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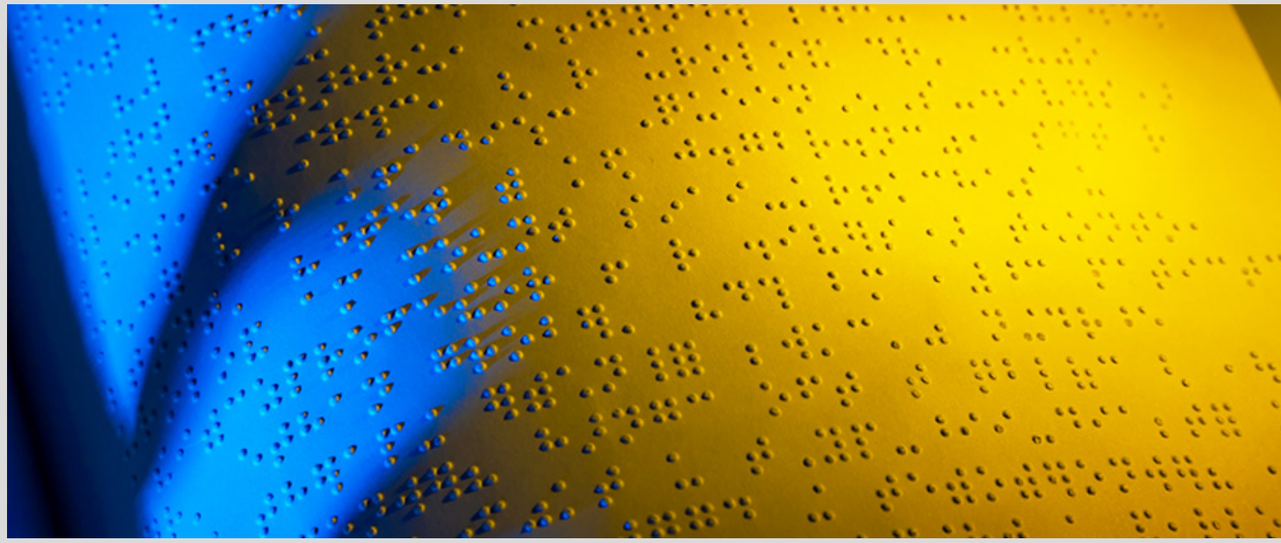

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The Journal on Efficiency and Responsibility in Education and Science publishes papers of the following categories: full research papers, short communications, review studies and book reviews (on invitation only).

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Papers must be closely scrutinized for typographical and grammatical errors. If English is not author's first language then the paper should be proof-read by a native English-speaking person, preferably one with experience of writing for academic use. Spelling should follow the Oxford English Dictionary.
Tables, graphs and illustrations should be drawn using a suitable drawing package. Colour may be used. Place all diagrams and tables where you wish them to appear in the paper. Ensure your diagrams fit within the margins and are resizable without distortion.

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Following Editorial recommendation, papers are submitted to a double-blind peer review process before publication. Commentary by reviewers will be summarized and sent by email to authors, who can choose to revise their papers in line with these remarks. Re-submitted papers should be accompanied by the description of the changes and other responses to reviewers' comments (see above), so that the desk-editor can easily see where changes have been made.

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We are delighted to share with our readers the results of the annual evaluation of the ERIES Journal in the Scimago Journal & Country Rank. In the 2024 edition, ERIES Journal was ranked again in the Q3 in the Education category, with an SJR of 0.241. The journal was evaluated as the best journal in the education category in the Czech Republic. The ERIES Journal recorded 83 citations during the last year, the highest number in history. Besides, the evaluation resulted in 1.447 citations per document in the 4-year average and 18.52% of international collaboration. This positive result is a commitment for us to keep the established editorial policy to deliver published content of the highest quality.

In this second issue of 2024 (Vol. 17, No. 2), we are delighted to present six articles from different regions around the world: the Czech Republic, Indonesia, Malaysia, Mexico, Tanzania, the United States, and Zimbabwe. The published articles cover topics related to employees' motivation and satisfaction, working environment evaluation, and teaching quality improvements.

