
IC5	Papers between 1985 to 2022

Table 1 shows that only publications that satisfy the criteria are chosen; chapter books, brief reports, articles, non-English papers, and works from before 1985 are all excluded. In this instance, 25 items were eliminated since they did not meet the requirements and 789 articles are still present. Another 749 pointless articles have been eliminated at this point.

4) Included: Overall, 100 articles that match the inclusion criteria remain. The 100 papers that can contribute to this study are examined in this final step. The papers are carefully read through to extract and condense key information. The information gathered will be used for this study. The flow of a database search using PRISMA is shown in Fig. 1.

This section aims to provide the key success factors that will be used to assess the IT technical support services provided to students at HEIs.

a) Dataset: For this study, a total of 81 factors have been identified from 100 research studies. They have been gathered and presented in binary form to display the attribute of the factors identified for further analysis.

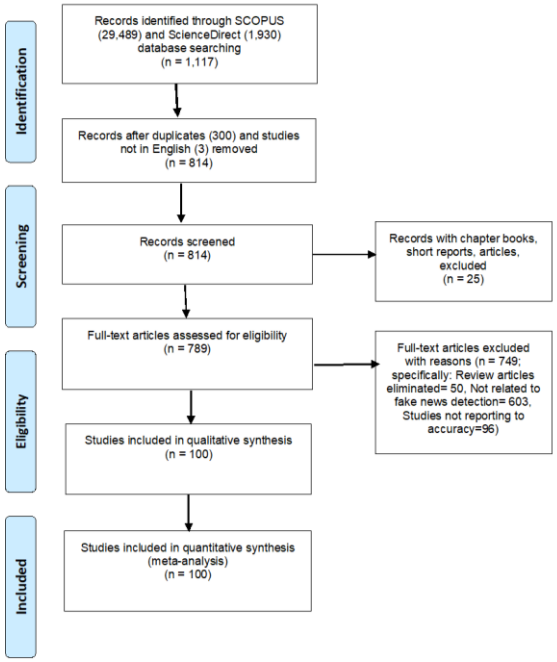

Fig. 1. Flow diagram of database search using PRISMA [31].

TABLE II. QUALITATIVE AND QUANTITATIVE IT TECHNICAL SUPPORT SERVICES (ITSS) FACTORS FOR PCA

ITSS FACTORS	NAME	DESCRIPTION	ADAPTED FROM SOURCE
F1	reliability	The student is assured that support staff to help resolve queries promptly.	[14] [32] [33] [15] [16] [18] [17] [19] [20] [21] [22]
F2	responsiveness	IT technical support staff's willingness to assist students and provide them with prompt service.	[34] [14] [32] [35] [15] [16] [18] [17] [19] [20] [21] [22]
F3	tangibility	Communication medium used to provide support services to students. Friendliness of staff.	[14] [33] [35] [15] [16] [18] [17] [19][20][21] [22]
F4	empathy	IT technical support staff gives students personal attention and understanding of the student's specific needs.	[14] [35] [15] [16] [18] [17] [19] [20] [21] [22]
F5	assurance	IT technical support staff being courteous to students as well as staff knowledge to answer students' queries.	[14] [35] [15] [16] [18] [17] [19] [20] [21] [22]
F6	trustworthy and loyalty	Loyalty requires developing a solid relationship with students.	[33]
F7	commitment	Students' likeliness to contact the same technical staff for assistance in the future.	[33]
F8	competence	IT technical staff have the appropriate knowledge and skills.	[14]
F9	reputation	IT technical staff are consistent in terms of	[34] [33]

