Impact of Educational Coaching Programs and Mentoring Services on Users' Perception and Preferences: A Qualitative and Quantitative Approach

KINGSLEY OKOYE[1], **(Graduate Student Member, IEEE),**
SAMIRA HOSSEINI[1,2], **(Member, IEEE), ARTURO ARRONA-PALACIOS**[1],
AND JOSE ESCAMILLA[3]

[1]Writing Lab, Institute for Future of Education, Office of the Vice President for Research and Technology Transfer, Tecnológico de Monterrey, Monterrey 64849, Mexico
[2]School of Engineering and Sciences, Tecnológico de Monterrey, Monterrey 64849, Mexico
[3]Institute for Future of Education, Office of the Vice President for Research and Technology Transfer, Tecnológico de Monterrey, Monterrey 64849, Mexico

Corresponding author: Samira Hosseini (samira.hosseini@tec.mx)

ABSTRACT This study determines how educational supporting services and mentoring programs can be improved based on the users' preferences and perception by benefiting from a data-driven design model and process innovation. To this end, the study proposed a data-driven support and decision model (DSDM) that uses a mixed methodology (qualitative and quantitative) to analyze data collected from different writing centers and coaching programs who responded to an online survey that comprised of both quantitative and qualitative items. Quantitatively, we applied a Linear and Mixed-effect logistic regression analysis to investigate the critical factors that motivate the users in seeking educational support services. And, qualitatively apply the Text mining technique to analyze the opinions given by the participants in order to establish its level of impact towards the several services offered by the coaching programs. Theoretically, the proposed research model is grounded on integration of a data-structure approach that builds on the descriptive decision theory; which studies the rationality of the decisions that users are disposed to make by means of the statistical method and textual data quantification. In turn, the method allowed us to capture the influential factors and state-of-the-art in faculties-students development and coaching programs, and to provide solutions to the ever-increasing need to improve educational supporting services and quality in a competitive and rapidly changing educational environment or market that have not been done before. Although there may be a considerable variation between the different categories of educational services offered by the coaching centers. The results of our study shows that the users hold services such as "tutoring" as a major factor that influences their visit and recommendations to the writing centers or coaching programs. Moreover, most users of the coaching programs are motivated by the need to gain "support" with their educational/academic performance and productivity.

INDEX TERMS Coaching programs, educational innovation, educational services, higher education, text mining, data-driven methods, writing centers, decision theory.

I. INTRODUCTION

Today, many educational coaching programs are created to support the stakeholders (e.g., students and teachers) with their learning, knowledge acquisition, teaching quality,

The associate editor coordinating the review of this manuscript and approving it for publication was Jon Atli Benediktsson.

performance and assessment, etc. Personal tutoring or coaching remains an under-developed and under-researched area particularly within the education domain, and have simultaneously created significant challenges in its delivery within the idyllic model of personal and/or professional development [1]. For example, in Education, the significance of the notion (coaching and mentoring) continues to show a gradual

increase as a result of the contextual impact or outcomes of key research in leu of the students/faculties retention, success, and professional improvement. Although, a considerable amount of the developed programs have shown to be effective in the different aspects of education by facilitating and encouraging activities of the users (faculties and students) as well as institutional production and ranking systems [2]–[5]. However, while Medne *et al.* [2] note that the current trends or efforts in sustaining the several universities services shows that the higher education institutions (HEIs) are continuously looking for ways to improve the quality and efficacy of the underlying programs, by incorporating strategies that involve the stakeholders training and academic improvement. The study [2] notes that the developed or resultant approaches would only do well if the main objectives are designed by considering the quality of the different coaching practices, key performance indicators, and support. Moreover, Tóth and Surman [4] note that the educational improvement frameworks can also be used to attain information/practices that are, in turn, used to deal with some of the practical to quality challenges related to the users' perspectives. Whereas, Mourad [3] notes that understanding of the users' perspectives and their role as a driver of the improvement strategies is paramount to Education quality assurance in the several HEIs [6].

To this end, this study believes that coaching and mentoring programs in education will go a long way in addressing the identified challenges, and in turn, ensure professional development of the users involved. The study shows that the real opinions of the participants who completed the questionnaire we administered to capture the extent and impact of the educational supporting services across the globe, can be used to understand the significant role the coaching and mentoring programs play in education, identification of the services that users deem significantly important, and how to use those information (data) to support the decision-making strategies for the HEIs. Thus, we illustrated that a mixed methodology that includes methods such as the text mining (qualitative approach) [7], [8] and quantitative approach [9], [10] can be used to analyze the readily available datasets to derive new insights and draw relevant information that can be used to drive the coaching and mentoring programs in education forward [11]–[13].

A. THE RATIONALE OF THE STUDY

This study determines the impact of educational supporting programs and services (case study of writing centers) by taking into account the perception of the users (e.g., faculties and students). We propose a data-driven support and decision model (DSDM) that is not only beneficial for understanding the implications of the different services and coaching programs for the users [14], [15]. But also can be applied within any organizational context to improve the activities of the users [16], [17]. The study utilized data collected through the database of the International Writing Centers Association (IWCA) [18] to illustrate the method. Prior studies

have shown that the state-of-the-art research or methodologies in coaching education or professional performance were predominately either quantitative and/or qualitative (textual) approach [19], [20].

The main research questions of this study are as follows:

1) How can we analyze the different (quantitative and qualitative) data captured from the various educational coaching programs or writing centers to understand how the users perceive the several supporting services offered by the institutions and their preferences?

2) How can we utilize the derived information to understand what could be the influential factors that affect or determines the users' choices and/or preferences considering the different services offered by the educational programs, and how the results can be used to support the different coaching programs or writing center services and decision-making strategies in the diaspora?

To this effect, the study developed a set of constructs it uses to conduct the research investigations and data analysis as follows:

- For the quantitative approach, we trail to identify the various potential factors that causes or motivate the users to utilize the educational coaching/mentoring services (case study of the writing centers) and how those factors are intercorrelated or associated.

- In the qualitative approach, we performed a sentiment analysis and emotional valence analysis (using the Text mining method) to determine the top services that the users prefer or seek when using the writing center' services and their levels of impact.

- Finally, we evaluated the implications of both the statistical significances/differences found in the results, impact of the top most frequent terms in the data used by the participants to describe the coaching programs, and then provide an empirical discussion of the findings.

Thus, based on the stated research questions and design; this study makes the following contributions to knowledge:

1. It defines a data-driven support and decision model (DSDM) that leverages the perspectives or opinions of the participants to understand the underlying foundation behind the use of coaching and mentoring programs to build professional/educational capacity of the users. In turn, the method provides information on how to understand and enhance the end-to-end processes and datasets within the educational programs or coaching settings.

2. It demonstrates the benefits of Text mining technologies and its application within the educational settings, particularly in the clearer context of coaching, professional development, or mentoring programs.

3. It describes a mixed methodology (quantitative and qualitative approach) applied to understand how the users perceive the different services offered by the different

educational coaching programs (case study of the writing center) and their implications for practice.

4. It illustrates how data about the users can be analyzed to provide solutions to the current challenges or themes that have emerged both in the literature, and in a competitive and rapidly changing educational and professional development environment or market.

The contributions of this study is important at a time when the use of information or insights drawn from data has become inevitably useful in informing the future directions of the educational and professional development programs [14], [15], [21], [22]. For instance, by being able to track the users' preferences and progress, and in turn, aligning the outcome of the developed methods towards improving the quality of the different offered services, decision making strategies, and/or the programs' ecosystems at large.

The rest of this paper is structured as follows: The Background Information (Section II) discusses the relevant state-of-the-art in the topic area, especially as it relates to the educational coaching programs and evaluation. We presented the Methodology of the study in Section III by introducing the proposed DSDM model and its main framework, the data sampling and participants' information, research instrument and constructs we used in the study. In addition, we presented the data analysis and results of the study. Section IV discusses the results in detail, particularly the implications of the DSDM method and data analysis in practice, and then concludes and points out the directions for future works in Section V.

II. BACKGROUND INFORMATION
A. COACHING AND MENTORING IN EDUCATION: STATE-OF-THE-ART

Coaching and Mentoring for schools or professional development has long been not only a debate for both educators and academic managers at all levels. But also, a developmental and strategic tool/initiative used by the several higher education institutions (HEIs) to drive the business operations forward. In the Education context, while *coaching* is seen as a central component of successful professional development, and *mentoring* refers to process of serving as someone who facilitates and assists other faculties' or students' development [23]–[25]. The two overlapping or interchangeable terms (coaching and mentoring) are adopted/associated with the intention of improving the performance of the stakeholders (e.g., faculties, students, educators) in a specific aspect of the learning practice [15], [26]. Dated back to late 1970s, the role of mentors has inadvertently been changed from not just one who provides socio-emotional support, for instance, beginner teachers and students, but to one who also serves as an instructional coach [27]–[30]. The North American Council for Online Learning (NACOL) [31] in its Colorado Online Learning (COL) model [32] designed to support the teachers, defines how a variety of mentoring types can be combined to meet the Schools' needs. Ranging

from Task-based and Experienced-based mentoring to Just-in-time mentoring, and One-to-one, Team, and Formal mentoring [32]. Indeed, Coaching and Mentoring has not only been a valued improvement paradigm embedded into the different HEIs performance and Schools' development policies [21]. But also, is an important practice towards achieving the United Nations Educational Scientific and Cultural Organization's (UNESCO) Global Citizenship Education (GCED) initiative [33] whose goals is to instil in learners; values, attitudes, and behaviours that support creativity, innovation, and commitment to learning and professional development [15], [34], [35].

Whereas, Holliday [36] notes that Coaching and Mentoring is not an add-on to academic leaders' role but an integral part of it. The study [36] believes that benefits of coaching and mentoring initiatives, e.g. StaffCoaching^{TM}model, are enormous. Ranging from managers or academic leaders who are capable of inspiring, persuading, influencing, and motivating organizational changes, to spearheading those actionable insights necessary to ensure success [26]. The above benefits have not been overemphasized, for instance, by the Center for the Use of Research and Evidence in Education (CUREE) [37] who over many years has reviewed and analyzed the evidence of what works in professional development for the educators. Their conclusions were that professional development (such as coaching and mentoring) is much more likely to be successful when it involves collaboration amongst the staffs, or when it's done well is one of the most effective methods for personal development proven to be key element of the several schools' improvement strategies [37]. Besides, CoachEd Perspective [38] on Global Framework for Coaching in Education believe that offering coaching to aspiring school leaders can support educators to make well-considered decisions about their professional futures and management. Directed towards School' improvement, the Australian Council for Educational Research (ACER) [39] was a program developed to support a small number of Northern Territory schools in Australia to establish a ''community of practice'' that enabled them to create developmental strategies by promoting conversations about students' achievement (e.g., literacy and numeracy skills), imbuing in the leaders and teachers the capacity to use effective coaching and mentoring practices that results in measurable gains in leu of the students achievements [40].

