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Using Factor Analysis to Determine the Factors Impacting Learning Python for Non-Technical Business Analytics Graduate Students

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Abstract

This pioneering research represents a unique and singular study conducted within the United States, with a specific focus on non-technical graduate students pursuing degrees in business analytics. The primary impetus behind this study stems from the escalating demand for data-driven professionals, the diverse academic backgrounds of students, the imperative for adaptable pedagogical methods, the ever-evolving landscape of curriculum designs, and the overarching commitment to fostering educational equity. To investigate these multifaceted dynamics, we employed a data collection method that included the distribution of an online survey on platforms such as LinkedIn. Our survey reached and engaged 74 graduate students actively pursuing degrees in Business Analytics within the United States. This comprehensive research is the first and only one of its kind conducted in this context, and it serves as a vanguard exploration into the challenges and influences that shape the learning journey of Python among non-technical graduate Business Analytics students. The analytical insights derived from this research underscore the pivotal role of hands-on learning strategies, exemplified by practice exercises and assignments. Moreover, the study highlights the positive and constructive influence of collaboration and peer support in the process of learning Python. These invaluable findings significantly augment the existing body of knowledge in the field of business analytics. Furthermore, they offer an essential resource for educators and institutions seeking to optimize the educational experiences of non-technical students as they acquire essential Python skills.

Keywords

Python, Data Analytics, Factor Analysis, Business Analytics, Programming

1. Introduction

This research paper focuses on the growing importance of Python in business analytics and the challenges faced by non-technical graduate students in learning this programming language. The paper explores the various factors affecting their learning process, including pedagogy, prior programming experience, available resources, motivations, and curriculum design. The study aims to benefit educators and institutions by helping them tailor their teaching methods to better serve non-technical students. It also provides a roadmap for non-technical graduate students to navigate Python learning effectively, enhancing their competitiveness in the data-driven job market. The research seeks to contribute valuable insights to the fields of education, business analytics, and Python programming.

1.1. Background and Context

In today's data-driven world, Python has become a vital tool for extracting insights from data. It's widely used in fields like business analytics, marketing, finance, and management due to its versatility and rich ecosystem of data-related libraries. However, integrating Python into graduate-level business analytics programs poses challenges, especially for non-technical students. These students often lack prior programming experience, making Python proficiency a significant learning hurdle. As data-driven decision-making becomes crucial in the workforce, understanding the factors affecting the learning experiences of non-technical graduate students in Python is essential. This necessitates a comprehensive investigation into the challenges and influences they face.

The rising demand for data-driven professionals has made business analytics programs crucial for students. These programs attract students with diverse academic backgrounds, many of whom lack prior programming experience, creating a need for specialized pedagogical approaches to teach Python effectively. As these programs evolve to incorporate Python, there's a need to examine how it fits within the broader curriculum. Educational equity is a priority to ensure non-technical students have equal access to resources and support. This research paper aims to provide a comprehensive understanding of factors affecting non-technical graduate students' Python learning journey in business analytics. The goal is to inform educators, institutions, and students about effective Python education strategies, contributing to the discourse on data literacy and the evolving workforce demands.

1.2. Importance of Python in Business Analytics

Python has had a profound impact on the field of business analytics, significantly changing how organizations leverage vast datasets for data-driven decision-making. With the increasing centrality of data in today's corporate landscape, Python's versatility has made it an indispensable tool in the transformation of raw data into actionable insights. Its adaptability, accessible syntax, and

extensive ecosystem of data-related libraries and frameworks make Python particularly suitable for non-technical professionals in the business analytics domain. The versatility and adaptability of Python are the keys to its indispensability for business analytics professionals. Its straightforward and readable syntax caters to individuals with non-technical backgrounds, offering an accessible entry point into data analysis and coding. The adaptability of Python enables its use across the entire analytics process, from data preprocessing to statistical modeling and visualization. Its ease of use empowers non-technical professionals to quickly grasp fundamental programming concepts, making it an effective choice for those aiming to harness the power of data.

The significance of Python is amplified by its rich ecosystem of specialized libraries and frameworks designed for data analysis and machine learning. These tools accelerate the analytics process and enhance the focus on solving business-specific challenges. Python's open-source nature encourages collaboration and innovation, fostering a community of developers who actively contribute to its growth. This open-source approach aligns with the ethos of business analytics, where sharing knowledge is crucial for informed decision-making. Python's seamless integration with big data technologies, its automation capabilities, scalability, industry-wide acceptance, and interdisciplinary applications further enhance its role in the field. Its broad acceptance across various sectors, such as finance, healthcare, e-commerce, and marketing, has led to a high demand for Python-proficient professionals, making Python proficiency a necessity rather than an option for non-technical graduate students seeking careers in these industries. In essence, Python bridges the gap between domain-specific expertise and the technical demands of data-driven decision-making, equipping non-technical graduate students with essential tools to extract actionable insights from data, thereby enhancing their problem-solving capabilities and career prospects. Understanding Python's pivotal role in business analytics underscores the need for tailored pedagogical strategies and curricula that meet the evolving demands of professionals and the data-driven industry. This recognition extends to educators, institutions, and students, collectively contributing to data literacy, education, and the modern workforce's dynamic needs.

1.3. Objective and Research Question

This research aims to provide a comprehensive understanding of the multifaceted factors influencing the learning of Python among non-technical graduate students in the field of business analytics. It seeks to offer actionable insights for educators, institutions, and students themselves, ultimately contributing to the enhancement of Python education and the success of non-technical students in the data-driven business landscape.