		service delivery.	
F10	technical support staff	Timeliness and effectiveness of solution provided.	[34] [36] [37] [38] [39]
F11	communication material	Documents provided to students are easy to follow and are easily accessible and accurate.	[40] [32] [33]
F12	communication method	Effective use of modern online tools and services. WhatsApp service is reliable and easy to use. Technical staff is easily accessible by this service.	[40] [36] [33]
F13	location	Remote technical support provided is very convenient. Remote technical support is available 24/7.	[40]
F14	customer orientation	The student is very satisfied with the service provided.	[41]
F15	competitor orientation	IT technical staff has a competitive advantage over others in terms of providing excellent service to students and knowledge of the technical staff.	[41]
F16	inter-functional orientation	Inter IT technical department communication.	[41]
F17	performance orientation	IT technical staff's commitment to service.	[41]
F18	employee orientation	IT technical staff choose to provide service excellence.	[41]
F19	long term orientation	IT staff continuously improving student services.	[41]
F20	academic aspects	IT staff assist students with queries thereby increasing student academic performance.	[42] [43] [44] [45] [40] [46] [47]
F21	non-academic aspects	Support services, financial aid, security, etc. are considered non-academic aspects.	[42] [43] [44] [45] [40] [46]
F22	dependability	Students rely on IT technical staff to assist with technical queries.	[48]
F23	effectiveness	Effective use of modern online tools and services.	[48]
F24	capability	The technical staff has the knowledge, skills, and experience to assist promptly with student queries.	[48]
F25	efficiency	Promptness of delivery.	[48] [49] [50]
F26	assurance	Courtesy of technical staff; ability to encourage confidence and trust.	[48] [51]
F27	unusual situation management	unusual situation management.	[48]
F28	semester	Usually, six months.	[48]
F29	syllabus	Course content.	[48] [49] [50]
F30	teaching methodology	The method used to conduct lecturers e.g., using blackboard.	[52] [49] [51] [53] [54]
F31	disciplinary action	Reprimand in response to rule violation or misconduct.	[52]
F32	environmental change in study factor	Universities' involvement in reducing their carbon footprint.	[52]
F33	mediating self-actualization placement	Fulfillment of one's talents and potential.	[52]
F34	NSE as a service quality measure	NSE dimensions of service quality include but are not limited to content and structure of the study, acquired general skills, acquired scientific skills, testing, and assessment, program schedules, etc.	[55]
F35	customer focus and need-based	The customer is driven by a specific need.	[56]
F36	channels of communication	Examples: university website, WhatsApp communication, Facebook, Twitter, alerts, and reminders.	[56,57]
F37	instructional competence	Important practices that lecturers must grasp for effective instruction to students to maximize knowledge and skills.	[56] [50] [57] [58]
F38	specific policies and procedures	Guidelines for development. implementation, monitoring, and evaluation of HEIs.	[56]

F39	evaluation and control system	Implemented through the preparation of emergency policies and a crisis management team.	[56]
F40	curriculum design	Relevance of materials to students. Enthusiasm and methodology used by lecturers.	[40] [47] [51]
F41	effective leadership	Efficient guidance.	[56]
F42	periodic review	Assessing regularly.	[56]
F43	resource allocation	Equipment provision.	[56]
F44	operational planning	Department goals, capabilities, and budgets.	[56]
F45	competence	Theoretical knowledge, practical knowledge, up-to-date, teaching expertise, and communication.	[59] [54]
F46	attitude	Understanding the needs of students.	[59] [43] [58] [53] [54]
F47	content	Documents given to students are easily obtainable and accurate. Adherence to course objectives.	[59] [43] [58] [53] [54]
F48	delivery	Easy access to IT technical support staff.	[59] [43] [58] [53] [54]
F49	academic services	Includes admissions, financial aid, disability services, etc.	[60 [58] [61] [54]
F50	leisure	Relaxation.	[60]
F51	industry links	HEIs in contact with outside companies	[60]
F52	cost	Cost of facilities.	[62, 60]
F53	facilities	Tangibles, ease of access, support services, recreational facilities, library services, staff availability	[63] [49] [64] [65] [62] [66]
F54	flexibility	Ability to assist out of normal hours.	[67] [62] [68]
F55	availability	Reachable.	[50] [57] [62] [65] [69] [68]
F56	personnel quality	Ability and skills of staff.	[50] [57] [62] [65] [70]
F57	sufficiency of resources	Adequate facilities available for students to use, e.g., computer laboratories, and libraries.	[50] [57] [62] [71]
F58	quality of faculty	Value of faculty.	[50] [66] [62] [71]
F59	access	Right to use.	[61] [53] [42] [70] [72] [43] [44] [40]
F60	courtesy	The staff is courteous with students.	[70] [72] [53]
F61	communication	Between lecturer and student.	[70] [72] [53]
F62	credibility	Trustworthiness.	[70] [72] [53]
F63	security	Campus facilities are safe.	[70] [72] [53]
F64	understanding	Both students and lecturer appreciate each other.	[70] [72] [53]
F65	standards of organizations	Each organization has its policies and guidelines.	[70]
F66	assessment	Evaluation methods.	[70]
F67	feedback	Opinions from staff and students.	[70]
F68	human resources quality	Capability and promptness of staff.	[46]
F69	privacy	Any information given by students (e.g., passwords) to technical staff is kept confidential.	[69]
F70	contact	Communication method.	[69]
F71	administrative services	Student support services.	[49] [64] [53] [61]
F72	campus infrastructure	Setup of HEI.	[49] [53] [73]
F73	leadership	Authority.	[74] [73]
F74	perishability	A service that cannot be made in advance	[75]