As example, Moyle [21] notes that seven schools located in both remote and urban contexts in Australia that chose to use coaching/mentoring as part of their respective school' improvement plans, reflected on how they considered their approaches were or were not working, and why. The five main themes that emerged from the study was [21]:

- The capacity to build the competency and abilities of the teachers, so that they can take stepladders towards achieving the school's strategic vision and priorities in relation to the curriculum, teaching and learning, and assessment, and can effectively make judgments about students' progress and outcomes [36], [41].

- Laying foundation to ensure commitment by the school' leadership to use coaching or mentoring strategies in building the capacity of the school' staffs [42], [43].
- Work with early adopters or teachers that are keen to try out new ideas and approaches, and in turn, model the new approaches to other staff members [44]–[47].
- The use of data to inform the achievements and future direction of the coaching and mentoring programs by being able to track individual students' progress, improving the quality of instruction in each settings, and aligning the outcomes to the school's vision for improvement [14], [15].
- Planning for overall school improvement by gaining consistency of pedagogical approaches across the schools and structured guidance for the stakeholders (teachers, students) about what it is they are expected to do [26], 29], [38].

In the same vein, this study looks at how information captured from the several coaching and mentoring programs (case study of the writing centers) across the globe can be used to understand the state-of-the-art in the development of the faculties/students, and to provide solutions to the ever-increasing need to improve educational supporting services and quality in a competitive and rapidly changing educational environment/market by benefiting from a data-driven design model and/or process innovation.

From theoretical perspective, three main models are currently being discussed in relation to Coaching and Mentoring programs or practice [15]. This includes the Zone of Proximal Development (ZPD) [48], Biggs's Presage-Process-Product Model [49], and The GROW Model [34], [50], [51]. However, regardless of the context in which the aforementioned models are used/applied, one common goal of the models is that they play a significant role in coaching and mentoring, since they are all useful in maximizing the potentials or academic performance of the users/coaches, vice and versa. While some coaching programs may not use models at all, or constraining for the coaches; other types of coaching models exist in the literature, each with its own different tactics of scaling and evaluating the outcomes, building upon other existing models, or escalating the results and action plans to help in assurance of coaching practices. These includes models such as ACHIEVE Model [52], CIGAR Model [53], and OSKAR Model [54].

In practice, there is emerging evidence-based research that Coaching and Mentoring is a powerful tool to support learning and development for students, teachers, school leaders, and their educational establishments, with majority of the research coming from the UK, USA and Australia [50], [55]. To note, the DDI World Leadership Development and Assessment consulting (DDI) [56] disclosed in its Mentoring Global Leadership Forecast in 2018 that 54% of institutions in the top third of financial performance have formal mentoring programs, as opposed to 33% in the bottom third [41]. According to Moore [41] the study conducted by Bellevue University in the United States found that

mentorship increased institutional retention by 23% with a major part of the organization experiencing a 25% higher retention rate when the employees participate in a mentoring program. The participating organizations showed or wanted 50% more time dedicated to mentorship and coaching, and twice as much time focused on developing leadership skills. In Canada, the teachers' training program in Western Québec School Board (WQSB), have grown fame as a means to supporting beginner teachers. Although the programs vary greatly in terms of delivery and effectiveness [42] as observed also in the results of this study. Back in late 90's, Veenman *et al.* [57] have studied the effect of a coaching and mentoring programme designed to stimulate self-reflection and self-analysis to improve instructional effectiveness in beginner teachers in a Dutch School. In an under-resourced higher education setting in Africa, Olivier & Burton [5] found that a structured peer mentoring programme, in which a mentor works with large group of mentees, can be a useful tool to assist with students' transition to university and contributed to the students' academic, social, and personal integration. Whereas, in a public university in the United States, Kearney *et al.* [43] found that the use of technology-based instructional strategy can help in establishing trust, providing critical feedback and broadening perspectives of the school' leaders. Recent thematic study by Hastings and Pennington [50] which identified methods used by six experienced external team coaches practicing in the UK, USA and Australia, shows that *team coaching* distinguishes itself from *team building* due to its focus on a performance outcome, and from *team training*, due to a systemic focus. The study [50] notes that coaches at all levels reported an eclectic and agnostic approach (which stresses the need to take a theoretical, philosophically fluid, and pragmatic approach) as key to which is being able to draw from and adapt a wide array of tools, theories, and methods for executive coaching. Drawn from studies both within and outside the UK, mentoring and coaching are considered to be central to enhancing pedagogical and subject-related knowledge and understanding [29], [58]. This includes national educational initiatives such as The National Grid for Learning (NGfL) [59] and imperatives such as the School Whiteboard Expansion project called Interactive Whiteboard (IWB) [60], [61] designed to utilize *technology-based* opportunities and affordances that are more feasible, available, and accessible to trainees and teachers in England. Also, the Mentoring and Coaching in the Further Education and Skills Sector [11] was a project designed in England to support the use of mentoring and coaching as a remedial strategy to address the perceived under-performance of teachers, and encourages teachers to openly discuss and seek to address their perceived limitations and professional learning and development (PLD) needs [29] in a safe, trusting environment.

Moreover, The International Coaching Federation (ICF) [35] notes in its recent study that ''coaching'' has, over the past few decades, become significantly more prevalent with a total of 71,000 coaching practitioners operating globally as

of 2019 in comparison to 53,300 in 2015, 47,500 in 2012, and 2,100 in 1999. According to ICF [35], the growth was especially strong in the emerging regions of Latin America and the Caribbean region (+174%) and Eastern Europe (+40%) with number of organizations/leaders using coaching skills estimated to have risen by almost half (+46%). Even though Asia more than doubled (+124%) in coaching skills, Latin America and the Caribbean recorded the largest growth (+198%). Overall, all turning ''Coaching and Mentoring'' into a USD$2.849 billion global business, representing a 21% increase over the 2015 estimate of USD$2.356 billion [35] which is a significant impact over the years both in terms of ''return in investment'' and ''global framework of practice'' in coaching and mentoring for education, professional learning, and socio-economic development.

In summary, this study shows that one of the most potent ways to address the identified challenges or emerging themes with respect to the educational coaching and mentoring programs, both in theory and practice, and to achieve the goals of the various educational support services and initiatives; is through a data-driven (user-centric) approach [13], [22], [62]. It is noteworthy to mention that this study believes that by leveraging and understanding the real opinions of the different users of the educational supporting services (data) that the results can be used to identify patterns which can then be transliterated into actionable plans, particularly in alignment with the five main themes that have emerged from the pieces of evidence we drew from the existing works of literature [14], [15], [21]. Besides, we note that when the said actions/plans are aligned with the main goal of ensuring quality of the different offered services; that not only will there be an enhanced support and benefit for the stakeholders (e.g., faculties, students, managers, educators). But also, there will surface an increased productivity and effectiveness of the several educational coaching programs in general [6]. Thus, we proposed the Data-driven Support and Decision Model (DSDM) (Section III) that can be used to analyze and understand the perspectives of the users (through a quantitative and qualitative lens) of the different educational coaching programs and services. Our main objective was particularly directed towards the extraction of meaningful information or insights from the readily available datasets about the educational coaching programs, and achieving as a whole, a quality educational service model and/or pedagogical professional development schemes in general.

III. METHODOLOGY

Fig. 1 is the conceptual framework or architecture of the data-driven support and decision model (DSDM) the work proposes for implementation of the defined method in this paper. The proposed model (DSDM) is described as an amalgamation of the data-structure approach [22] that is based on the descriptive decision theory [63], [64]; which is concerned with the study of the rationale behind the decisions that users are disposed to make through a statistical means and textual data quantification or evaluation.

As demonstrated in Fig. 1, the DSDM model (data-driven support and decision model) is designed by taking into account three main components:

1) *Process domain data:* describes information about the users (e.g. faculties, students, etc.) that uses the different services of the writing centers or coaching programs.
2) *Model deployment and data analysis:* includes the real-time application, data-structure (user-centric) analysis, and model deployment using the mixed methodology.
3) *Educational process innovation:* constitutes an improved or enhanced performance and support for the users through information drawn from the model and/or analysis of the readily available data.

It is noteworthy to mention that although the DSDM model is explained using the case study of the writing center services, the resultant model can be applied to any organizational process or context provided that there is an availability of data recorded about the users in question.

A. EXPERIMENTAL SETUP

Given the mixed methodology or approach of this paper, a quantitative analysis (Linear and Mixed-effect logistic regression) was carried out to statistically determine the potential cause effects (correlation and significant differences) between the different variables (factors) that motivate the users to utilize the services of the writing centers. While in the qualitative analysis (Text mining) that we performed, we trail to understand the level of impact of the different comments (opinions) provided by the participants with regards to the writing center services. This involves identifying the most frequently used terms (wordcloud) in the data, the correlation between the most frequent terms, and sentiment and emotional valence analysis of the different users' comments as contained in the data.