In the first article, "Academic Benchmarking and the Provision of Quality Secondary Education in Tanzania," Haruni Machumu and Apolonia Agaptus explored the use of academic benchmarking in providing quality education in Tanzanian secondary schools. To do so, the authors employed a cross-sectional research design; data were collected from 188 participants, such as teachers, heads of schools, deputy of schools secondary education officers, and school management committee members. The obtained responses were subsequently analysed both descriptively and thematically. The results indicate that the academic benchmarking process plays a significant role in ensuring the provision of quality education through internal assessment, comparisons, and the adoption of best practices from benchmarked schools. The authors recommend field visits, study tours, and planning to raise the provision of quality education in secondary schools in Tanzania.

In the second article, "Evaluation of the Efficiency of the Sudden Implementation of the Synchronous Online Course: Findings of a Mixed Method Study," Linda Margarita Medina-Herrera, José Carlos Miranda-Valenzuela, Patricia Vázquez-Villegas, Edgardo Jorge Escalante-Vázquez, Luis Alberto Mejía-Manzano and Jorge Membrillo-Hernández analyzed the transition from classroom classes to distance classes due to an earthquake that hit Mexico City in 2017, damaging its buildings and infrastructure. The objective of the analysis was to find the necessary aspects for an efficient transition in these cases, using different Tecnologico de Monterrey's institutional data. The authors interviewed 45 faculty members, observed students' grades, as well as revised students' comments in teacher satisfaction surveys. The analysis revealed that teachers reported difficulties using digital technologies, an exhausted time spent preparing classes, and a lack of knowledge of the online teaching model. However, no correlation was found between teacher-associated variables and teacher performance indicators with the student grade averages.

In the third article, "Gender Differences in Faculty Experience with Start-up Packages: A Case Study from a Public University in the Southeastern U.S.," Alena Höfrová, Arelis Moore, Mark A. Small, Patrick J. Rosopa, Kayla Steele Payne and Pavla Rymešová examined the faculty experience with start-up packages at one public university in the Southeastern United States, as a part of a tool for a successful transition to an academic career. The authors analyzed data from 121 participants using descriptive statistics, chi-square tests of independence, and thematic analysis. The results show that most start-up package agreements included moving expenses, personal computers and software, and start-up funds. Conversely, the agreements' most missing benefits were child daycare, guaranteed junior sabbatical, and salary advancement. Further, in their agreements, male faculty obtained significantly more often than female faculty a specific number of years for secure funding, laboratory space, and student or postdoc funding.

The fourth article, "Improving Teachers' Professional Vision Through a Video-based Reflection Program: A Case Study in Mexican Primary Schools," by Michaela Cocca and Armando Cocca, investigated the effect of a video-based reflection program on Teachers' professional vision in Physical Education. Two teachers participated in a 3-step video-analysis program consisting of self-reflection, peer reflection, and expert feedback. The research included 155 children from the fourth and fifth grades of a primary school from General Escobedo, Monterrey (MEX). Notable changes were found in teachers at the end of the 6-month intervention, both in terms of teachers' selective attention to classroom events and their knowledge-based reasoning. The observations suggest that video-based reflection interventions could represent an important component of any teacher training program aiming to increase physical education teachers' ability to evaluate and respond to various in-class situations.

In the fifth article, "More Pay and Benefits or Better Work-life Balance? Post-Pandemic Perspectives on Employee Centricity among University Frontline Staff", Phillip Dangaiso, Divaries Cosmas Jaravaza, Paul Mukucha, Audrey Bowora, Gaylord Hlabiso and Knowledge Jonasi examined the differential effect of employee remuneration, remote working, and flexible scheduling on employee job satisfaction and loyalty intentions among university frontline employees. The study evaluated responses from 327 frontline employees at three public universities in Zimbabwe. For this purpose, the authors used Structural Equation Modeling (SEM) methodology. The results revealed that employee remuneration, remote working, and flexible scheduling positively and significantly influenced employee job satisfaction. To enhance employee job satisfaction and loyalty, the authors recommend that service providers design flexible work schedules and foster remote work and electronic job design.