		and stored.	
F75	intangibility	A service has no physical substance.	[75]
F76	variability	Service may vary in quality from one provider to the next.	[75]
F77	lack of ownership	Shortage or absence of something required.	[75]
F78	inseparability	Makes customer-provider collaboration compulsory.	[75]
F79	infrastructure	Setup of an organization.	[76]
F80	teamwork	Colleagues working together.	[76]
F81	institutions management	Process of planning and organizing resources to run a successful organization.	[77]

a) Principal Component Analysis: Principle component analysis (PCA) is a multivariate statistical technique that summarizes the data by breaking it down into principle components (PCs), which are smaller elements that may be used to assess the construct more precisely without sacrificing any of the data's information [12]. Using built-in R stats package functions, PCA was applied to R-Studio.

b) Data Standardization: In PCA, data normalization *is referred to as scaling. Here, the dataset is altered* using an equation (1). This indicates that the attribute's mean is zero and that the resulting distribution has a unit standard deviation. The dataset was standardized as follows*:*

$$Xij = (Xij - Xm) / \sigma \quad (1)$$

where i = 1, 2, 3, . . ., 100 (research no.) and j = 1, 2, 3, ..., 81 (factor no.), Xij represents the original value of the ith research rating of the jth factor, Xm is the mean, and σ represents the standard deviation of the series formed by values of the ith research for all 81 factors. To standardize the data the R-Studio function scale () was used. The numeric matrix is entered as input and then the scaling on the columns is performed [78].

Table 2 displays the study dataset, which includes 100 quantitative examples and 81 qualitative cases for each element, and describes them all. To show the factors and determine the weights of each element, PCA was used to analyze the dataset. The dataset was standardized into items of classes and attributes using the PCA approach known as scaling in R-Studio to ascertain the transformation of the factors. The Kaiser criteria, which uses a minimal eigenvalue of unity, was used to calculate the number of PCS. Factors 1 through 81 were included in the dataset as @ ATTRIBUTE F1–F81 and their extraction was coded as @ ATTRIBUTE class PC 1–PC 100. R-Studio 22022.07.01 Build 554 and WEKA 3.8.6 were used to obtain the statistical methods for analyzing the transformed dataset. By using these two statistical approaches, we were able to assess the contributions of multiple factors and uncover transformations among the factors with increased validation. WEKA's PCA was employed to order the attributes.

As can be seen in Table 3 there are now 25 factors from the original 81 factors that have been identified as the key success factors to determine students' satisfaction in terms of the IT technical support services that are provided at HEIs.