Research Questions:

What are the key factors that influence the learning process of Python among non-technical Business Analytics graduate students pursuing business analytics degrees?

1.4. Significance of the Study

The significance of this study is multifaceted, impacting various stakeholders, including educators, institutions, students, and the broader field of business analytics. Here is an expanded discussion of its importance and potential future directions for research:

1) *Educational Enhancement*:

Improved Pedagogy: Beyond just understanding what works for non-technical students, future research could focus on the development and testing of specific teaching methods. This may involve creating tailored learning modules, implementing adaptive learning technologies, or even exploring innovative teaching approaches like gamification or blended learning.

Enhanced Curriculum: Building on the study's findings, the development of specialized curricula for non-technical students in business analytics is a potential future direction. These curricula can incorporate not only Python but also other essential skills, ensuring graduates are well-rounded professionals in the field.

2) *Student Empowerment*:

Enhanced Learning: Research can expand into exploring the impact of enhanced learning experiences on students' long-term career trajectories. Does improved Python proficiency lead to better job placement and career advancement? How does this empowerment translate into job satisfaction and success in the business analytics field?

Competitive Advantage: Future studies could assess the competitive advantage gained by empowered students. Are they more likely to secure high-demand positions, earn higher salaries, or adapt more effectively to industry changes? Understanding the long-term implications of student empowerment is crucial.

3) *Institutional Development*:

Improved Program Attraction: Institutions can further explore the diversity of their student body and adapt their recruitment strategies accordingly. Research might investigate how tailored programs attract students from different backgrounds and what role scholarships or financial aid play in this process.

Positive Reputation: Future research can analyze the impact of a positive institutional reputation on factors like alumni donations, industry partnerships, and faculty recruitment. A strong reputation can create a virtuous cycle of growth and excellence in business analytics education.

4) *Industry Alignment*:

Skilled Workforce: Research can assess how a more skilled and adaptable workforce, empowered by enhanced Python learning, influences the business analytics industry. Are companies with such workforces more agile and competitive? How does this reflect in their financial performance and market positioning?

Enhanced Business Analytics Impact: The study's significance in terms of business impact could be the focus of further research. How do organizations

with a data-savvy workforce experience improved decision-making, cost reduction, and revenue growth? Understanding these dynamics can help shape industry practices.

5) *Research Advancement*:

Filling Research Gaps: Building on the foundation of this study, future research can explore specific aspects of Python education, such as effective assessment methods, cross-disciplinary applications, or international comparisons. These focused inquiries can provide in-depth insights.

Foundation for Future Research: The study's findings can inspire a range of subsequent investigations. These might include comparative studies across universities, longitudinal studies tracking graduates' career trajectories, or in-depth case studies of successful educational programs.

6) *Educational Equity*:

Access for All: Research can go beyond identifying barriers to Python learning and delve into interventions that actively promote equity. Initiatives like mentorship programs, peer tutoring, or inclusive course design could be investigated and their impact measured.

7) *Data-Driven Decision-Making*:

Evidence-Based Strategies: Future research can assess the effectiveness of strategies derived from this study's evidence. For example, do institutions that implement evidence-based pedagogical changes witness increased enrollment, improved student outcomes, and positive financial impacts?

The study's significance lies in its potential to drive improvements in Python education, empower non-technical graduate students, align business analytics programs with industry needs, advance research, promote educational equity, and enhance the overall effectiveness of data-driven decision-making in business analytics.

2. Literature Review

2.1. Learning Resources and Motivation

Reference [1] extensive research offers valuable insights into the complex influences on students' educational outcomes and career paths within STEM (Science, Technology, Engineering, and Mathematics) fields. Their discoveries highlight that learning within STEM is multifaceted, influenced significantly by personal and environmental factors. Individually, a student's motivation, aptitude, and interests are pivotal in shaping their journey within STEM, acting as either catalysts or hindrances to their progress. These intrinsic factors combine uniquely to create a distinct learning profile for each student. Concurrently, external factors, including societal, economic, and cultural dimensions, have a substantial impact. These encompass how society views STEM disciplines, the economic prospects in STEM-related professions, and the broader cultural context, all shaping a student's overall STEM experience. These external elements serve as the backdrop against which individual learning experiences unfold.

Given the intricate web of influences on STEM learning, as highlighted [1], it is reasonable to assume that similar dynamics are at play for non-technical graduate students pursuing business analytics degrees and their efforts to master Python. Social, motivational, and instructional factors will likely be instrumental in shaping the journey of Python learning in this context. For instance, personal factors such as student self-efficacy or their belief in their capacity to learn and master Python can significantly impact their learning outcomes [2]. Students with high self-efficacy may approach Python learning with greater confidence, resilience, and persistence.

Motivation, another crucial personal factor, can similarly influence the learning trajectory. Highly motivated students are more inclined to invest time and effort into mastering Python. Their intrinsic interest in the subject can drive them to overcome challenges and achieve proficiency [2].

Moreover, attitudes toward Python, whether positive or negative, can profoundly affect a student's willingness to engage with the language and enhance their skills. An encouraging and supportive learning environment, guided by instructional strategies that emphasize active learning and collaboration, can further enhance students' proficiency and confidence [3].

The insights derived from [1] research, emphasizing the multifaceted nature of STEM learning, driven by various personal and environmental factors, provide a compelling framework for understanding how social, motivational, and instructional elements are likely to shape the learning process of Python among non-technical graduate students pursuing business analytics degrees. The convergence of these factors will undoubtedly impact students' proficiency and confidence in using Python for data analysis and decision-making, potentially influencing their future careers in this rapidly evolving field.