B. INSTRUMENT

The research instrument went through different stages of validation in order to ensure the reliability and validity of the collected data. First, we conducted a pilot test by discussing the designed survey with expert within the writing center pedagogy to have a clear understanding of the connotations and evaluation mechanisms of the constructs that we considered for the research as defined in the rationale of this study. The administering of the survey was voluntary, and it took approximately 3 to 5 minutes for the participants to complete the questionnaire. The participants answered a 15-item questionnaire with both ranked Likert-scale, multiple and single choice questions, and an open-ended question. The survey was provided in over 35 different languages that allowed the participants to complete the answers in any language of their choice, as well as, to cover the target population across the globe taking into account the different linguistic and cultural origins. The estimated sample size for the research
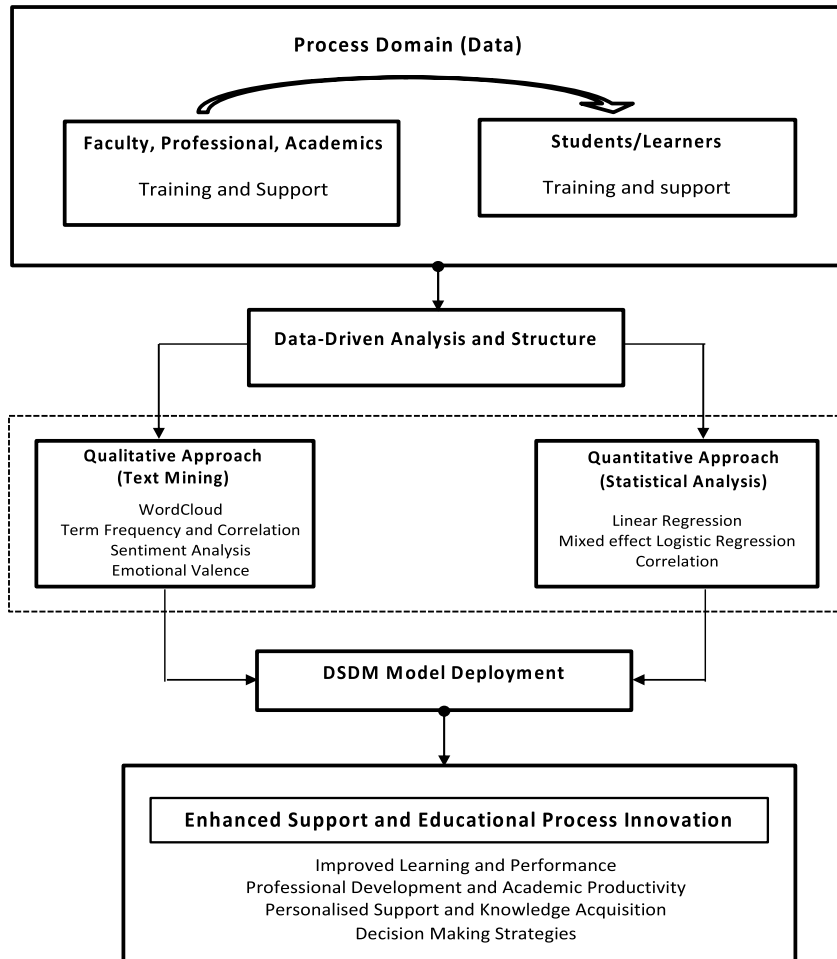
FIGURE 1. Data-driven support and decision model (DSDM).

was a minimum of 40 which we considered to be a scientifically acceptable large enough sample size ($n > 30$ or 40) [65]–[69] for conducting the different statistical analysis and procedures described in this study.

Second, the main constructs we targeted while designing the instrument was to understand who goes to the writing centers or educational coaching programs, and why? Thus, to understand (i) what services do the users mostly require or utilize when seeking the educational coaching programs or support? (ii) what could be the influential factors that affect such choices considering the different services offered by the writing centers or coaching programs? and (iii) how frequently do the users of the coaching/mentoring programs return or seek for support with their different educational activities/preferences? Accordingly, based on the identified constructs or research objective, we analyzed the reliability and validity of the following items in the survey that allowed us to answer the questions as reported in Table 1.

As gathered in Table 1, Cronbach's Alpha test [70], [71] was used to analyze the survey items to determine its reliability and adequacy in measuring the research objectives. The results of the Cronbach Alpha test ($\alpha = 0.76$) shows that the research items were valid and reliable (adequate) for testing

the set-out constructs. Also, it is important to mention that the last question in the survey which we used to conduct the qualitative analysis (text mining) is a text-based open-ended comment question ''What additional service(s) do you think would improve the operations of your Writing Lab/Center?'' that was asked to the participants which we did not include in the Items' test.

C. DATA SAMPLING

The study used the data from the Writing Lab Research Survey conducted at the host Institute for Future of Education [72] to carry out the experimentations and analysis. The questionnaire was sent through the information (database) about the several writing centers that are registered in the International Writing Centers Association (IWCA) [18] distributed across the several higher education institutions of the globe. Therefore, a wide variety of the writing centers services, user perspectives, and variables considered for this research were represented in the data. For our analysis, we made use of the data collected over a period of six months between May-Nov 2019 to conduct the investigations. The collected data consists of a total of $n = 222$ respondents who participated in the survey. To validate the

TABLE 1. Reliability test of the research item and survey.

Research Instrument and Item Statistics (*n*=222)				
Construct/Item	Item Selection	Mean	Std. D	Scale
What services do the users mostly require or utilize when seeking the coaching programs or support?	Tutoring	1.32	0.90	5 point Likert
	Workshops	2.52	1.17	5 point Likert
	English Editing/Translation	3.21	1.68	5 point Likert
	Assignments/Thesis/Projects	1.73	1.23	5 point Likert
	Conference Preparation/Funding	3.54	1.55	5 point Likert
	Articles/Books/Chapters	3.45	1.48	5 point Likert
	Grants/Scholarship Applications	3.06	1.42	5 point Likert
	Other services	0.42	1.11	5 point Likert
How frequent the clients return for more support and/or to use the services?	Very often to Not at all	1.85	0.87	Single choice Rank
Suggestion of client's visits to the writing centers	Voluntary vs Mandatory	1.98	0.65	Single choice Rank
Reliability Statistics		Mean	Std. D	Variance
Scale Statistics	Items	23.08	7.12	50.71
	Within/Between Items	232.74	2094.69	197.52
Cronbach's Alpha		0.76		
Cronbach's Alpha Based on Std. Items		0.73		
Note: Significance level ($p > 0.70$)				

adequate sample size for the study, we assume that half (50%) of the respondents must have either used or works within the settings of the educational coaching or writing center programs, and have a training or development program in place in their different institutions to give us maximum variability [73]. To do this, we assumed a 95% confidence level with a margin of error of between ±4% to ±8%. This means that there could only be a maximum of 8% percent chance, typically determined through precision, of our sample results differing from the target population. The 95% confidence level means that 95 out of 100 samples in our survey will have the true value of the population within the specified margin of error. Moreover, the acceptable margin of error used by most survey researchers typically falls between 4% and 8% at the 95% confidence level [74], [75]. To this end, the estimate of the margin of error is given by $1/\sqrt{N}$ [76]–[78] where N is the number of participants in our sample ($n = 222$). This resulted to a margin of error of equal to 0.06. Thus, implying that if we eventually find that 50% of our participants have used or works within the educational coaching or writing center programs, and have a training or development program in place in their different settings, then the actual proportion of the target population and sample we studied/analyzed could only vary by ±6% (0.06). Our survey shows that a large number of the centers were mainly focused

on coaching and support for the clients (Students = 89.83%, Faculties = 7.20%, both Students and Faculty = 2.97%) with 70.44% agreeing to conduct their own research and development initiatives as part of activities of the establishments as discussed in detail in the discussion section (Section IV). To conduct the experiment, after cleaning the data by filtering out incomplete responses and those participants who have not commented in the data; we utilized a total sample of $n = 158$ for the quantitative analysis (Linear and Mixed-effect logistic regression), and $n = 146$ for the qualitative analysis (Text mining) as presented in detail in the subsequent Sections III −D(1) and D(2).

D. DATA ANALYSIS AND RESULTS

The data analysis and implementation of the proposed method (DSDM) of this paper involves both a quantitative and qualitative analysis we conducted by considering the described research parameters or items. This was done using R statistics software [79]. Each step and results of the applied methods are described in detail in the following section D(1) and D(2).

1) QUANTITATIVE ANALYSIS

For the *regression* analysis: first, we applied a Linear regression (OLS) model to analyze the relationship that the users

TABLE 2. Generalized linear mixed model fit (random and fixed effect) analysis for recommendation of visits vs writing center services.

glmerModel: Recommendation for Visits vs Writing center Services				
Random effects (Intercept):			**Std.Dev.**	**Variance**
Tutoring			4.915e-10	2.416e-19
Workshops			0.000	0.000
English Editing/Translation			0.000	0.000
Assignments/Thesis/Projects			0.491	0.241
Conference Preparation/Funding			0.000	0.000
Articles/Books/Chapters			0.000	0.000
Grants/Scholarship Applications			0.572	0.327
Fixed effects (Intercept):	**Estimate**	**Std. Error**	**z value**	**Pr(>|z|)**
Tutoring	-8.558	3.888	2.201	0.027*
Workshops	-8.558	3.888	2.201	0.027*
English Editing/Translation	-8.558	3.888	2.201	0.027*
Assignments/Thesis/Projects	-8.634	4.128	-2.092	0.036*
Conference Preparation/Funding	-8.558	3.888	-2.201	0.027*
Articles/Books/Chapters	-8.558	3.888	-2.201	0.027*
Grants/Scholarship Applications	-9.410	4.998	-1.882	0.0598.
Note: Significance code ($p<=0.05$) 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1				

frequency of visit or return for support/use of the writing center services (predictor variable) have on the participants recommendation for visits to the writing centers (response variable), i.e., lm(frequency of visits ∼ recommendation of visit). Our hypothesis for testing whether the two variables were related (correlated) was *if* the coefficient of linearity, determined through the p-value or significance level, is less than 0.05 ($p < 0.05$), *then* we assume there is a correlation between the considered variables. In other words, an increase or decrease in the clients visit to the writing centers will consequently affect whether the participants suggests the visit to the writing centers to be voluntary or mandatory (H_1). *Else if* the significant level is greater than 0.05 ($p < 0.05$) *then* we reject the alternative hypothesis (H_1) and assume that the variables are not dependent or correlated with each other (H_0). Consequently, the result of the OLS model statistically shows that there exists a linear relationship between the frequency of visits and recommendation for visits to the writing centers ($Z = 14.74, p = .000$). Therefore, we accept the H_1.

Furthermore, we deemed it important to conduct a Mixed-effect regression analysis to determine the effects (random and fixed) that the recommendation of visits to the writing centers have on the users choices by taking into account the different individual services offered by the writing centers (see: Table 1). To do this, we applied the generalized linear mixed effect regression (glmer) model in R [79]; whereby for the random and fixed effect model, we assume that the unobserved effects (recommendation for visits) are uncorrelated with (statistically independent of) all the observed predictor variables (writing center services) (H_0). Else, in our model, we can presume that the observed effects or response variable (recommendation of visits) have some associations with the predictor variables, i.e., the writing center services (H_1). In essence, we evaluated the significant factors that

may influence the participants' recommendation for visits to the writing centers (response variable) in the glmer model, we performed for the individual cases, by considering the different services the writing centers offer (predictor variable). The results are as shown in Table 2.

As gathered in Table 2, although we observed that there may be a considerable variation between the random effects for the different supporting services; the fixed effect values (predominantly $p = 0.027$) (Table 2) shows that the analyzed variables were all significant when recommending the visits to the writing centers. The deviance residuals are also statistically acceptable as they are close to being centered on zero. Therefore, the assumption that the recommendation for visits (voluntary vs mandatory) is dependent on the different supporting services is strong as the p-value for the different measurement variables were statistically significant $p <= 0.05$ (Table 2). Thus, we conclude that the different services are a good predictor of recommendations for visits by the stakeholders. It is also noteworthy to mention that services such as "tutoring" ($Z = 2.201, p = 0.027$) is a major factor that influences recommendations for visits to the writing centers with both the random and fixed effects showing to be exceptionally significant (see: Table 2). This is also evidenced in the chart and figures we reported in Fig. 2 and Table 3.