TABLE III. A 5-FACTOR LOADING RANKING OF THE QUALITIES

Ranked	Attribute	Contribution
0.8813	1	-0.224F4-0.22F5-0.203F2+0.193F30+0.192F57...
0.7779	2	-0.292F41-0.292F42-0.292F39-0.292F38-0.292F43...
0.6936	3	-0.23F24-0.23F26-0.228F23-0.228F27-0.228F28...
0.6175	4	0.371F16+0.371F15+0.371F18+0.371F19+0.371F14...
0.5488	5	0.247F22+0.247F28+0.247F27+0.247F23+0.206F67...
0.4853	6	-0.402F77-0.402F76-0.402F75-0.402F74-0.402F78...
0.4329	7	0.372F20+0.36 F21+0.33 F9+0.217F6-0.207F5...
0.3905	8	0.389F31+0.389F33+0.389F32-0.246F46-0.246F48...
0.3515	9	0.304F33+0.304F31+0.304F32-0.259F52-0.248F51...
0.3145	10	-0.276F69-0.276F70-0.267F55-0.257F11-0.231F25...
0.2809	11	0.48 F50+0.48 F51+0.28 F49+0.253F52-0.208F72...
0.2507	12	-0.482F80-0.482F79-0.347F54+0.25 F11+0.23 F12...
0.2215	13	-0.446F69-0.446F70+0.286F11+0.253F80+0.253F79...
0.1933	14	0.271F10-0.258F20-0.255F21+0.241F67+0.241F65...
0.1695	15	0.338F12+0.324F7+0.323F6-0.243F10+0.219F13...
0.1506	16	0.626F73+0.322F7-0.288F13+0.288F58-0.253F10...
0.1333	17	-0.631F68-0.438F6+0.225F9+0.178F59+0.154F40...
0.1184	18	-0.339F34+0.318F72+0.3 F71-0.289F10+0.272F49...
0.105	19	0.584F34+0.514F81-0.364F10-0.185F12-0.185F29...
0.092	20	0.796F81-0.493F34+0.126F10-0.111F4-0.105F5...
0.0804	21	-0.376F8+0.271F13+0.256F58+0.217F56-0.21F6...
0.0694	22	-0.402F53+0.327F68+0.318F58-0.303F56+0.262F57...
0.0597	23	0.409F34+0.326F58+0.31 F29+0.281F57+0.266F3...
0.0511	24	0.504F7-0.368F53+0.312F49-0.292F58+0.24 F29...
0.0433	25	-0.536F45+0.288F8+0.278F10+0.273F49-0.261F40...

IV. RESULTS AND DISCUSSION

Table 4 shows the eigenvalue, variance, and cumulative percentage values for the 25 PCs and 81 PCs that WEKA and R Studio, respectively, were identified.

TABLE IV. COMPARATIVE RESULTS PCS OF THE FACTORS FOR WEKA AND RSTUDIO

25 Principal Components: WEKA Initial Eigenvalue				81 Principal Components: RStudio Initial Eigenvalue			
principal component	eigenvalue	proportion	cumulative	principal component	eigenvalue	% of variance	cumulative % of the variance
PC1	9.615	0.119	0.119	PC1	9.615	1.187	11.871
PC2	8.376	0.103	0.222	PC2	8.376	1.034	22.211
PC3	6.827	0.084	0.306	PC3	6.827	8.428	30.639
PC4	6.165	0.076	0.383	PC4	6.165	7.611	38.250
PC5	5.567	0.069	0.451	PC5	5.567	6.873	45.123
PC6	5.144	0.064	0.515	PC6	5.144	6.351	51.474
PC7	4.245	0.052	0.567	PC7	4.245	5.241	56.715
PC8	3.429	0.042	0.609	PC8	3.429	4.234	60.949
PC9	3.161	0.039	0.649	PC9	3.161	3.902	64.851
PC10	2.998	0.037	0.686	PC10	2.998	3.701	68.552
PC11	2.722	0.034	0.719	PC11	2.722	3.360	71.912
PC12	2.448	0.030	0.749	PC12	2.448	3.022	74.935
PC13	2.358	0.029	0.778	PC13	2.358	2.911	77.845
PC14	2.286	0.028	0.807	PC14	2.286	2.822	80.667
PC15	1.929	0.024	0.830	PC15	1.929	2.382	83.049
PC16	1.533	0.019	0.849	PC16	1.533	1.892	84.941
PC17	1.397	0.017	0.867	PC17	1.397	1.725	86.666
PC18	1.209	0.015	0.882	PC18	1.209	1.493	88.159
PC19	1.089	0.013	0.895	PC19	1.089	1.344	89.503
PC20	1.054	0.013	0.908	PC20	1.054	1.302	90.805
PC21	0.936	0.012	0.920	PC21	0.936	1.155	91.960
PC22	0.893	0.011	0.931	PC22	0.893	1.102	93.062
PC23	0.786	0.010	0.940	PC23	0.786	0.970	94.032
PC24	0.693	0.009	0.949	PC24	0.693	0.856	94.888
PC25	0.630	0.008	0.957	PC25	0.630	0.777	95.665
-	-	-	-	PC26	0.552	0.681	96.346
-	-	-	-	PC27	0.488	0.603	96.949
-	-	-	-	PC28	0.425	0.525	97.474
-	-	-	-	PC29	0.404	0.498	97.972
-	-	-	-	PC30	0.327	0.404	98.376
-	-	-	-	PC31	0.261	0.322	98.698
-	-	-	-	PC32	0.229	0.283	98.981
-	-	-	-	PC33	0.192	0.237	99.219
-	-	-	-	PC34	0.142	0.176	99.394
-	-	-	-	PC35	0.125	0.154	99.549
-	-	-	-	PC36	0.098	0.121	99.669
-	-	-	-	PC37	0.076	0.094	99.763
-	-	-	-	PC38	0.061	0.075	99.838
-	-	-	-	PC39	0.047	0.057	99.896
-	-	-	-	PC40	0.036	0.044	99.940