2.2. Prior Programming Experience and Quality of Instruction

Students' adaptability to Python as a programming language can significantly vary based on their prior programming experience [1]. Students who come to the Python classroom with prior programming exposure often find it easier to transition due to their familiarity with programming concepts and logic. Their existing knowledge is a valuable foundation for building Python proficiency. In contrast, students without previous programming experience may face a steeper learning curve and thus require specialized instructional methods as in [4].

Reference [1], educators can employ pedagogical techniques that resonate with diverse learners to facilitate the effective learning of Python. Instrumental approaches include Active, collaborative, and multimedia learning [4]. These methods encourage students to engage with course material actively, encouraging them to apply Python skills to real-world scenarios. Students can grasp Python concepts more effectively through active participation in problem-solving, group activities, and multimedia-rich content. This can significantly boost their proficiency and confidence in using Python for data analysis and decision-making. Furthermore, well-structured Python courses with clearly defined learning ob-

jectives are indispensable. Instructors should design courses that equip students with Python skills and foster a deep understanding of its practical applications. Effective pedagogical techniques, like active and collaborative learning, play a pivotal role [5]. By embracing these techniques, students can connect theoretical knowledge to real-world problems, reinforcing their proficiency and confidence in Python.

A study by [6] highlights Python's motivational and cognitive benefits. Students who acquire Python skills tend to exhibit higher motivation levels, greater self-efficacy in computer programming, and improved cognitive approaches to learning. These findings underscore Python's potential to enhance technical skills and positively influence students' self-perception and learning performance. Collaborative learning, group projects, and peer support further contribute to Python proficiency and confidence, emphasizing the role of social interaction in the learning process.

Access to comprehensive learning resources is another vital factor affecting students' Python learning experiences. Critical considerations include the availability, affordability, and quality of resources like textbooks, online tutorials, and interactive coding platforms. These resources significantly shape students' learning journeys, potentially as enablers or barriers to their progress. Affordable and easily accessible instructional resources, mainly textbooks, have been recognized as cost-effective inputs directly impacting student performance [7].

In programming, possessing robust analytical and reasoning abilities is fundamental to effectiveness. These cognitive skills are essential for problem-solving, code optimization, and creative programming. Educators play a pivotal role in nurturing these skills among their students. However, surprisingly, there is a notable absence of comprehensive research that identifies the primary challenges faced by programming students. A dedicated study focusing on these challenges could provide educators with invaluable insights for developing tailored educational materials and structuring lectures to meet the unique needs of their students [7]. Such research can significantly enhance programming education and develop future programmers with strong analytical and reasoning capabilities.

2.3. Motivation and Self-Directed Learning

Genuine self-assurance is a fundamental cornerstone of achievement, acting as the cohesive factor that leverages physical and mental capabilities to drive individuals toward their objectives. This exceptional quality goes beyond mere knowledge and skills, encompassing many attributes that empower individuals to thrive [1]. Intellectual competence, emotional maturity, independence, and leadership aptitude are among its dimensions. It is crucial to recognize that self-confidence is not an inherent trait but rather something cultivated and honed over time. It represents an unwavering belief in one's capabilities and a sense of command over one's life. This quality thrives on practical aspirations, granting individuals the resilience to bounce back from setbacks and adversity catalyzing personal growth and accomplishment [8].

Self-directed, hands-on learning is founded on the principles of autonomous education, marking a shift from external guidance provided by educators to self-reliant learners who independently define their learning needs, set goals, curate their learning materials, select strategies, and autonomously implement their chosen learning methods [9] [10]. This approach to learning strongly emphasizes the importance of precise attentional control at each phase of the learning process [11]. Effective attentional control is vital and requires advanced executive skills that enable learners to combat distractions [12]. Working memory capacity plays a pivotal role in managing the limited elements that can be simultaneously active in working memory before being transferred to long-term memory [13]. The differences between students with high and low working memory capacities are significant, profoundly affecting their ability to retain and manipulate essential information [14].

Complex learning tasks engage various cognitive functions, particularly abstraction and differentiation. These cognitive processes do not mature instantly but evolve gradually, especially in younger learners. This developmental characteristic makes younger learners more susceptible to working memory overload when facing high cognitive loads [15] [16]. Complex hands-on learning, in particular, imposes a substantial cognitive load, as students must manage multiple tasks concurrently while maintaining control over their learning. This complexity results in a much higher cognitive load than traditional learning methods [17] [18]. In such situations, executive control takes the forefront, safeguarding the flow of information between working memory and long-term memory during the process of memorization. It plays a crucial role in resisting distractions and preserving the integrity of the knowledge acquisition process [19] [20] [21]

These findings collectively underscore the pivotal roles of self-confidence, attentional control, working memory, executive control, and collaborative learning in hands-on learning, which is essential for students' growth, development, and educational attainment.

2.4. Peer Learning and Collaboration

Instructing an introductory Python course for diverse business students with varying coding experience levels presents challenges. To overcome these challenges, the instructor implemented strategies, including grouping students by programming knowledge, using in-class programming tasks as building blocks for skill development, and reducing advanced Python topics in favor of practical data analysis skills. These adjustments aimed to tailor the learning experience to students' needs and future careers in business analytics [22].