2) QUALITATIVE ANALYSIS

To expound on the quantitative analysis and to triangulate the outcome of our method through a qualitative lens or approach; we conducted a Text mining study of the different comments given by the participants in response to the following question "what additional services do you think would improve the operations of your writing Lab/Center?". To implements this second part of the DSDM model, we first determined the top most frequently used terms (words) in the
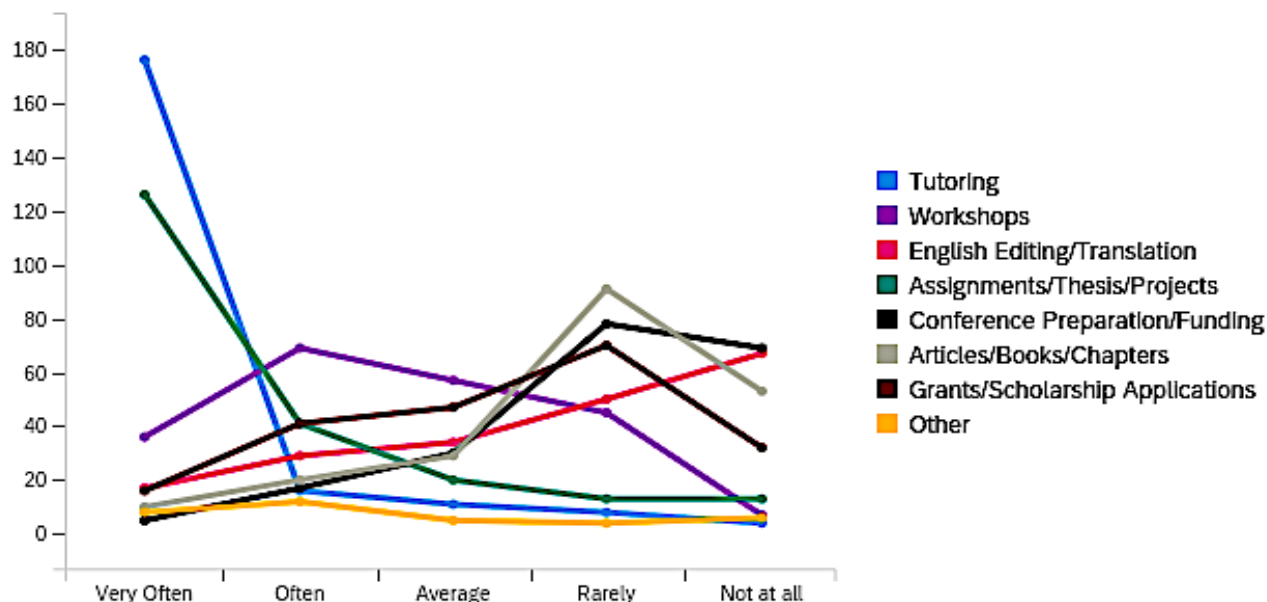
FIGURE 2. Chart representing the frequency of writing center services visits/requests by the users.

TABLE 3. Distribution of the frequency (%) of visits to the writing centers by the users.

Writing Center services	Frequency of users visits to the writing centers				
	Very Often	Often	Average	Rarely	Not at all
Tutoring	81.99%	7.11%	5.21%	3.79%	1.90%
Workshops	16.75%	32.54%	25.84%	21.53%	3.35%
English Editing/Translation	8.29%	15.03%	17.62%	24.87%	34.20%
Assignments/Thesis/Projects	59.62%	19.23%	9.62%	6.25%	5.29%
Conference Preparation/Funding	2.05%	8.72%	15.38%	40.00%	33.85%
Articles/Books/Chapters	5.05%	9.09%	14.14%	45.96%	25.76%
Grants/Scholarship Applications	7.46%	20.40%	23.38%	34.33%	14.43%
Other services	23.53%	35.29%	11.76%	11.76%	17.65%

comments used by the participants to describe the writing center' services as contained in the data, and then consequently, determined the correlation of the identified terms. This was done using R statistics and packages [79]. To do this, we built a corpus (library of words) and term document matrix (dataframe) to allow for the text-based analysis (i.e., sentiment analysis and emotional valence) to follow. Computationally, we analyzed the data by representing the texts as a dataframe where: each row represents a single comment from the source file. As shown in Fig. 3, Fig. 4, and Table 4; the word frequencies were represented according to the highest to lowest occurring words (Fig. 4), whereas the correlation of words (Table 4) was determined by measuring the probability scales from 0 to 1 where: 0 represents 0% and 1 represents 100% likelihood of the stakeholders using the corresponding terms across the analyzed data.

As gathered in Table 4, Fig. 3 and Fig. 4; the outcome of the text analysis shows that most users of the writing center are motivated by the need to gain ''support'' with their educational activities or undertakings. Also noteworthy is the fact that term such as ''support'' tends to not only be the most

frequently used word (term) by the participants across the data, but also appears to be the most correlated word with the other terms we found (see: Table 4). Although terms like ''tutoring'', ''training'', and ''strategies'' were also found to be substantial.

Furthermore, we considered it necessary to determine the impact (sentiment analysis and emotional valence) of the different combinations of words (i.e., the individual comments provided by the respondents). To do this, we first determined the average sentiment score for the individual comments as contained in the dataset (see: Table 5), and then subsequently quantified the impact (intensity) of the different comments (emotional valence) by determining the goodness (positive), neutrality, and aversiveness (negative) of each of the comments [7], [80]–[82] as shown in Table 6. We also provide some example of such comments (i.e., positive, neutral, negative) (see: Fig. 6).

To explain the aforementioned steps in detail; for the sentiment analysis (Table 5), we made use of the *get_sentiment* and *get_nrc_sentiment* function in R [79] to not only determine the different word counts that make up each of the individual
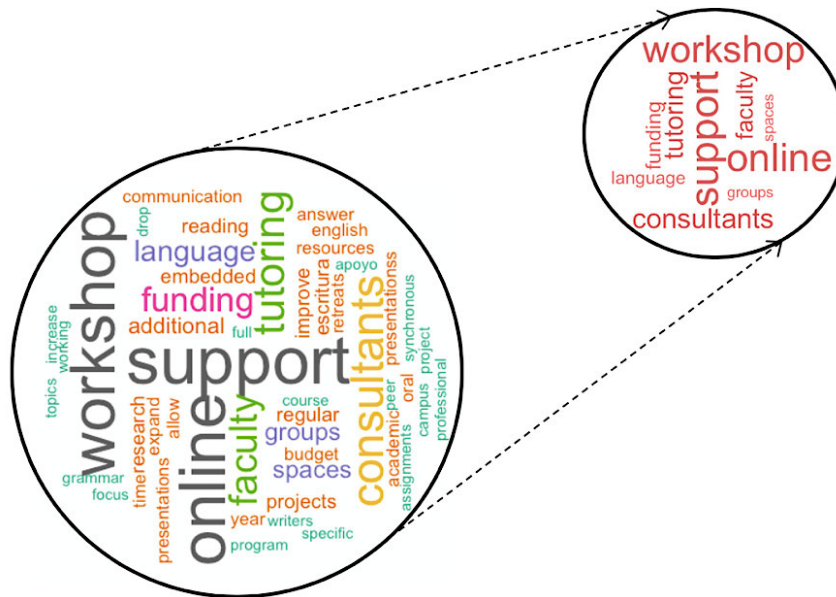
FIGURE 3. Wordcloud for the top most frequently used term by the participants in the data.

TABLE 4. Frequency and correlation of the top most used terms across the dataset.

Comments by the Participants						
Frequency of Terms		**Correlation of Terms (Cor)**				
Term	**Freq.**	**Terms association and Average probability**				
Support	25	strategic	training	language	presentations	funding
		0.50	0.32	0.27	0.12	0.11
Online	24	tutoring	essay	conferencing	handouts	learning
		0.46	0.39	0.18	0.18	0.10
Workshop	23	foster	grammar	writers	consultations	advising
		0.57	0.18	0.18	0.17	0.17
Consultants	16	management	strategies	training	tutor	dedicated
		0.73	0.51	0.17	0.17	0.10
Tutoring	15	assessment	online	peer	forums	subjects
		0.48	0.46	0.25	0.23	0.23
Faculty	13	strategic	development	consultations	funding	support
		0.27	0.27	0.27	0.17	0.14
Funding	11	voluntary	mandates	faculty	employees	support
		0.55	0.27	0.17	0.17	0.11
Language	9	english	specialist	multiliteracy	program	support
		0.48	0.46	0.32	0.28	0.27
Groups	7	conversation	retreats	expand	support	funding
		0.46	0.32	0.25	0.23	0.10
Spaces	7	growing	session	write	digital	synchronous
		0.37	0.37	0.37	0.25	0.19

Note: Cor limit = 0 to 1 where 0 represents 0% and 1 represents 100% likelihood of the individual terms associated with the corresponding freq. term

comments but also to deduce the sentiment scores for each of the comments. The average sentiment scores were represented as interval between minus (−) to 0 and 0 to plus (+) values to denote the level of impact for each of the comments. As shown in Table 5, we present the first five comments and last five comments in the data ($n = 146$) to show the resultant outcomes.

Next, we measured the different (polarization) levels (impact) of the emotions (valence score) expressed by the participants for the purpose of comparison and validation of
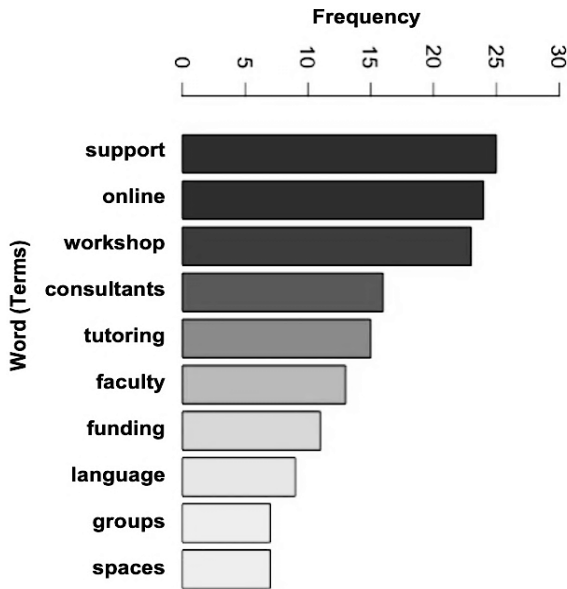
Frequency

FIGURE 4. Chart representing the frequency of the top 10 most used terms by the participants.