The sixth article, "Bidirectional Braille-speech Communication System for Deaf-blind Students," from Ana Paula Pérez-Aguirre, Iván Arturo Morales-Pérez, Jorge Allan Gómez-Mercado, Rodrigo Alberto Gutiérrez-Martínez, Iván Matehuala-Moran, and Rubén Fuentes-Alvarez described development of a device that enables two-way communication between a severely deaf-blind user and a hearing person with no prior knowledge of Braille and no additional intermediaries. A Convolutional Neural Network (CNN) scheme for speech recognition was designed and implemented along with the development of an algorithm capable of developing both text-to-speech and Finger-Braille-to-text conversion. Lastly, a system integration via 3D modeling and additive manufacturing was carried out to deliver a functional prototype. Users testing the device achieved an average typing accuracy of over 95% and demonstrated an understanding of commands transmitted through the device's components.

In the last article, "Does Entrepreneurial Ecosystem Drive Entrepreneurial Intention and Students' Business Preparation? Lesson from Indonesia", Bagus Shandy Narmaditya, Cipto Wardoyo, Agus Wibowo and Sheerad Sahid employed structural equation modeling with partial least squares to raise understanding how the entrepreneurial ecosystem explains Indonesian students' entrepreneurial intention and business preparation. The authors collected 350 responses from students attending universities in Malang of East Java in Indonesia. The analysis indicates that the entrepreneurial ecosystem robustly links with students' entrepreneurial intention and new business creation. The study confirms that access to finance, government programs, support, access to physical infrastructure factors, education, and training factors are crucial for determining Indonesian university students' business intentions.

We would like to thank all authors who have submitted their articles to the ERIES Journal, and special thanks to all reviewers for their endless effort in revising the articles. We hope all our readers will find this second issue of the year interesting. You can follow the latest updates related to the ERIES Journal on its LinkedIn page, where we post information about the most cited articles, related upcoming events, and calls for special issues.

Sincerely

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CONTENT

ACADEMIC BENCHMARKING AND THE PROVISION OF QUALITY SECONDARY EDUCATION IN TANZANIA

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ABSTRACT

The academic benchmarking process is broadly employed by private secondary education providers and educational stakeholders in Tanzania to examine the benefits and drawbacks of service delivery. The study explored the use of academic benchmarking in providing quality education in Tanzanian secondary schools. Employing a cross-sectional research design, data were collected from 188 participants and subsequently analysed both descriptively and thematically. The study found that the academic benchmarking process plays a significant role in ensuring the provision of quality education through internal assessment, comparisons, and the adoption of best practices from benchmarked schools. Further, the findings reveal that six types of academic benchmarking are utilized in Tanzanian secondary schools. According to the study, proper academic benchmarking in secondary schools will improve educational results among secondary school graduates. Furthermore, academic benchmarking in secondary schools affects school rankings, which reflect a school's potential to do well at the end of national examinations. The study concludes that academic benchmarking enhances the provision of quality education by influencing future performance and commitments to work on secondary schools' goals, vision, and mission. Moreover, the study provides both theoretical and practical insight to the understanding of the necessity of academic benchmarking in secondary schools.

KEYWORDS

Academic benchmarking, benchmarking process, quality assurance, quality education, secondary schools

HOW TO CITE

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Highlights

- *Providing high-quality education in secondary schools is positively impacted by academic benchmarking activity.*
- *The types of academic benchmarking employed in secondary schools impact the delivery of high-quality instruction.*
- *Academic benchmarking strengthens the provision of quality education in secondary schools.*
- *Academic benchmarking gives the management team of secondary schools room to improve the delivery of high-quality education.*