Reference [3] emphasizes the crucial role of creating a supportive environment for students, especially when they have a role in shaping students' programming journeys. This supportive atmosphere is essential for motivating students, helping them tackle challenges, and nurturing their interest in programming. Interdisciplinary collaboration in computer technology is on the rise, with fields like social science increasingly incorporating programming, particularly in

areas like human-computer interaction and computer-supported cooperative work. As academic departments merge, programming education gains significance for students across various disciplines, highlighting the importance of equipping them with programming skills that enhance their versatility and employability. This underscores the need for adaptable and customized programming education programs to meet the unique requirements of students in diverse fields.

From a developmental perspective heavily influenced by Vygotsky's theories, it becomes evident that social support and collaborative learning profoundly impact student engagement and the learning experience [23] [24] [25]. Group work is both a pedagogical tool and a medium for social cognitive development. It helps structure autonomous learning and serves as a platform for social cognitive growth [26] [27]. Negotiation within the learning process encourages face-to-face interactions and sub-achievement assessment, leading to improved group effectiveness [28] [29]. Collaborative learning fosters an open exchange of ideas, promoting a cooperative, non-competitive atmosphere [9]. Outdoors, students may rely on peers for support and share knowledge through social interaction, emphasizing the significant role of peer learning in knowledge acquisition [30]

2.5. Impact on Proficiency and Confidence

Enrolling in elective software courses offers students a valuable opportunity to enhance their productivity by acquiring new skills and expertise. While students may have encountered various software applications in the past, Python stands out as an exceptionally powerful tool for efficiently executing complex algorithms, as noted by [31].

Python's strength lies in its ability to efficiently execute complex algorithms, a proficiency that extends to diverse applications, from data analysis and machine learning to web development and automation. Its user-friendly and readable syntax makes it accessible to programmers of all levels, contributing to its widespread adoption across various domains [32].

By harnessing Python, students can streamline their problem-solving processes, automate repetitive tasks, and develop effective and highly efficient solutions. The language's extensive collection of libraries and frameworks empowers students to tackle various challenges across different disciplines.

2.6. Summary and Gaps in the Literature

The literature review provides insights into the multifaceted factors that influence the process of learning Python among non-technical graduate students pursuing degrees in business analytics. These factors encompass a range of elements, each playing a pivotal role in shaping students' experiences and outcomes.

Prior Experience: Students' familiarity with programming and coding con-

cepts, particularly in Python, can significantly impact their learning journey. Those with prior experience may adapt more quickly due to their existing knowledge, while those without such experience may require tailored instructional methods to bridge the gap effectively.

Instructional Quality: The quality of instruction, including the choice of pedagogical techniques and the instructor's expertise, can significantly influence the learning process. Effective teaching methods, such as active and collaborative learning, can enhance students' engagement and comprehension of Python.

Learning Resources: Access to comprehensive and high-quality learning resources, including textbooks, online tutorials, and interactive coding platforms, can be a game-changer for students. The availability and affordability of these resources can significantly impact the learning experience.

Peer Interactions: Collaboration and peer interactions contribute to a supportive learning environment. Working together on group projects, engaging in problem-solving with peers, and sharing knowledge can enhance students' understanding of Python and confidence in using it.

Motivation: Students' motivation is critical to their ability to learn Python effectively. Motivated students are more likely to invest the time and effort required to become proficient in Python and often exhibit higher confidence in their abilities.

Proficiency and confidence in Python are crucial as they directly affect students' data analysis and decision-making abilities in the context of business analytics. Students proficient in Python can leverage its capabilities for more in-depth data analysis, modeling, and visualization, ultimately contributing to more informed decision-making processes.

However, the literature review also reveals specific gaps in the current body of knowledge. For instance, there is a need for further research to explore the effectiveness of different instructional approaches in Python education. Investigating how various teaching methods impact students' proficiency and confidence can lead to more tailored and effective pedagogical strategies.

Additionally, the role of assessment methods in Python learning warrants attention. Assessments can influence students' motivation and engagement. Evaluating how different assessment strategies impact learning outcomes and students' confidence levels can provide valuable insights.

Exploring how varying proficiency in Python translates into decision-making abilities in real-world business scenarios is essential. Understanding the relationship between skill levels and practical applications can guide educational institutions and instructors in preparing students for the demands of the business analytics field.

The literature review underscores the complex interplay of factors in Python learning among non-technical graduate students in business analytics. Proficiency and confidence in Python are critical components of their educational journey, with several areas in need of further exploration and research to en-

hance the quality of education in this main.

3. Methods

The research strives to comprehensively explore the diverse factors impacting the Python learning experience of non-technical graduate students in the business analytics field. Its objective is to generate practical insights benefiting educators, institutions, and students, aiming to improve Python education and the academic achievements of non-technical students within the data-driven business environment.

3.1. Participants

The sample selection process and questionnaire design for this research study were carefully executed to ensure data accuracy and quality. Here's a detailed overview:

Sample Selection Process:

Pre-Contact: Prior to survey distribution, candidates were contacted to inform them about the upcoming survey. This pre-contact step served to establish a connection with potential participants and to seek their willingness to participate.

Pilot Surveys: Two pilot surveys were conducted with a select group of candidates. These pilot surveys aimed to identify and address any potential issues with the questionnaire and to gather feedback from participants. The feedback received from these pilot surveys was considered and incorporated into the subsequent survey design to enhance its quality and clarity.

Target Audience: The specific target audience for this research consisted of graduate students actively pursuing their master's degrees with a specialization in the field of Business Analytics. This group was chosen due to the growing significance of Business Analytics in contemporary education.