-	-	-	-	PC41	0.028	0.034	99.974
-	-	-	-	PC42	0.017	0.021	99.995
-	-	-	-	PC43	0.003	0.003	99.998
-	-	-	-	PC44	0.001	0.002	100.000
-	-	-	-	PC45	0.000	0.000	100.000
-	-	-	-	PC46	0.000	0.000	100.000
-	-	-	-	PC47	0.000	0.000	100.000
-	-	-	-	PC48	0.000	0.000	100.000
-	-	-	-	PC49	0.000	0.000	100.000
-	-	-	-	PC50	0.000	0.000	100.000
-	-	-	-	PC51	0.000	0.000	100.000
-	-	-	-	PC52	0.000	0.000	100.000
-	-	-	-	PC53	0.000	0.000	100.000
-	-	-	-	PC54	0.000	0.000	100.000
-	-	-	-	PC55	0.000	0.000	100.000
-	-	-	-	PC56	0.000	0.000	100.000
-	-	-	-	PC57	0.000	0.000	100.000
-	-	-	-	PC58	0.000	0.000	100.000
-	-	-	-	PC59	0.000	0.000	100.000
-	-	-	-	PC60	0.000	0.000	100.000
-	-	-	-	PC61	0.000	0.000	100.000
-	-	-	-	PC62	0.000	0.000	100.000
-	-	-	-	PC63	0.000	0.000	100.000
-	-	-	-	PC64	0.000	0.000	100.000
-	-	-	-	PC65	0.000	0.000	100.000
-	-	-	-	PC66	0.000	0.000	100.000
-	-	-	-	PC67	0.000	0.000	100.000
-	-	-	-	PC68	0.000	0.000	100.000
-	-	-	-	PC69	0.000	0.000	100.000
-	-	-	-	PC70	0.000	0.000	100.000
-	-	-	-	PC71	0.000	0.000	100.000
-	-	-	-	PC72	0.000	0.000	100.000
-	-	-	-	PC73	0.000	0.000	100.000
-	-	-	-	PC74	0.000	0.000	100.000
-	-	-	-	PC75	0.000	0.000	100.000
-	-	-	-	PC76	0.000	0.000	100.000
-	-	-	-	PC77	0.000	0.000	100.000
-	-	-	-	PC78	0.000	0.000	100.000
-	-	-	-	PC79	0.000	0.000	100.000
-	-	-	-	PC80	0.000	0.000	100.000
-	-	-	-	PC81	0.000	0.000	100.000

The WEKA statistical software identified 25 PCs with eigenvalues of 9.615 to 0.630, a variance of 0.119 to 0.008, and a cumulative variance of 0.119 to 0.957. The percentage ranges for each of the 81 PCs found by R Studio were as follows: eigenvalue 9.615 to 0.001, variance 1.187 to 0.002, and cumulative variance 11.871 to 100. The 81 components, like other research that have used PCA to address various real-world issues, only take into account eigenvalues bigger than unity. The 81 PCs' eigenvalues, on the other hand, ranged

from 9.615 for the first component to 0.001 for the last. Moreover, for PCs 81 and 25, respectively, the 56 consecutive PCs had eigenvalues that ranged from 9.615 to 0.630, which is less than unity. A cumulative variance of 11.871 and an eigenvalue of 9.615 for PC1 explain the same total variance of 11.871.