TABLE 5. Average sentiment scores for the different individual comments in the data (*n* = 146).

	element_id	word_count	ave_sentm
	1:	16	0.312500
	2:	2	0.3181981
	3:	1	0.7500000
	4:	55	0.1573270
	5:	3	0.2886751

	142:	11	0.3768892
	143:	12	0.1726211
	144:	1	0.0000000
	145:	13	0.1248075
	146:	3	0.0000000
Min	1	1	-0.5000
Median	73.5	7	0.1018
Mean	73.5	10.95	0.1708
Max	146	70	1.2139

- **element_id** represents the individual comments by the students
- **word_count** denotes the number of words in each comment
- **sd** represents the standard deviation, and
- **ave_sentm** is average sentiment score for each of the comments.

the method. We quantified the sentiments by ascertaining the goodness (positive $++1$), neutrality (0), and aversiveness (negative -1) of the different comments. Specifically, we assume that a positive $(+)$ valence signifies attractiveness (goodness) of the associated comment, whereas zero (0) denotes a neutral comment and a negative $(-)$ valence means aversiveness (badness) of the evaluated comment in question. The results are as shown in Table 6 and Fig. 5.

As shown in Table 6, the comments column labeled (1) - (144) represents the individual id of the different comments in each row; whereby the first scores in each row

TABLE 6. Valence scores for the different comments provided by the stakeholders in the data.

Comments (*n*=146)	Emotional Valence (score)
[1]	2 1 1 4 0 0 5 0 1 0 1 1 1
[14]	2 6 0 0 0 1 3 0 2 1 2 2 -1
[27]	0 0 4 1 7 0 0 0 0 0 1 1 0
[40]	1 0 1 1 3 0 0 1 2 0 1 0 0
[53]	0 1 1 3 0 0 1 3 0 1 0 1 2
[66]	1 1 1 2 0 0 0 0 0 0 0 0 0
[79]	1 1 0 0 0 0 0 -1 0 4 1 0 0
[92]	2 1 2 1 0 0 0 2 1 0 0 0 1
[105]	2 1 1 1 0 3 0 0 1 1 1 0 1
[118]	0 0 0 1 0 0 0 0 1 3 0 1 2
[131]	1 1 0 0 0 0 0 -2 3 1 7 1 0
[144]	0 0 0

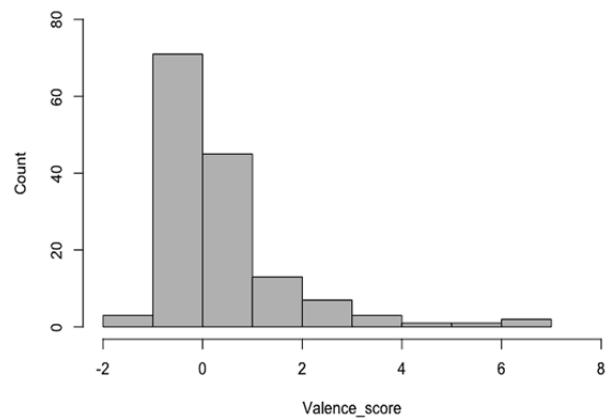Note: Min = -2, Median = 0, Mean = 0.8562, Max = 7

FIGURE 5. Chart representing the different levels of emotion (valence score) expressed by the participants.

represents the id of the corresponding comments. There were a total of $n = 146$ comments used for the analysis. Each emotion score/value implies either a positive $(+)$, neutral (0), or negative $(-)$ valence [7], [80]–[82]. Accordingly, considering the intensity (polarity) of the analyzed comments, we note that the min value (representing a negative emotion) was -2, and the max value (positive emotion) was 7. Notably, as shown in Fig. 5 and Table 6, we found that majority of the emotions were classified to be neutral and positive, i.e., between 0 and 1 (Fig. 5). In addition, as highlighted in Table 6, we show some example of the comments that signifies both a positive, neutral, and negative emotions (valence) in order to validate the outcomes of the text analysis as shown in Fig. 6.

In Fig. 7, we summarized the outcome of the DSDM model applied to determine intensity of the emotions expressed by the participants in relation to the writing center services. We performed a cumulative analysis of the impact of the participants' opinions (emotions) across the dataset. The definition of emotional valence and its implication for the different studied phenomenon have been discussed in the current literature by different studies especially with
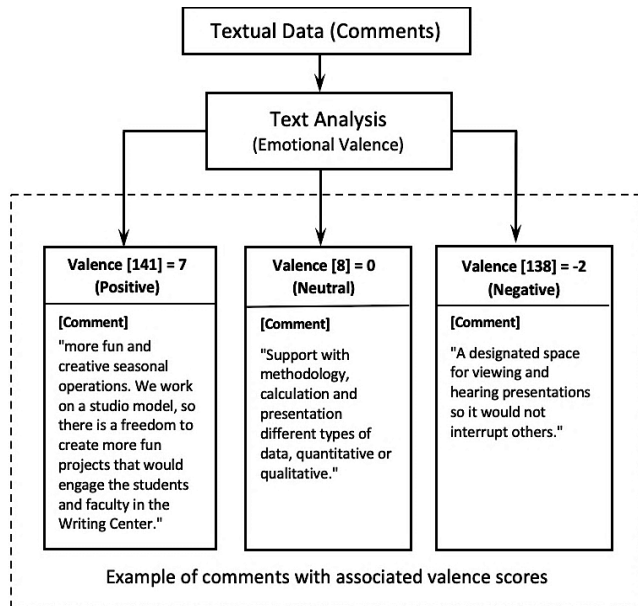
FIGURE 6. Example of the comments with their emotional valence scores by the participants in the data.
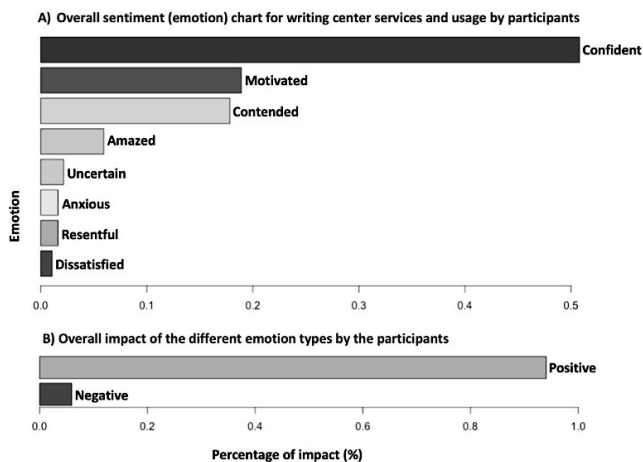

FIGURE 7. Overall impact (intensities) of the emotions expressed by the participants in relation to the writing center services.

regards to the various domain areas of its application [7], [8], [82]–[84]. As illustrated in this study, such type of analysis (sentiment and emotional valence) is achieved by extracting and leveraging the underlying information (textual data) that are contained in the captured datasets. Accordingly, we adopted the sentiment/emotion polarization or classifications of educational datasets as described in Litman and Forbes [82] and Okoye *et al.* [81] to classify the different types or categories of emotions we have found in the study in order to determine their overall impact across the data. The results are as shown in Fig. 7 (A) and (B).

IV. DISCUSSION

This study used data collected from the educational domain, case study of writing centers, to describe a data-driven support and decision model (DSDM) (Fig. 1). The DSDM model was applied to understand the perspectives of the various users of the writing center' services or coaching programs,

and the influential factors (impact) on the choice of services made by the users. Considering the findings of this study, it can be said that most users of the coaching or mentoring programs (e.g., writing centers) do so due to the need to gain ''support'' with their different educational activities, e.g., help with academic writing, tutoring, mentoring, academic publications, performance, and productivity, etc.

The series of experiments and analysis we conducted (see: Sections III - D(1) and D(2)), shows that the several offered services or an attempt to maximize the professional development/outcome of the coaching programs, is not only applicable to just the users of the different offered services (e.g., to improve their writing skills, production, competences, or knowledge acquisition, etc.). But is also beneficial for the different educational institutions whose goals are to enhance the Schools' vision and academic rankings or status. For example, in the research survey we found that a large number of the writing centers are mainly focused on the students' support and development (89.83%) in comparison to 7.20% that focuses only on Faculties development, and 2.97% that focused on both (students and faculties). Also, when we analyzed which discipline do most of the users come from? We found that majority of the writing center' users are from the areas of Arts & Humanities (33.48%), followed by Social Sciences (20.35%), then Natural Sciences (12.04%), Engineering (10.94%), Business & Law (10.94%), Medicine (4.81%), and Other backgrounds (7.44%). Besides, we note that 70.44% of the writing centers agrees to conducting their own Research as part of activities of the establishments, against 29.56% that do not. Plus, when we considered the goals and global impact of the educational support services especially in today's competitive market and ranking of institutions as discussed in the background information section (Section II), we purportedly note that most of the contributing factors comes from the faculty members (e.g., research and development activities that results in publications, international conferences or workshops, research projects, etc.). Thus far, we believe that educational or professional service providers, coaching and mentoring programs, or writing centers whose resources are also directed towards the development and training of the faculties will benefit significantly in the aforenoted aspects. Moreover, the students have been shown to be direct consumers of the academic tutors' intellectual properties or knowledge [13]. In turn, we strongly believe that the stakeholders (teachers, students, HEIs, etc.) will not only benefit from exploring a wider coaching practice, e.g., settings whereby the faculties are directly trained to provide adequate academic support for the students. But will also inadvertently introduce (ensure) a more value-added delivery of professional development service, and/or early attainment of relevant skills needed by the students and their faculties who seek the educational support, as highlighted in the literature review section.

From practical perspective, there is evidence that early factors that spans the emergence of data-driven methods for analysing or understanding the educational processes, such as

the DSDM model described in this paper, includes the need to support and provide effective pedagogies for professional development and quality of Service Science [85] in the diaspora. Extensive user-based explanatory analyses have also been carried out in terms of the Coaching and Mentoring programs with minimal emphasis being placed on implementing solutions or practices that supports the faculties/students development [86]. Moreover, Etzkorn & Braddock [85] notes that in order to support or provide an effective mentoring/coaching, it is necessary that higher educational organizations institutionalize the coaching or mentoring initiatives and develop a purposeful training program in which they can train and support the mentees and mentors, vice and versa, in addition to allowing for flexibility of the faculties input at various stages. Interestingly, the results of this study as reported in Tables 3 to 6 shows that if the educational institutions or coaching programs (case study of the writing centers) would dedicate adequate resources towards provision of an effective "support" ecosystem for the stakeholders (e.g., through workshops, online courses/certifications, tutoring and mentoring, etc.), not only will there be an exponential increase in delivery of services and quality of the programs [16], [17], but also expectations on why the users visit and/or require the services of the coaching and mentoring programs will also be eventually met.