Geographical Focus: The survey was distributed within the United States-based universities and colleges known for their strong academic programs focusing on business and analytics. This geographical focus was selected to ensure a relevant and specialized pool of respondents.

Questionnaire Design:

The questionnaire was meticulously designed in English and executed using the Qualtrics survey platform. The following key points were considered during its construction.

Comprehensiveness: The questionnaire was constructed to comprehensively address the research objectives and to collect data that would offer valuable insights into Python learning among non-technical students in the field of Business Analytics.

Clarity: Questions were crafted to be unambiguous, ensuring that respondents could easily understand and respond to them.

Relevance: Each question was designed to be directly relevant to the research goals, avoiding any unnecessary or extraneous inquiries.

Data Collection:

The data collection phase occurred between October 1st, 2023, and October 17th, 2023. This timeframe allowed for a substantial and comprehensive gathering of insights and responses from the selected participants. The survey was strategically disseminated across multiple social media platforms, with a predominant presence on LinkedIn, which is well-known for its professional and scholarly user base.

During this period, a total of 74 valuable responses were collected. These responses constitute a diverse and representative dataset, offering a rich tapestry of perspectives and opinions from graduate students specializing in Business Analytics. This dataset will serve as the foundation for the research, providing invaluable insights into the factors influencing Python learning among non-technical students in this specific field of study.

The meticulous approach taken in sample selection, questionnaire design, and data collection ensures that the research will be based on high-quality, relevant, and representative data.

3.2. Measures

Prior Programming Experience

As a crucial research measure, we meticulously assessed our participants' prior programming experience before embarking on their Python course. This parameter was pivotal in gauging the participants' familiarity with programming concepts, coding languages, and the overall depth of their technical background.

By scrutinizing their prior programming experience, we aimed to gain a profound understanding of the diversity within our cohort. This encompassed participants who might have had extensive programming knowledge, those who had dabbled in coding casually, and those who entered the Python course with minimal or no prior programming exposure.

This research measure allowed us to differentiate between the various subgroups within our sample, facilitating a more nuanced analysis of their Python learning experiences. Moreover, it enabled us to evaluate the impact of their prior programming background on their learning outcomes, ease of Python adoption, and overall course satisfaction.

This research measure concerning prior programming experience provided valuable insights into the participants' starting points on their Python learning journey, serving as a foundational aspect of our study into the dynamics of Python education among non-technical graduate students in the field of business analytics.

Challenges in learning Python for Data Analysis

One of the pivotal research measures in our study was assessing how challenging participants found the process of learning Python for data analysis. This parameter was paramount as it delved into the individual learning experiences and perceptions of Python, a versatile and integral tool in data analysis.

Exploring the perceived challenges allowed us to investigate the factors con-

tributing to these experiences, such as the teaching methods, course materials, and individual learning styles. Moreover, it allowed us to gauge participants' overall sentiment and satisfaction levels in their Python learning journey, influencing our ability to provide actionable insights for improving Python education.

Online Learning Resources

Utilizing online learning resources represented a significant aspect of our participants' Python learning journey. Participants often sought supplementary materials, tutorials, and guidance from online platforms to reinforce their understanding of Python's intricacies. These resources included interactive tutorials, web-based courses, forums, and community-driven knowledge-sharing media.

Through this research measure, we aimed to gauge how these online resources contributed to participants' Python learning experience. We evaluated whether these resources effectively complement the formal curriculum, helping participants bridge gaps in their understanding, gain practical insights, and connect with a broader community of learners.

By investigating the role of online resources, we gained insights into the self-directed and collaborative nature of Python learning. It allowed us to assess the participants' preferences for particular learning resources, the extent to which they relied on online forums for problem-solving, and how these resources influenced their Python learning outcomes.

Python's Relevance in the Field of Business Analytics

The assessment of Python's relevance in the field of business analytics provided us with valuable insights into the participants' perspectives on the practical application and importance of Python within their academic and future professional pursuits. By exploring this dimension, we sought to uncover the intricate dynamics that govern Python's position in the discipline of business analytics.

Examining the relevance of Python allowed us to delve into the factors that influenced these perceptions. We evaluated the participants' experiences, coursework, and industry insights to discern how Python's versatility, data manipulation capabilities, and integration with analytics tools shaped their understanding of its role in business analytics.

Confidence in Python Programming Skills

The assessment of participants' confidence in their Python programming skills was pivotal in understanding the psychological and emotional dimensions of their Python learning journey. It provided insights into the participants' perceived competence in using Python to manipulate, analyze, and visualize data, an essential skill in data analysis.

This research measure allowed us to categorize participants into varying levels of confidence, spanning from those who were highly confident in their Python abilities to those who harbored self-doubt and hesitancy. By examining this spectrum of confidence, we gained a nuanced understanding of the diverse experiences within our cohort.

Importance of Python Proficiency

The assessment of the importance of Python proficiency provided a window into the participants' career aspirations and the role that Python played in their strategic career planning. By scrutinizing this aspect, we aimed to gain insights into how participants perceived Python as a critical tool for their future success in the data-driven business analytics landscape.

Exploring the importance of Python proficiency was instrumental in understanding the factors that influenced these perceptions. We assessed how industry trends, job market demands, and the participants' career aspirations shaped their views on Python's significance in business analytics.