The Institutions Management (F81) extraction value for PC represents 0.001, while the maximum 0.997 extracted values are for F14 – Customer Orientation, F15 – Competitor Orientation, F16 - Inter Functional Orientation, F17 – Performance Orientation, F18 – Employee Orientation, F19 – Long term Orientation. These factor loadings were integrated to account for the high eigenvalue, as seen in the first component.

According to Table 4, the cumulative variances for the first six PCs are 11.87%, 22.21%, 30.64%, 38.25%, 45.12%, and 51.47%.

TABLE V. DEPICTS THE CONTRIBUTION OF 10 FACTORS IDENTIFYING THE DIFFERENT GROUPS FOR THE 6 PCS

PC1	-0.224F4-0.22F5-0.203F2+0.193F30+0.192F57-0.19F3 +0.183F63+0.183F61+0.183F62+0.183F60...
PC2	-0.292F41-0.292F42-0.292F39-0.292F38-0.292F43 -0.292F44-0.292F35-0.245F36-0.182F40+0.168F63...
PC3	-0.23F24-0.23F26-0.228F23-0.228F27-0.228F28 -0.228F22-0.212F25-0.194F29+0.18 F61+0.18 F62...
PC4	0.371F16+0.371F15+0.371F18+0.371F19+0.371F14 +0.371F17-0.131F26-0.131F24-0.127F23-0.127F22...
PC5	0.247F22+0.247F28+0.247F27+0.247F23+0.206F67 +0.206F65+0.206F66+0.205F24+0.205F26+0.177F25...
PC6	-0.402F77-0.402F76-0.402F75-0.402F74-0.402F78 +0.093F46+0.093F47+0.093F48-0.092F66-0.092F67...

As depicted in Table 5, Empathy has an eigenvector value of -0.224 and is one of the KSFs in the first group of PC1. Compared to subsequent components, this one describes the dataset's largest irregularity. In PC2, F41(effective leadership), F42(periodic review), F39(evaluation and control system), F38(specific policies and procedures), F43(resource allocation), F44(operational planning) and F35(customer focus and need based) have an eigenvector value of -0.292. F36(channels of communication) has -0.245; F40(curriculum design): -0.182 and F63(security): 0.168. The highest eigenvector value of +0.18 for PC3 is F61(communication) and F62(credibility). The highest eigenvector value of 0.371 for PC4 is F16(inter functional orientation), F15(competitor orientation), F18(employee orientation), F19(long term orientation), F14(customer orientation) and F17(performance orientation). For PC5, F22(dependability), F28(semester), F27(unusualsituation management), F23(effectiveness): 0.247. For PC6, F46(attitude), F47(content), F48(delivery): 0.093. The contribution of 10 factors identifying the different groups for the 6 PCs can be seen in Table 5.

The individually weighted factor values contribute to the PC from the factors in Table 6 that are shown there. The communalities shown in Table 6 show each factor loading that was employed for extraction, as observed between the extracted component's minimum and highest ranges of 0.089 and 0.997. Table 6 also displays the outcomes of each factor's presentation of its contribution to the communality.