To triangulate the outcome of our study with the existing works of literature; first we note, within the educational coaching and writing center pedagogy, methods which draws upon the socio-pedagogical research on users' choices to use educational supporting services [87]. For example, Salem [87] studied the social dimensions of decision making in terms of writing center practices, and notes that the magnitudes have not been largely implemented since views about the writing centers (e.g. what they are? services they offer? who goes to writing centers? and why?) are related and goes beyond the current theories and practices. Along these lines, the work done in this study aimed to disentangle the aforementioned magnitudes by taking into account the use of a data-structure method or approach [22] to inform the perspective of the users, as well as, the future directions of the coaching and mentoring programs. For instance, the overall positive satisfaction we observed for the participants (Fig. 7) could be a justification for the reason as to why the empirical study by Hastings & Pennington [50] notes that users (e.g., coaches and mentors) at all levels reported an eclectic and agnostic approach as key to which is being able to draw from and adapt a wide array of tools, theories and methods for coaching. Moreover, taking into account the scientific and innovative implications of the proposed methods, such as the DSDM model (Fig. 1) described in this study, Salem [87] notes that there is nothing to lose and everything to gain from such type of research that are backed by the most powerful, up-to-date, and rigorous approach. Henceforth, this study shows that there is a tenacious need to develop innovative methodologies or approaches that can be used to support activities of the different educational coaching programs or writing

centers by taking into account the insights (information) drawn from the collections of data recorded about the different services and users, as well as, transforming the derived information into actionable acumens and/or decision-making strategies.

The aforementioned affirmations points us to the second driver for the work done in this study. We note that the concept of *datafication* [22], [81], [88] which forms the basis of the DSDM model we proposed in this paper, and one of the main themes that have emerged within the discourse of the Coaching and Mentoring programs as noted in the background information section [14], [15], [21]; have been professed to be one of the most effective ways to lay foundation for organizational innovation (e.g., the coaching and mentoring programs) particularly through *digitalization* of the processes and/or services [22]. Through datafication, organizations are able to create space for *meaning-making* and *theoretical reflection* [22] on the different services or practices that underlies the said institutions. Interestingly, while Williamson [88] notes that a lot of the organizations have experienced transformations in the past as new forms of digital data were being generated, analyzed, and used to support the decision-making processes. The results of the experimentation and outcome of this study also shows that the "data-driven" method plays a vital role in understanding and enabling such innovative development within the clearer context of the educational coaching and mentoring programs. This includes leveraging the state-of-the-art techno-structure approaches such as the Text mining method defined in this study.

Last but not least, is also the fact that the mixed methods (quantitative and qualitative) for analyzing and determining the impact of the educational services or processes have shown to be effective [19], [20], [89]. Accordingly, the mixed methodology and analysis performed in this study can be defined as implementation of a user-centric model (DSDM) (Fig. 1) that amalgamates the *quantitative* and *qualitative* approach to research based on a techno-data-structure applied for a holistic evaluation of the impact and quality of the different services offered by the writing centers or educational coaching programs in general. Theoretically, while the proposed mixed methodology (quantitative and qualitative) in this study opens the way for scholars or educators to embrace a deeper and cross-evaluation method that not only involves the process of statistically drawing inferences about the studied phenomenon, but also incorporates a powerful text mining technique that proves useful toward extraction of relevant information from the readily available datasets. Thus, in essence, the techno-data-structure element or component of the DSDM model proves to open the way for the *use of data* to analyze and inform the state-of-the-art or future directions of the educational coaching/mentoring programs by being able to draw inferences and/or meaningful insights towards improvement of the quality of services, decision making strategies, and users' experience at large.

V. CONCLUSION

This study offers a user-centered qualitative and quantitative approach that can be used to evaluate and improve the impact of the educational coaching and mentoring programs. The mixed methodology or approach (DSDM model) we introduced in this study can be defined as a tool that can be applied for holistic evaluation of educational services such as the coaching and mentoring programs. The authors demonstrated the practical application of the method (DSDM) using data collected from international writing centers across the globe. In theory, the results of our study shows that a well-defined learning performance or professional development strategy for educators is essential towards achieving quality of service and support for the stakeholders. Future works can adopt the proposed model described in this study to analyze the impact of the different offered services or training programs in the different organizational contexts, or yet, can modify the proposed model to include further components that may have not already been introduced in this paper.

REFERENCES

[1] B. W. Walker, "Tackling the personal tutoring conundrum: A qualitative study on the impact of developmental support for tutors," *Act. Learn. Higher Educ.*, Jun. 2020, Art. no. 146978742092600, doi: 10.1177/1469787420926007.

[2] A. Medne, I. Lapina, and A. Zeps, "Sustainability of a university's quality system: Adaptation of the EFQM excellence model," *Int. J. Qual. Service Sci.*, vol. 12, no. 1, pp. 29–43, Feb. 2020, doi: 10.1108/IJQSS-09-2019-0108.

[3] M. Mourad, "Quality assurance as a driver of information management strategy: Stakeholders' perspectives in higher education," *J. Enterprise Inf. Manage.*, vol. 30, no. 5, pp. 779–794, Sep. 2017, doi: 10.1108/JEIM-06-2016-0104.

[4] Z. E. Tóth and V. Surman, "Listening to the voice of students, developing a service quality measuring and evaluating framework for a special course," *Int. J. Qual. Service Sci.*, vol. 11, no. 4, pp. 455–472, Dec. 2019, doi: 10.1108/IJQSS-02-2019-0025.

[5] C. Olivier and C. Burton, "A large-group peer mentoring programme in an under-resourced higher education environment," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 4, pp. 341–356, Jul. 2020, doi: 10.1108/IJMCE-07-2019-0074.

[6] M. Gomes and W. Ma, "Engaging expectations: Measuring helpfulness as an alternative to student evaluations of teaching," *Assessing Writing*, vol. 45, Jul. 2020, Art. no. 100464, doi: 10.1016/j.asw.2020.100464.

[7] S. Kiritchenko, X. Zhu, and S. M. Mohammad, "Sentiment analysis of short informal texts," *J. Artif. Intell. Res.*, vol. 50, pp. 723–762, Aug. 2014.

[8] L. Tian, C. Lai, and J. D. Moore, "Polarity and intensity: The two aspects of sentiment analysis," 2018, *arXiv:1807.01466*. [Online]. Available: https://arxiv.org/abs/1807.01466

[9] L. D. Schumacher, L. Jäger, R. Meier, Y. Rachamin, O. Senn, T. Rosemann, and S. Markun, "Trends and between-physician variation in laboratory testing: A retrospective longitudinal study in general practice," *J. Clin. Med.*, vol. 9, no. 6, p. 1787, Jun. 2020, doi: 10.3390/jcm9061787.

[10] A. Tapia, V. Leiva, M. D. P. Diaz, and V. Giampaoli, "Influence diagnostics in mixed effects logistic regression models," *Test*, vol. 28, no. 3, pp. 920–942, Sep. 2019, doi: 10.1007/s11749-018-0613-3.

[11] A. J. Hobson, B. Maxwell, A. Stevens, K. Doyle, and A. Malderez. (2015). *Mentoring and Coaching in the Further Education and Skills Sector in England*. Accessed: Nov. 24, 2020. [Online]. Available: https://www.gatsby.org.uk/uploads/education/reports/pdf/mentoring-full-report.pdf

[12] A. N. Hakro and P. Mathew, "Coaching and mentoring in higher education institutions: A case study in oman," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 3, pp. 307–322, Jun. 2020, doi: 10.1108/IJMCE-05-2019-0060.

[13] K. Hobson and Z. W. Taylor, "Mentoring.Ca: Types of mentoring programs featured on Canadian postsecondary education Websites," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 3, pp. 279–290, May 2020, doi: 10.1108/IJMCE-09-2019-0089.

[14] M. K. Gaines, "A review of best practices in new teacher mentoring," OSPI Beginning Educator Support Team (BEST), Washington Office of Superintendent of Public Instruction, 2020. Accessed: Nov. 23, 2020. [Online]. Available: https://www.k12.wa.us/sites/default/files/public/best/AReviewofBestPracticesinNewTeacherMentoring.pdf

[15] P. Lord, M. Atkinson, and H. Mitchell, "Mentoring and coaching for professionals: A study of the research evidence," Nat. Found. Educ. Res., Northern Office, Slough, U.K., Tech. Rep., 2008. Accessed: Nov. 23, 2020. [Online]. Available: https://www.nfer.ac.uk/media/2003/mcm01.pdf

[16] L. A. Rogers and S. Graham, "Effectiveness of volunteer-led strategy instruction on the story writing of third grade students experiencing difficulties learning to write," *Reading Writing*, vol. 33, no. 3, pp. 761–782, Mar. 2020, doi: 10.1007/s11145-019-09988-x.

[17] P.-S. Yeung, C. S.-H. Ho, D. W.-O. Chan, and K. K.-H. Chung, "Writing motivation and performance in Chinese children," *Reading Writing*, vol. 33, no. 2, pp. 427–449, Feb. 2020, doi: 10.1007/s11145-019-09969-0.

[18] IWCA. (2020). *International Writing Centers and Association*. Accessed: Jul. 9, 2020. [Online]. Available: https://writingcenters.org/

[19] R. Cameron and J. F. Molina-Azorin, "The acceptance of mixed methods in business and management research," *Int. J. Organizational Anal.*, vol. 19, no. 3, pp. 256–271, Jul. 2011, doi: 10.1108/19348831111149204.

[20] M. Seyfried and F. Reith, *Mixed Methods for Research into Higher Education: Solving the Problem of Institutionalized Introspection?* Bingley, U.K.: Emerald, 2019, pp. 111–127.

[21] K. Moyle. (2015). *Coaching and Mentoring for School Improvement—Teacher Magazine*. Charles Sturt University. Accessed: Nov. 23, 2020. [Online]. Available: https://www.teachermagazine.com/au_en/articles/coaching-and-mentoring-for-school-improvement

[22] J. E. Raffaghelli, S. Manca, B. Stewart, P. Prinsloo, and A. Sangrà, "Supporting the development of critical data literacies in higher education: Building blocks for fair data cultures in society," *Int. J. Educ. Technol. Higher Educ.*, vol. 17, no. 1, Dec. 2020, Art. no. 58, doi: 10.1186/s41239-020-00235-w.