Participants' Beliefs in the Positive Impact of Collaborative Learning Group

The assessment of participants' beliefs in the positive impact of collaborative group projects aimed to unveil the perceived benefits of working together with peers to enhance Python skills. By exploring this dimension, we aimed to uncover the extent to which participants considered collaborative projects as a valuable strategy for Python learning.

Exploring these beliefs enabled us to delve into the factors that influenced their perceptions. We evaluated the participants' experiences, teamwork dynamics, and the extent to which collaborative projects align with their learning styles and goals in Python education.

4. Analysis

A total of 74 responses were received from the survey. Two participants were removed due to missing responses for a total of 72 responses analyzed in R. The survey had a Cronbach alpha and correlation of 0.84, which indicates strong reliability and validity. The survey questions used a Likert scale of 1 to 5. **Table 1** shows the mean and standard deviation of each response.

Most respondents had limited exposure to Python before beginning their course (mean = 2.39) but did not believe that learning Python was challenging for data analysis (mean = 3.82). Many felt neutral about the usefulness of online resources in aiding their Python learning (mean = 3.34) and their confidence in their Python programming skills for data analysis (mean = 3.63). However, most respondents believed that the availability of practice exercises strongly impacted their Python proficiency (mean = 4.38), that Python was greatly relevant to business analytics (mean = 4.26), and placed high importance on Python proficiency for their future careers in business analytics (mean = 4.38). Additionally, respondents were satisfied with their experience of learning Python in their business analytics program (mean = 4.01), believed that group projects positively impacted their Python learning and proficiency (mean = 4.08), and believed that they received enough support from their peers in learning Python (mean = 4.29).

The standard deviation ranged from 0.52 to 0.99 for all questions. The largest deviations were in prior programming experience before starting the Python course, which shows a variety of skill levels in the program; the extent to group projects improved Python learning and proficiency; satisfaction with the overall

Table 1. The mean and standard deviation of each response.

Question	Mean	Standard Deviation
Please rate your level of prior programming experience before starting the Python course.	2.39	0.99
How challenging do you find learning Python for data analysis?	3.82	0.78
Please rate the helpfulness of online learning resources (e.g., tutorials, forums) in aiding your Python learning.	3.34	0.53
How confident are you in your Python programming skills for data analysis?	3.63	0.86
To what extent does the availability of practice exercises and assignments impact your Python proficiency?	4.38	0.52
How do you rate the relevance of Python in the field of business analytics?	4.26	0.63
How much importance do you place on Python proficiency for your future career in business analytics?	4.38	0.72
How satisfied are you with the overall learning experience of Python in your business analytics program?	4.01	0.97
To what extent do you believe that collaborative group projects positively impact your Python learning and proficiency?	4.08	0.93
I receive enough support from my peers in learning Python.	4.29	0.76

learning experience of Python in their business analytics program; and confidence in Python programming skills for data analysis.

A factor analysis model in Figure 1 was created based on a scree plot showing that the optimal number of factors was 3. The factor analysis model grouped the relevance of Python programming skills for data analysis, the extent to which respondents placed importance on Python proficiency for their future career in business analytics, the extent to which the availability of practice exercises and assignments aided their Python learning, the extent to which collaboration improved their overall learning experience of Python, receiving support from peers in learning Python, and the helpfulness of online learning resources in Python learning. The model also grouped prior programming experience, satisfaction of the Python learning experience, and confidence in Python programming skills. The extent to which respondents found Python challenging for data analysis was not grouped with any other questions.

Figure Key:

Q1: Please rate your level of prior programming experience before starting the Python course.

Q2: How challenging do you find learning Python for data analysis?

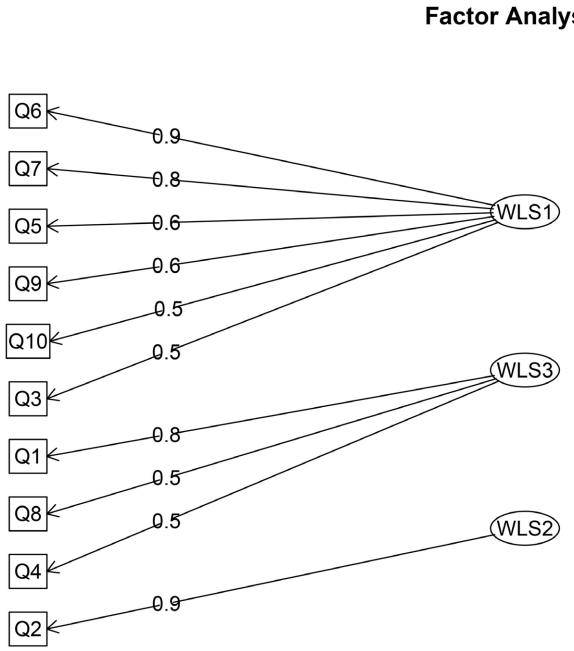

Figure 1. Factor analysis of survey questions.

Q3: Please rate the helpfulness of online learning resources (e.g., tutorials, forums) in aiding your Python learning.

Q4: How confident are you in your Python programming skills for data analysis?

Q5: To what extent does the availability of practice exercises and assignments impact your Python proficiency?

Q6: How do you rate the relevance of Python in the field of business analytics?

Q7: How much importance do you place on Python proficiency for your future career in business analytics?

Q8: How satisfied are you with the overall learning experience of Python in your business analytics program?

Q9: To what extent do you believe that collaborative group projects positively impact your Python learning and proficiency?

Q10: I receive enough support from my peers in learning Python.