INTRODUCTION

Over the last few decades, benchmarking activity has been a source of critical information for educational stakeholders, policymakers, policy analysts, and management teams in terms of decision-making (Ambula, 2006). Research indicates that high-ranking educational institutions employ a range of methods, including curriculum review, quality assurance tools, instructional approaches, comparative analysis, evaluation, and self-assessment (Darling-Hammond and Wentworth, 2010). These methods pertain to the core functions and activities of schools, aiming to enhance the quality of both graduates and the teaching-learning experience for students and teachers alike (Achama and Nwogu, 2013; Sankey et al., 2019). In this study, 'benchmarking' is defined as an ongoing process where an organisation evaluates and contrasts its functions, systems, and practices against those of leading competitors. This process helps to identify areas for improvement within the organization, aiming for a competitive edge both locally and globally (Knipe, 2002; Stroud, 2020). Within this framework, benchmarking pertains to quantifiable and measurable standards for teaching and learning. Benchmarking in education refers to the establishment of measurable learning standards. It provides a valuable tool for evaluating performance against established benchmarks or standards

in comparison to peers (The University of Adelaide, 2020). Specifically, Academic Benchmarking (ABM) ensures that educational institutions deliver quality education in secondary education. Such benchmarks serve as assessments that evaluate students' performances against the set institutional standards and learning goals (Top Hat, n.d).

Ideally, the ABM process would evaluate performance and examine the broader educational context, such as strategies to enhance teaching methods and optimize student learning across various settings. However, recent studies suggest that a significant portion of ABM projects arise from client grievances (Kailong, 2019). It is also worth noting that the concept of ABM is rooted in the industry and business sectors. Here, regular evaluations, introspective assessments, and performance reviews are vital to ensure the delivery of top-tier services and products to clients (Al-Khalifa, 2015; Rafsanjani et al., 2022).

Furthermore, when used in secondary education, the ABM process may provide educational providers, school management teams, government agencies, and stakeholders with the answers they need to deliver high-quality education. As a result, it is critical to recognize that school administrators can use the ABM process to improve performance among specific students or schools within large at-risk schools and districts (Bano and Vasantha, 2019; Silva et al., 2020). Research suggests that the first use of Academic Benchmarking (ABM) in education can be traced back to the United Kingdom (UK), where it was employed to evaluate student performance, school systems, and standards of skills and knowledge (Portela et al., 2011; Sankey and Padró, 2016). Its popularity surged in the 1990s, especially in higher education (Al-Khalifa, 2015; Ambula, 2006). From that point onward, numerous ABM projects emerged globally, with a significant presence in regions like Europe, Asia, America, and Australia (Portela et al., 2011).

It is important to note that there have been limited ABM exercises and initiatives in African countries, especially when addressing the quality and standards of education across various levels, with particular emphasis on secondary education. This highlights a significant research gap concerning benchmarking processes in most of these countries. ABM primarily aims to address both public and governmental concerns regarding the quality and standards of educational services within countries (Nyaoga et al., 2013). However, to truly measure the effectiveness of these education systems, there is a need for in-country comparisons, assessments, and evaluations. Such measures can determine whether students acquire the necessary skills to thrive in today's competitive job market (Amunga et al., 2013; OECD, 2013). In the context of Tanzania, numerous education stakeholders have voiced concerns about the quality of secondary education. These apprehensions range from graduates lacking essential employability skills to an increase in antisocial behavior and consistently poor performance in final examinations (Nyaoga et al., 2013). While these challenges are recognized across other educational levels, they are particularly acute and confusing in most public secondary schools.

Moreover, different approaches have addressed the shortfalls in managing, providing, and developing secondary education sectors. For example, in recent years, secondary school administrations have applied the ABM approach to learn from the best actors in several areas, including academic undertakings, leadership, and planning and executing various activities (OECD, 2013). The ABM process offers invaluable insights into optimizing secondary school development and clarifying strategies to enhance the provision of quality education, decision-making, and academic performance (Achama and Nwogu, 2013; Ambula, 2006; Amunga et al., 2013; García y García, 2021). Despite its significance, there is limited understanding of the ABM process and its impact on the quality of secondary education in Tanzania. Given this context, there is an evident need to delve deeper into the ABM process and its role in promoting quality education within Tanzanian secondary schools. The subsequent section investigates into the intricacies of quality education in the Tanzanian setting.