[23] M. B. Kamarudin, A. Y. B. Kamarudin, R. B. Darmi, and N. S. B. M. Saad, "A review of coaching and mentoring theories and models," *Int. J. Acad. Res. Progressive Educ. Develop.*, vol. 9, no. 2, pp. 289–298, Jun. 2020, doi: 10.6007/IJARPED/v9-i2/7302.

[24] S. Fletcher and C. A. Mullen, *SAGE Handbook of Mentoring and Coaching in Education*. Newbury Park, CA, USA: SAGE, 2012.

[25] M. Pegg, "The art of mentoring," *Ind. Commer. Train.*, vol. 31, no. 4, pp. 136–141, 1999.

[26] K. E. Cornelius, M. S. Rosenberg, and K. N. Sandmel, "Examining the impact of professional development and coaching on mentoring of novice special educators," *Action Teacher Educ.*, vol. 42, no. 3, pp. 253–270, Jul. 2020, doi: 10.1080/01626620.2019.1638847.

[27] J. B. Rowley, "The good mentor as formal mentoring programs gain popularity, the need for identifying and preparing good mentors grows," *Educ. Leardersh., Supp. New Teach.*, vol. 56, no. 8, pp. 20–22, 1999.

[28] H. Portner, "Teacher mentoring and induction: The state of the art and beyond," in *Harvard Educational Review*. Thousand Oaks, CA, USA: Corwin Press, 2005, p. 280.

[29] J. Pattisson, "Teacher trainees' understandings of mentoring within a middle eastern BEd program," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 4, pp. 325–339, Jul. 2020, doi: 10.1108/IJMCE-04-2019-0058.

[30] L. L. Zentgraf, "Mentoring reality: From concepts and theory to real expertise and the mentor's point of view," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 4, pp. 427–443, Oct. 2020, doi: 10.1108/ijmce-12-2017-0077.

[31] NACOL. (2020). *North American Council for Online Learning (NACOL) | Cause IQ*. Accessed: Nov. 24, 2020. [Online]. Available: https://www.causeiq.com/organizations/north-american-council-for-online-learning, 200310109/

[32] K. Wortmann, C. Cavanaugh, K. Kennedy, Y. Beldarrain, T. Letourneau, and V. Zygouris-Coe, "Online teacher support programs: Mentoring and coaching models," North Amer. Council Online Learn., Tech. Rep., 2008. Accessed: Nov. 23, 2020. [Online]. Available: https://files.eric.ed.gov/fulltext/ED509629.pdf

[33] UNESCO. (2014). *Global Citizenship Education: Preparing Learners for the Challenges of the 21st Century*. UNESCO Digital Library. Accessed: Aug. 24, 2020. [Online]. Available: https://unesdoc.unesco.org/ark:/48223/pf0000227729

[34] M. Eriksen, S. Collins, B. Finocchio, and J. Oakley, "Developing students' coaching ability through peer coaching," *J. Manage. Educ.*, vol. 44, no. 1, pp. 9–38, Feb. 2020, doi: 10.1177/1052562919858645.

[35] *2020 ICF Global Coaching Study*, Int. Coaching Fed., Lexington, KY, USA, 2020.

[36] M. Holliday, *Coaching, Mentoring and Managing: A Coach Guidebook*, 2nd ed. Wayne, NJ, USA: Career Press, 2001.

[37] CUREE. (2020). *Mentoring and Coaching—A Central Role in Professional Development | Centre for the Use of Research & Evidence in Education (CUREE)*. Accessed: Nov. 23, 2020. [Online]. Available: http://www.curee.co.uk/mentoring-and-coaching

[38] C. Van Nieuwerburgh and J. Campbell, "The teaching leaders coaching journal—A global framework for coaching in education coaching: A fellow's journey review of the complete handbook of coaching," CoachEd. Tech. Rep., Feb. 2015, no. 1. Accessed: Nov. 24, 2020. [Online]. Available: https://www.growthcoachinguk.com/pdf/CoachEd_February-2015.pdf

[39] ACER. (2020). *Australian Council for Educational Research—ACER*. Accessed: Nov. 24, 2020. [Online]. Available: https://www.acer.org/au/publications-and-resources

[40] K. Moyle and P. Erfurt. (2016). *A Guide to Support Coaching and Mentoring for Schools Improvement—ACER*. Accessed: Nov. 24, 2020. [Online]. Available: https://research.acer.edu.au/cgi/viewcontent.cgi?article=1012&context=professional_dev

[41] M. Moore. (2019). *The Return on Investment of Workplace Mentoring Initiatives*. Accessed: Nov. 23, 2020. [Online]. Available: https://women2.com/2019/11/14/return-on-investment-of-workplace-mentoring/

[42] T. Hollweck, "Growing the top: Examining a mentor–coach professional learning network," in *Professional Learning Networks: Facilitating Transformation in Diverse Contexts With Equity-Seeking Communities*. Bingley, U.K.: Emerald, 2020, pp. 141–170.

[43] W. S. Kearney, J. Jurica, and T. Entzi, "Near-peer video-based feedback: A useful activity for aspiring school leaders?" *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 4, pp. 357–373, Jul. 2020, doi: 10.1108/IJMCE-09-2019-0087.

[44] J. Aspfors and G. Fransson, "Research on mentor education for mentors of newly qualified teachers: A qualitative meta-synthesis," *Teaching Teacher Educ.*, vol. 48, pp. 75–86, May 2015, doi: 10.1016/j.tate.2015.02.004.

[45] M. L. Carr, W. Holmes, and K. Flynn, "Using mentoring, coaching, and self-mentoring to support public school educators," *Clearing House A, J. Educ. Strategies, Issues Ideas*, vol. 90, no. 4, pp. 116–124, Jul. 2017, doi: 10.1080/00098655.2017.1316624.

[46] B. S. Zugelder, "Beyond new teacher mentoring: The role of instructional coaching," *Kappa Delta Pi Rec.*, vol. 55, no. 4, pp. 181–183, Oct. 2019, doi: 10.1080/00228958.2019.1659074.

[47] S. Connolly, G. Bates, and J. Shea, "'First meetings': Constructive first encounters between pre-service teachers and their mentors," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 4, pp. 411–426, Jul. 2020, doi: 10.1108/IJMCE-10-2019-0096.

[48] S. Breive, "Student–teacher dialectic in the co-creation of a zone of proximal development: An example from kindergarten mathematics," *Eur. Early Childhood Educ. Res. J.*, vol. 28, no. 3, pp. 413–423, May 2020, doi: 10.1080/1350293X.2020.1755498.

[49] F. A. Ganotice and L. K. Chan, "How can students succeed in computer-supported interprofessional team-based learning? Understanding the underlying psychological pathways using Biggs' 3P model," *Comput. Hum. Behav.*, vol. 91, pp. 211–219, Feb. 2019, doi: 10.1016/j.chb.2018.09.029.

[50] R. Hastings and W. Pennington, "Team Coaching: A thematic analysis of methods used by external coaches in a work domain," *Int. J. Evid. Based Coach. Mentor.*, vol. 17, no. 2, pp. 174–188, 2019, doi: 10.24384/akra-6r08.

[51] G. Thipatdee, "The development of coaching and mentoring skills through the grow technique for student teachers," *J. Educ. Learn.*, vol. 8, no. 5, pp. 168–174, 2019.

[52] G. A. Khawaldeh, "Impact of knowledge management (KM) on human resource management (HRM) performance based on the ACHIEVE model in selected banks of Amman–Jordan," *Int. J. Bus. Manage.*, vol. 15, no. 3, p. 1, Feb. 2020, doi: 10.5539/ijbm.v15n3p1.

[53] A. Wenu and C. Tan, "The applied, knowledge, and work-based oriented project management coaching frame-work (AKW-PMCF)," *J. Mod. Proj. Manag.*, vol. 6, no. 3, pp. 28–45, 2019.

[54] M. Alabdali, "Activate the learning and development agenda using coaching culture," *Eur. J. Hum. Resour. Manag. Stud.*, vol. 3, no. 2, 2019, Art. no. 11, doi: 10.5281/zenodo.3608804.

[55] M. Devine, R. Meyers, and C. Houssemand, "How can coaching make a positive impact within educational settings?" *Procedia Social Behav. Sci.*, vol. 93, pp. 1382–1389, Oct. 2013, doi: 10.1016/j.sbspro.2013.10.048.

[56] (2020). *DDI | Leadership Assessment & Development*. Accessed: Nov. 23, 2020. [Online]. Available: https://www.ddiworld.com/about

[57] S. Veenman, H. D. Laat, and C. Staring, "Evaluation of a coaching programme for mentors of beginning teachers," *J. In-Service Educ.*, vol. 24, no. 3, pp. 411–431, Sep. 1998, doi: 10.1080/13674589800200061.

[58] R. Bennett, "The role of technology in the mentoring and coaching of teachers," Becta–Lead. Next Gener. Learn., Tech. Rep., 2010. Accessed: Nov. 24, 2020. [Online]. Available: https://www.irisconnect.com/us/wp-content/uploads/2014/08/the-role-of-technology-in-mentoring-and-coachingfinal-1-33.pdf

[59] NGfL. (2020). *LGfL Training Centre—National Grid for Learning*. Accessed: Nov. 24, 2020. [Online]. Available: https://www.lgfl.net/training/

[60] G. Moss *et al.*, "The interactive whiteboards, pedagogy and pupil performance evaluation: An evaluation of the schools whiteboard expansion (SWE) project: London challenge," Dept. Educ. Skills, London, U.K., Res. Rep. 816, 2007. Accessed: Nov. 24, 2020. [Online]. Available: https://core.ac.uk/download/pdf/79539525.pdf

[61] B. Gregorcic, E. Etkina, and G. Planinsic, "A new way of using the interactive whiteboard in a high school physics classroom: A case study," *Res. Sci. Educ.*, vol. 48, no. 2, pp. 465–489, Apr. 2018, doi: 10.1007/s11165-016-9576-0.

[62] S. Grover, S. Basu, M. Bienkowski, M. Eagle, N. Diana, and J. Stamper, "A framework for using hypothesis-driven approaches to support data-driven learning analytics in measuring computational thinking in block-based programming environments," *ACM Trans. Comput. Educ.*, vol. 17, no. 3, pp. 1–25, Aug. 2017, doi: 10.1145/3105910.

[63] J. Chandler, *Descriptive Decision Theory* (Stanford Encyclopedia of Philosophy), E. N. Zalta, Ed. Metaphysics Research Lab, Stanford University, 2017. Accessed: Jan. 21, 2021. [Online]. Available: https://plato.stanford.edu/entries/decision-theory-descriptive/

[64] M. Baucells and K. V. Katsikopoulos, "Descriptive models of decision making," in *Wiley Encyclopedia of Operations Research and Management Science*. Hoboken, NJ, USA: Wiley, 2011, doi: 10.1002/9780470400531.eorms0249.