5. Discussion

The investigation employs a multifaceted approach grounded in various theoretical frameworks to provide a deeper understanding of the determinants shaping the acquisition of Python proficiency among non-technical graduate students in the field of business analytics:

Self-Determination Theory (SDT): Per [32], this framework postulates that motivation and learning are driven by an individual's intrinsic and extrinsic motivation. The analysis of means and standard deviations reveals that the influence of online learning resources on Python proficiency is relatively weak, suggesting that external factors may not significantly motivate these students. In

contrast, the strong impact of practice exercises and assignments on Python proficiency aligns with SDT, as they represent more intrinsically motivating activities that engage students in active learning.

Social Learning Theory: The discussion surrounding the diverse responses to group projects and the importance of collaboration and peer support aligns with the tenets of Social Learning Theory [33]. This theory posits that learning occurs through observation, imitation, and interaction with others. The varied responses to group projects indicate that not all students learn equally from this social interaction, underscoring the importance of individual differences in the effectiveness of collaborative learning experiences.

Cognitive Load Theory: Factor 2, which highlights the perceived complexity of Python for data analysis, can be interpreted through Cognitive Load Theory. This theory suggests that individuals have limited cognitive resources, and the perception of high cognitive load can hinder learning [34]. The results indicate that students perceive Python for data analysis as challenging, which may result in increased cognitive load and impact their learning experiences.

Sociocultural Theory: The discussion of informal communication among peers and the support provided by the student's social network resonates with Sociocultural Theory [35]. This framework emphasizes the role of social interactions and cultural contexts in shaping learning. The study suggests that students benefit from peer support and informal learning interactions outside of formal settings, highlighting the importance of the sociocultural context in Python acquisition.

Expectancy-Value Theory: Factor 3, which incorporates variables like satisfaction with the Python learning course, prior programming experience, and self-confidence, can be framed within the Expectancy-Value Theory [36]. This theory posits that individuals are motivated to learn when they expect success and value the learning outcomes. In this case, prior programming experience emerges as a strong influencer, indicating that students with prior experience have higher expectations of success and value in learning Python.

Constructivism: Factor 1, which underscores the influence of internal beliefs on Python learning, aligns with the principles of Constructivism [37]. This theory posits that individuals construct their knowledge and understanding based on their beliefs and experiences. The findings suggest that personal convictions about the relevance of Python in their field significantly shape their learning experiences, highlighting the constructivist nature of their learning process.

This analysis combines these theoretical frameworks to offer a more nuanced and comprehensive understanding of the factors that influence Python learning among non-technical graduate students in business analytics. It reveals that motivation, social interactions, cognitive load, prior experience, and individual beliefs all play intricate roles in shaping the learning journey, emphasizing the need for a holistic approach to pedagogy and support in this specific academic context.

Impact of Cooperation and Peer on Students' Learning Outcomes and Satisfaction

One significant finding relates to the role of cooperation and peer support in the learning process. While the analysis revealed that online learning resources had a relatively minor impact on Python learning, the importance of collaborative learning and peer support emerged as a significant factor. Students perceived substantial support from their peers in mastering Python, both within and outside of group projects. This suggests that informal communication among peers, even beyond structured group settings, plays a valuable role in the learning journey. It underscores the significance of fostering a supportive and interconnected learning environment that encourages collaboration, sharing of insights, and mutual assistance.

Furthermore, the diverse responses regarding the influence of group projects on Python learning indicate that this approach may only be sometimes effective. However, the fact that students perceive substantial peer support outside the formal group project context suggests that peer interactions are a valuable contributor to the learning process.

The impact of cooperation and peer support on students' learning outcomes and satisfaction is evident in the analysis. Collaborative learning and peer interactions influence the learning experiences of non-technical graduate students in business analytics. These findings underscore the importance of fostering an environment that encourages collaboration and peer support to optimize Python learning outcomes within this academic context. A multifaceted approach to pedagogy and support that incorporates these elements is likely beneficial in enhancing students' learning experiences and outcomes.

6. Conclusions

The analysis of means, standard deviations, and the factor analysis model provides a comprehensive understanding of the dynamics surrounding the acquisition of Python skills among non-technical graduate students in business analytics. Several key insights have emerged from this examination.

Firstly, online learning resources appear to have a relatively minor impact on Python learning for these students, suggesting that traditional online materials may not be the most effective way to facilitate Python proficiency. In contrast, practice exercises and assignments have proven to be influential drivers of Python proficiency, emphasizing the significance of hands-on, practical engagement in the learning process.

Group projects' influence on Python learning varied, with collaboration and peer support being consistently essential. Students received substantial support from their peers, both within and outside of group projects, underscoring the value of a supportive and interconnected learning environment.

Factor 2 highlighted the perceived difficulty of Python for data analysis as a significant influence on the learning process. This factor accentuates the role of

perceived complexity in shaping students' learning experiences.

Factor 3 introduced a multifaceted aspect, emphasizing the interplay of formal education, prior knowledge, and self-assurance in shaping the Python learning journey. Previous programming experience emerged as the most influential variable, indicating its advantage in learning Python.

Factor 1 underscored the critical influence of personal beliefs regarding the relevance and importance of Python in business analytics. This implies that individual perceptions and convictions carry more weight in learning than external factors.

This analysis illuminates the complex interplay of factors that affect Python learning among non-technical graduate students in business analytics. It emphasizes the importance of practical engagement, collaboration, and personal beliefs in the learning process, suggesting that a multifaceted pedagogical approach and support system are essential for optimizing Python learning outcomes in this academic context.