TABLE VI. COMMUNALITY

Factors	Initial (I)	Extraction			
F1	1.000	0.782	F42	1.000	0.984
F2	1.000	0.861	F43	1.000	0.984
F3	1.000	0.726	F44	1.000	0.984
F4	1.000	0.828	F45	1.000	0.554
F5	1.000	0.829	F46	1.000	0.865
F6	1.000	0.283	F47	1.000	0.865
F7	1.000	0.089	F48	1.000	0.865
F8	1.000	0.545	F49	1.000	0.419
F9	1.000	0.611	F50	1.000	0.297
F10	1.000	0.114	F51	1.000	0.297
F11	1.000	0.291	F52	1.000	0.577
F12	1.000	0.108	F53	1.000	0.388
F13	1.000	0.369	F54	1.000	0.345
F14	1.000	0.997	F55	1.000	0.757
F15	1.000	0.997	F56	1.000	0.673
F16	1.000	0.997	F57	1.000	0.681
F17	1.000	0.997	F58	1.000	0.471
F18	1.000	0.997	F59	1.000	0.656
F19	1.000	0.997	F60	1.000	0.933
F20	1.000	0.715	F61	1.000	0.933
F21	1.000	0.678	F62	1.000	0.933
F22	1.000	0.953	F63	1.000	0.933
F23	1.000	0.953	F64	1.000	0.768
F24	1.000	0.864	F65	1.000	0.663
F25	1.000	0.846	F66	1.000	0.663
F26	1.000	0.864	F67	1.000	0.663
F27	1.000	0.953	F68	1.000	0.123
F28	1.000	0.953	F69	1.000	0.257
F29	1.000	0.567	F70	1.000	0.257
F30	1.000	0.794	F71	1.000	0.463
F31	1.000	0.960	F72	1.000	0.507
F32	1.000	0.960	F73	1.000	0.093
F33	1.000	0.960	F74	1.000	0.995
F34	1.000	0.012	F75	1.000	0.995
F35	1.000	0.984	F76	1.000	0.995
F36	1.000	0.831	F77	1.000	0.995
F37	1.000	0.754	F78	1.000	0.995
F38	1.000	0.984	F79	1.000	0.092
F39	1.000	0.984	F80	1.000	0.092
F40	1.000	0.540	F81	1.000	0.001
F41	1.000	0.984			

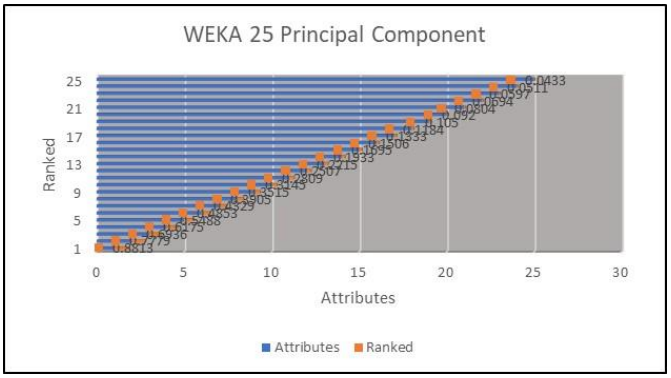

Fig. 2. Ranking of 25 PCs.

The 25 PCs are ranked in Fig. 2, with the top six components scoring, respectively, 88.13%, 77.79%, 69.36%, 61.75%, 54.88%, and 48.53%.

A scree plot is a diagnostic tool that determines whether or not PCA performs properly on the data. The most variety is captured by PC1, followed by PC2, and so on. Although there are as many primary components in PCA as there are qualities, each one gives some information about the data. Information is lost if PCs are not present. The number of PCs is on the x-axis, while the eigenvalues are on the y-axis. The screen plot in Fig. 3 illustrates these PCs.

The graphic depiction of PCA is shown in Fig. 4. The graphic illustrates the correlation between the variables in the dataset; it indicates that if two variables point in the same direction, they are correlated; if they create a 90-degree angle, there is no connection; and if they point in the opposite directions, there is a negative correlation. For instance, variables F49, F55, and F56 are correlated because they all point in the same direction; variables F4 and F30 are negatively linked because they point oppositely; and variables F36 and F64 are uncorrelated since they form a 90-degree angle.

'Rotated' loading score is where each PC has its loading score, creating a matrix of eigenvectors. From this, it can be determined which factor has a positive or negative loading score. Fig. 5 depicts the 10-factor loading scores for the first 5 ranked attributes.

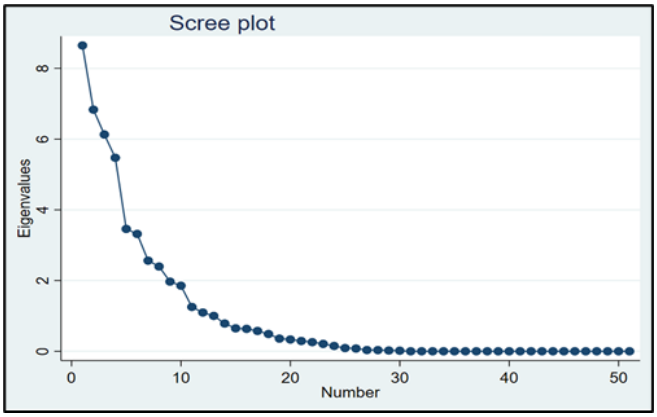

Fig. 3. Scree plot of the PCs.