Provision of Quality Education in the Context of the Study

The Ministry of Education, Science, and Technology (MoEST) plays a fundamental role in ensuring high-quality education in the country, endorsing the concept of school quality assurance (SQA) to maintain educational standards. Even though inspection-based supervision remains a dominant method, the MoEST has expanded SQA's scope to incorporate both internal and external mechanisms (United Republic of Tanzania (URT), 2014). Experience reveals that SQA primarily focuses on the effectiveness of teachers in preparing essential documents like the scheme of work, lesson plans, and lesson notes (URT, 2017b). The 2014 Education and Training Policy, particularly in policy statements 3.2.1, 3.2.2, and 3.2.3, emphasizes the commitment to quality education. This policy emphasizes that, in collaboration with stakeholders, the government will strengthen quality control processes, equip monitoring entities with essential resources, and revamp the inspection philosophy and system to enhance SQA efficiency in basic education. Specifically, the policy statement 3.2.3 stipulates that:

> "*The government will strengthen the system, methods, concepts, and philosophy of school inspections to improve basic education quality control. (URT, 2014, p.25).*"

The policy recognises the role of SQA organs in enhancing the quality of education at all levels. In 2017, the government launched the SQA in response to the policy statement outlined above. This organ ensures high-quality education through internal and external evaluations (URT, 2017a). It is worth noting that the SQA department supervises Tanzania's endeavours to maintain educational quality. However, the SQA guidelines document does not specify the suitable quality assurance methods to be introduced to both teachers and quality assurers to guarantee the delivery of top-quality education. The focus is on the thorough preparation of professional teaching documents such as lesson plans, schemes of work, and lesson notes as the primary strategy. The difference is observed in using the school self-evaluation form (SSEF) as a notification to SQA officials before their official visit (URT, 2017b). Hence, methods such as ABM, an internal mechanism for ensuring the delivery of quality education, are seldom introduced in

Tanzanian secondary schools. The current study contends that, by implementing the ABM process, schools perceived as underperforming academically might find feasible solutions if applied systematically. With this in mind, this study addressed the following research questions: (a) Which types of ABM are utilised in Tanzanian secondary schools? (b) What role does ABM play in improving the quality of education in Tanzanian secondary schools?

Theory Base

This study was informed by Edwin Locke's goal-setting theory of performance management, which was developed in the 1960s. Most benchmarking methodologies, including those centred around activity, process, and exercise, serve the same purpose as performance gap analysis. Moreover, the goal-setting theory stresses that challenging goals lead to higher performance than merely urging individuals to give their best (Latham and Locke, 2018). The theory advocates that educational managers and administrators should strive to guide and motivate high performance among staff. According to Heslin et al. (2008), the goal-setting theory directly links to the provision of formal performance appraisals, rewards, and recognition for high performance. Studies have progressively highlighted that school managers, administrators, superintendents, and supervisors widely accept that goal setting is a means to improve and sustain established institutional work-related performance (Lunenburg, 2011; DuBrin, 2012).

Goal-setting theory deals with taking remedial actions to address performance deficiencies. It is emphasised that most performance management initiatives are associated with performance comparison, gap closing, and changes in the management process (Latham and Locke, 2018), which are common tactics of the ABM process. The theory is relevant to the ABM process and the provision of quality education for the following reasons: first, the theory is a technique used to raise incentives for staff to complete their work quickly and effectively. Second, the theory facilitates anticipated performance by amplifying motivation and effort while enhancing the calibre of feedback (Lunenburg, 2011). Third, it focuses on the resulting process while keeping the institution's goals, mission, and vision like a school. Based on these insights, the current study sought to use goal-setting theory to explore the role of ABM in delivering quality education in Tanzanian secondary schools.

Types of ABM in Secondary Schools

The literature review shows several types of ABM established, deployed, and executed in business, industrial, and educational institutions (Levy and Ronco, 2012; Bhola, 2018; Marr, 2020). Most early studies, including the present work, concentrate on benchmarking and differentiate between the following types of benchmarking: product, process, strategic, and organisational (Nazarko et al., 2009; Kailong', 2019; Hughes et al., 2020). However, the literature reports that internal ABM, process ABM, competitive ABM (4), generic ABM, strategic ABM, and functional are the types of ABM that are primarily implemented and sustained within the educational sector (Harper, 2019; Spiegel, 2020; Ivancevich et al., 2000). These are described in the following paragraphs.