[65] A. Ghasemi and S. Zahediasl, "Normality tests for statistical analysis: A guide for non-statisticians," *Int. J. Endocrinology Metabolism*, vol. 10, no. 2, pp. 486–489, Dec. 2012, doi: 10.5812/ijem.3505.

[66] J. Pallant, *SPSS Survival Manual, a Step by Step Guide to Data Analysis Using SPSS for Windows*, 3rd ed. Sydney, NSW, Australia: McGraw-Hill, 2007.

[67] A. C. Elliott and W. A. Woodward, *Statistical Analysis Quick Reference Guidebook With SPSS Examples*, 1st ed. London, U.K.: Sage, 2007.

[68] P. Mishra, C. M. Pandey, U. Singh, A. Gupta, C. Sahu, and A. Keshri, "Descriptive statistics and normality tests for statistical data," *Ann. Card. Anaesth.*, vol. 22, no. 1, pp. 67–72, Jan. 2019, doi: 10.4103/aca.ACA_157_18.

[69] J. T. Roscoe, *Fundamental Research Statistics for the Behavioral Sciences*, 2nd ed. New York, NY, USA: Holt, Rinehart, and Winston, 1975.

[70] K. S. Taber, "The use of Cronbach's alpha when developing and reporting research instruments in science education," *Res. Sci. Educ.*, vol. 48, no. 6, pp. 1273–1296, Dec. 2018, doi: 10.1007/s11165-016-9602-2.

[71] M. Tavakol and R. Dennick, "Making sense of Cronbach's alpha," *Int. J. Med. Educ.*, vol. 2, pp. 53–55, Jun. 2011, doi: 10.5116/ijme.4dfb.8dfd.

[72] TEC. (2020). *Home | Institute for Future of Education*. Tecnológico de Monterrey. Accessed: May 25, 2020. [Online]. Available: https://tec.mx/en/ife

[73] H. Taherdoost, "Determining sample size; how to calculate survey sample size," *Int. J. Econ. Manage. Syst.*, vol. 2, pp. 237–239, 2017.

[74] DataStar. (2008). What every researcher should know about statistical significance. StarTips—A resource for survey researchers. DataStar Inc. Waltham, MA, USA. Accessed: Jan. 20, 2021. [Online]. Available: http://www.surveystar.com/startips/significance.pdf

[75] P. Page, "Beyond statistical significance: Clinical interpretation of rehabilitation research literature," *Int. J. Sports Phys. Ther.*, vol. 9, no. 5, pp. 36–726, Oct. 2014.

[76] A. M. Adam, "Sample size determination in survey research," *J. Sci. Res. Rep.*, vol. 26, pp. 90–97, Jun. 2020, doi: 10.9734/jsrr/2020/v26i530263.

[77] J. Martínez-Mesa, D. A. González-Chica, J. L. Bastos, R. R. Bonamigo, and R. P. Duquia, "Sample size: How many participants do I need in myresearch?" *An. Bras. Dermatol.*, vol. 89, no. 4, pp. 609–615, 2014, doi: 10.1590/ABD1806-4841.20143705.

[78] R. Niles. (2006). *Survey Sample Sizes and Margin of Error*. [Online]. Available: http://www.robertniles.com/stats/margin.shtml

[79] Rstudio. (2020). *RStudio—RStudio*. Accessed: Apr. 20, 2020. [Online]. Available: https://rstudio.com/products/rstudio/

[80] C.-W. Tseng, J.-J. Chou, and Y.-C. Tsai, "Text mining analysis of teaching evaluation questionnaires for the selection of outstanding teaching faculty members," *IEEE Access*, vol. 6, pp. 72870–72879, 2018, doi: 10.1109/ACCESS.2018.2878478.

[81] K. Okoye, A. Arrona-Palacios, C. Camacho-Zuñiga, N. Hammout, E. L. Nakamura, J. Escamilla, and S. Hosseini, "Impact of students evaluation of teaching: A text analysis of the teachers qualities by gender," *Int. J. Educ. Technol. Higher Educ.*, vol. 17, no. 1, p. 49, Dec. 2020, doi: 10.1186/s41239-020-00224-z.

[82] D. J. Litman and K. Forbes-Riley, "Predicting student emotions in computer-human tutoring dialogues," in *Proc. 42nd Annu. Meeting Assoc. Comput. Linguistics*, 2004, pp. 351–358, doi: 10.3115/1218955.1219000.

[83] K. Nosu and T. Kurokawa, "A multi-modal emotion-diagnosis system to support e-learning," *Innov. Comput. Inf. Control*, vol. 2, pp. 274–278, Aug. 2006.

[84] F. Tian, Q. Zheng, and D. Zheng, "Mining patterns of e-learner emotion communication in turn level of chinese interactive texts: Experiments and findings," in *Proc. 14th Int. Conf. Comput. Supported Cooperat. Work Design (CSCWD)*, Apr. 2010, pp. 664–670, doi: 10.1109/CSCWD.2010.5471892.

[85] K. B. Etzkorn and A. Braddock, "Are you my mentor? A study of faculty mentoring relationships in US higher education and the implications for tenure," *Int. J. Mentoring Coaching Educ.*, vol. 9, no. 3, pp. 221–237, Apr. 2020, doi: 10.1108/IJMCE-08-2019-0083.

[86] T. G. Cech, T. J. Spaulding, and J. A. Cazier, "Data competence maturity: Developing data-driven decision making," *J. Res. Innov. Teaching Learn.*, vol. 11, no. 2, pp. 139–158, Aug. 2018, doi: 10.1108/JRIT-03-2018-0007.

[87] L. Salem, "Decisions...decisions: Who chooses to use the writing center?" *Writ. Cent. J.*, vol. 35, no. 2, pp. 147–171, 2016.

[88] B. Williamson, "The hidden architecture of higher education: Building a big data infrastructure for the 'smarter university,'" *Int. J. Educ. Technol. Higher Educ.*, vol. 15, no. 1, p. 12, Dec. 2018, doi: 10.1186/s41239-018-0094-1.

[89] C. Yang, L. J. Zhang, and J. M. Parr, "The reactivity of think-alouds in writing research: Quantitative and qualitative evidence from writing in English as a foreign language," *Reading Writing*, vol. 33, no. 2, pp. 451–483, Feb. 2020, doi: 10.1007/s11145-019-09970-7.

SAMIRA HOSSEINI (Member, IEEE) received the B.Sc. degree in applied physics from the University of North Tehran, Iran, and the M.Sc. degree in polymer chemistry and the Ph.D. degree in biomedical engineering from the University of Malaya, Kuala Lumpur, Malaysia. She has served as a Postdoctoral Associate for the Tecnológico de Monterrey, Mexico, while holding a Postdoctoral Fellowship with the Massachusetts Institute of Technology, Cambridge, MA, USA. She is currently the Director of the Writing Lab, Institute for Future of Education, Tecnológico de Monterrey, and the Center for Educational Innovation, Tecnológico de Monterrey. She also holds the position of Research Professor with the School of Engineering and Sciences, Tecnológico de Monterrey. She is the author/coauthor of more than 25 scientific publications, 19 book chapters, and is the inventor/co-inventor of four intellectual properties. She is also a member of the Mexican National Academy of Researchers (level one) and is on the Editorial Board of different international journals.

ARTURO ARRONA-PALACIOS received the B.Sc. degree in criminology and the M.Sc. degree in criminology and forensic sciences from the Autonomous University of Tamaulipas, Reynosa, Mexico, and the Ph.D. degree in psychology from the Autonomous University of Nuevo Leon, Monterrey, Mexico. He is currently working as a Postdoctoral Researcher with the Writing Lab, Tecnológico de Monterrey, Monterrey, and the Center for Educational Innovation, Tecnológico de Monterrey. He is the author/coauthor of 12 scientific articles, a book, and a book chapter. He is also a Level-one-Member of the National System of Researchers in the National Council of Science and Technology of Mexico.

KINGSLEY OKOYE (Graduate Student Member, IEEE) received the B.Sc. degree in computer science, in 2007, the M.Sc. degree in technology management, in 2011, and the Ph.D. degree in software engineering from the University of East London, U.K., in 2017. He is currently a MIET Member with the Institution of Engineering and Technology, U.K. He is also a Data Architect with the Institute for Future of Education, at the Center of Educational Innovation, Tecnologico de Monterrey for Educational Innovation, Tecnológico de Monterrey. He is also a devoted Researcher to Industry and Academia in both hardware and software fields of computing in areas, such as data science, machine learning, artificial intelligence, big data and advanced analytics, software development and programming, and business process management. It is Kingsley's mission to foster sustainable technical research and provide solutions through critical thinking, creative problem solving, and cross-functional collaboration. The outcomes of his research have been published as journal articles, books, book chapters, conference proceedings, and technical reports in high indexed and reputable journals, publishers, and conferences within the areas of computing and educational innovation. His research interests include process mining and automation, learning analytics and systems design, computer education, educational innovation, big data and big analytics, knowledge engineering and data management, semantic web technologies, internet applications, and ontologies. He also serves as a main guest editor, an editorial board member, a special session organizer, and a reviewer for reputable journals and conferences, and has contributed to research and project outcomes by assessing and evaluating their impact upon the scientific and industrial communities. He is also a member of the Machine Intelligence Research Labs, USA, and the IEEE SMCS Technical Committee (TC) on Soft Computing.

JOSE ESCAMILLA received the degree in computer science engineering from the Tecnológico de Monterrey, Mexico, and the Ph.D. degree in artificial intelligence from the Institute Polytechnique de Grenoble, France. He is currently the Director of TecLabs–Learning Reimagined disruptive innovation unit whose objective is to explore the higher education in 2030 in addition to articulating the research, innovation, and entrepreneurship processes for Educational Innovation at the Tecnológico de Monterrey. Additionally, he holds the position of the Associate Director of the Institute for the Future of Education, Tecnológico de Monterrey. He has served as the Dean for the Graduate School of Education from 2010 to 2013. He has worked on the use of technologies in educational and artificial intelligence in education and other educational innovation projects. He has worked as a consultant for several companies, universities, and government, including IBM, World Bank, UNCTAD, Minister of Education of Saudi Arabia, Minister of Education of Argentina, as well as several universities. Within the frame of World University Network (WUN) and under the guidelines of United Nations (UN), he also serves as the Chair for the Global Higher Education and Research (GHEAR) Global Challenge Steering Group. Moreover, he is also the Chair of International conference of Educational Innovation (CIIE) and a member of the International Advisory Committee of the Institute for Ethical AI in Education, the Digital Credentials Leadership Council, and the Coursera Council, among others.

● ● ●