In terms of contribution, this research promises to enrich our understanding of the evolving dynamics in business analytics education, offering valuable insights into the path to Python proficiency for non-technical graduate students. It holds significance for the fields of education, business analytics, and the expanding realm of Python programming.

6.1. Contribution to the Literature and Academic Practice

This groundbreaking research constitutes a remarkable contribution to the realm of literature, particularly within the United States educational landscape. With its exclusive focus on non-technical graduate students pursuing business analytics degrees, it addresses a critical need in a world increasingly reliant on data-driven professionals. The research responds to the challenges posed by a diverse student body with varying academic backgrounds. It underscores the necessity for flexible pedagogical methods in the dynamic sphere of curriculum design. The study's paramount objective is the promotion of educational equity, aligning with the broader educational discourse. Through a meticulously executed data collection method, including an online survey distributed on platforms such as LinkedIn, the research engaged 74 graduate students who are actively shaping the future of business analytics education in the United States. As the first and only study of its kind in this context, it pioneers an exploration into the challenges and factors influencing the journey of learning Python among non-technical graduate Business Analytics students. The research's analytical insights unequivocally highlight the significance of hands-on learning strategies, underscored by practical exercises and assignments, as well as the positive impact of collaboration and peer support in mastering Python. These invaluable discoveries significantly expand the existing body of knowledge in the field of business analytics and furnish educators and institutions with essential insights for enhancing the educational journey of non-technical students as they acquire indispensable Python skills.

6.2. Implications for Related Areas of Business Analytics

The implications of the article's findings extend far beyond the immediate context and have far-reaching consequences for various relevant areas of business analytics, including data science and artificial intelligence. This groundbreaking research represents a significant contribution to the academic and professional landscape in several ways:

Relevance to Diverse Student Backgrounds: The study's exclusive focus on non-technical graduate students pursuing business analytics degrees addresses a critical need in a world increasingly reliant on data-driven professionals. The findings emphasize the importance of accommodating a diverse student body with varying academic backgrounds. This flexibility is not limited to business analytics but can be extrapolated to data science and artificial intelligence, where students may have diverse educational foundations.

Flexible Pedagogical Approaches: The research underscores the necessity for flexible pedagogical methods in the dynamic sphere of curriculum design. This is a lesson that can be applied to educational programs across various disciplines, including data science and artificial intelligence. Adapting teaching methods to suit the diverse learning needs of students is essential for promoting educational equity and fostering a more inclusive educational environment.

Promotion of Educational Equity: The paramount objective of the study is the promotion of educational equity, aligning with the broader educational discourse. This objective is not limited to business analytics but resonates with the broader field of data science and artificial intelligence. Equity in education is a fundamental principle, and the research's insights can guide educators and institutions in designing curricula that are inclusive and accessible to students from diverse backgrounds.

Data-Driven Decision-Making: The meticulously executed data collection method, including the online survey distributed on platforms like LinkedIn, serves as a model for data-driven decision-making in educational research. This approach can be replicated in other areas of data-intensive research, including data science and artificial intelligence, to gather valuable insights and inform evidence-based strategies.

Pioneering Exploration: As the first and only study of its kind in the context of non-technical graduate Business Analytics students, this research pioneers an exploration into the challenges and factors influencing the learning journey of Python. Similarly, in data science and artificial intelligence, where interdisciplinary skills are increasingly valuable, understanding the challenges faced by students from diverse backgrounds is essential for shaping educational programs that meet the needs of the next generation of data professionals.

The analytical insights and discoveries from this research significantly expand the existing body of knowledge in business analytics. They furnish educators and institutions with essential insights for enhancing the educational journey of non-technical students as they acquire indispensable Python skills. These impli-

cations ripple out into the broader domain of data-driven professions, including data science and artificial intelligence, enriching the educational landscape and promoting inclusivity and equity in learning.

6.3. Future Research

The study's findings provide valuable insights into the acquisition of Python skills among non-technical graduate students in the field of business analytics. It highlights the limited impact of traditional online resources and the significant influence of hands-on practice exercises and assignments in fostering Python proficiency. Collaboration and peer support emerged as crucial factors, indicating the importance of a supportive learning environment. Moreover, the research identifies the perceived difficulty of Python, multifaceted aspects of Python learning, and personal beliefs as influential components of the learning process. These findings pave the way for future research directions that can optimize online learning, enhance curriculum designs, and promote educational equity, benefiting educators, institutions, and students alike. Furthermore, the study's significance extends beyond business analytics to related fields like data science and artificial intelligence, emphasizing the need for flexible pedagogical approaches and data-driven decision-making strategies in the evolving landscape of education.

The research's implications transcend its immediate context, offering valuable lessons for various facets of the educational and professional landscape. It can guide educators in tailoring their teaching methods and curriculum designs to accommodate diverse student backgrounds and promote educational equity. Institutions can leverage these insights to enhance program attraction and build positive reputations in the domain of business analytics education. The study's impact also extends to industry, where a more skilled and adaptable workforce can contribute to better decision-making processes and enhanced business analytics. Moreover, the meticulously executed data collection method serves as a model for data-driven decision-making in educational research, fostering evidence-based strategies that can be replicated in other data-intensive fields. Lastly, the research pioneers an exploration into challenges and factors influencing Python learning, providing a foundation for further investigations in areas like data science and artificial intelligence, where interdisciplinary skills are increasingly valuable.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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