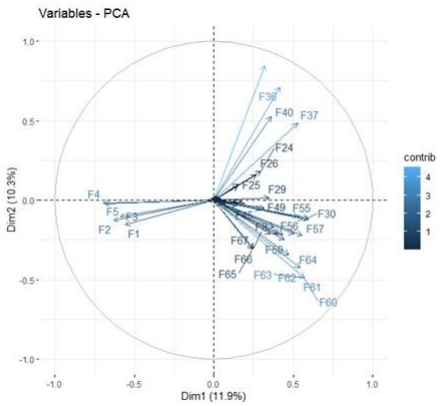

Fig. 4. Contribution of each variable.

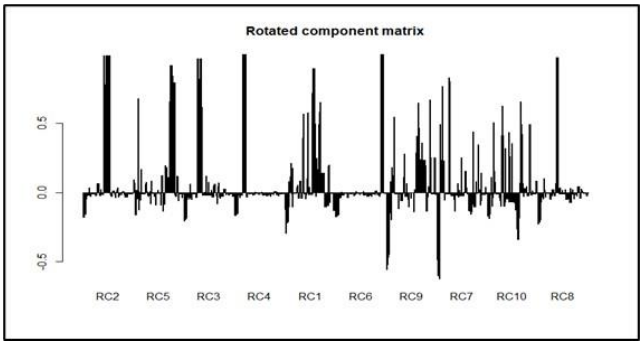

Fig. 5. Bar plot of the rotated component matrix for the 10-factor loadings.

According to these results, several KSFs that are used to specify the KSF diversity of the IT technical support satisfaction model based on the taxonomy of the groups that may have been discovered by the selection of these KSFs exhibit significant morphological variance. In this study, we attempted to explain the morphological diversity and map the KSFs to numerous relevant IT technical support satisfaction model components. These findings indicate that taxonomic groups could have been created by selecting certain characteristics. PCA was used in studies [81,82,83] to locate KSFs. According to different identity categories, the current study shows how KSF diversity differs. Several KSF studies have selected particular KSFs to contextualize their results. However, to offer a thorough nature of KSFs with varied morphologies, the results from this research were achieved by including all the KSFs that were found. A hybrid PCA and factor analysis technique was used in this study to identify, validate, rank, and categorize a dataset of 25 inputs as critical, leading to the discovery and description of all KSFs. The results of this study demonstrate that tangibility, reliability, responsiveness, empathy, and assurance are the KSFs that are most frequently used to categorize IT technical support services.

V. Conclusion

By examining the physical traits that serve as a crucial preliminary method for evaluating various KSFs and simultaneously clarifying their effectiveness when utilized successfully, diversity was computed using many KSF markers. The range of KSFs that may be used for diverse IT technical support service satisfaction model implementations

is the important information offered by the study's findings. From the 81 factors for evaluating student IT technical support services provided to students at HEIs, only 25 of the most substantial have been uncovered. The first six primary components' low variances demonstrate unequivocally that the highest KSFs considerably increased the pool's diversity having eigenvectors not limited to values 0.23, 0.224, 0.247, 0.292, 0.371, and 0.402. The results of this study significantly advance our understanding of KSFs for IT technical support. With a special emphasis on the morphological traits of a divergent model that was created from a variety of distinct morphological taxonomies of the KSFs that were found. The study's conclusions can help practitioners avoid neglecting any KSF and help them consider their roles in creating a successful technical support service model. To date, no study has concentrated on studying the key success factors of student IT technical support services in HEIs. It is recommended that the identified key success factors be used to evaluate IT technical support services that are being rendered to students at HEIs so that services can be improved and/or maintained. HEIs will be able to attract and retain more students. Future studies will focus on providing IT technical support services to staff and students and secondary schools (public and private).

Finally, The findings of this study make an essential contribution to the body of knowledge, with special emphasis on the identified CSFs of IT technical support services provided to students at HEIs. The study findings can assist HEI policymakers and IT practitioners in HEIs in not overlooking any essential success factors, therefore attaching a substantial consideration to providing the effective delivery of IT support services provided to students.

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