Firstly, Internal-ABM (IABM), as the name suggests, is a process used in secondary schools to identify the best practice, mechanism, or procedure for conducting a particular task. According to Marr (2020) and Bhola (2018), IABM compares performance, processes, and practices against other parts of professionals within a school. Ivancevich et al. (2000) contend that "if a particular department has adopted a method of scheduling classes which is far superior to methods used in other departments in a secondary school, the school might want the departments using few effective measures to benchmark the department with the superior scheduling system" (p. 50). IABM aims to discover the best practice available within an organisation to accomplish a task with the least effort or resources (Harper, 2019; the Economics Times, 2016).

Secondly, the competitive ABM (CABM) focuses on competitive activities that yield high performance among competitors. In CABMP, the school examines performance against peers or competitors to improve its inputs, processes, and practices (Marr, 2020). A study by Zairi and Leonard (1996) suggested that CABM can be employed to inform parents and clients about how poorly or effectively a school is performing in comparison to direct competitors. Past research findings indicate that CABMP contrasts an operation with its immediate competitors (Booth et al., 2011; Kailong, 2019; Nyaoga et al., 2013). In Tanzania, CABMP has demonstrated success in many private secondary schools, notably in the outcomes of the national examinations, with consistent placements within the top ten over several years.

Thirdly, there is Functional ABM (FABM), which entails examining specific or akin functions with superior performance across education or industry (Jetmarová, 2011). For example, high-performing schools are benchmarked by several other secondary schools in terms of the teaching and learning process. Furthermore, FABM compares an operation with similar ones across a wide spectrum of secondary schools. For instance, a school might choose to embark on a study tour in a commercial sector, such as banking, to assess how commercial subjects like accounting, customer care, and financial management are implemented in the real world. Studies show that most private secondary schools and other education sectors engage in FABM activities (Marr, 2020), benchmark academic programs, leadership styles, and operational and management procedures.

Fourthly, generic ABM (GABM). According to Bhola (2018), generic ABM (GABM) aims to overhaul ineffective organizational systems by implementing benchmarking strategies and best practices. A popular explanation of GABM in secondary school education is that secondary schools seek innovative practices to improve performance across multiple secondary schools (Al-Khalifa, 2015; Harper, 2019; Levy and Ronco, 2012). In general, it is interesting to note that secondary schools may opt to use one or all of the procedures based on the requirements and aims of the ABM process.

The fifth type of ABM employed in secondary education is strategic ABM (SABM). SABM is typically external and specifically analyses how other secondary schools have

achieved success (Spiegel, 2020). In implementing SABM, schools specifically examine the corporate strategies employed by other schools. This helps school leaders learn from successful practices within and outside their institutions, such as current academic achievements or success in sports and games. SABM compares actions taken at a strategic level to support the long-lasting advantage over the competition. In short, the literature about ABM strongly suggests that SABM looks at the drivers of high performance, usually across different schools (Booth, 2013; Nazarko et al., 2009; Sammut-Bonnici, 2015).

The sixth and final type of ABA is Process ABM (PABM). It compares the procedures and processes of different secondary schools, identifying and isolating areas for both short-term and long-term school improvement (Harper, 2019). PABM consists of a mechanism for identifying specific work procedures that could be improved by imitating external examples of excellence that can be set as the best standard in the education field (Marr, 2020; Spiegel, 2020). In that regard, PABM involves comparing one's utility with that of similar utilities, with the aim of self-improvement by adopting structures or methods proven successful elsewhere.

The Roles of ABM in Enhancing Quality Education in Secondary Schools

ABM plays a significant role in bolstering academic productivity. Studies indicate that benchmarking techniques, such as pairing with colleagues, are essential for enhancing diversity in academic performance (Hughes et al., 2020). Furthermore, it is posited that ABM holds potential for academic performance and serves as a remedy to bolster employee performance through mentorship. This, in turn, alleviates work-related stress and augments staff well-being (Kinman and Wray, 2020). Al-Khalifa (2015) maintains that ABM positively impacts students' academic performance through continuous, systematic learning processes, comparing and adapting best practices from higher-performing schools. Similarly, Achama and Nwogu (2013) highlight that ABM, as an improvement process, allows an institution to assess its performance against top-performing entities. This helps understand how these institutions attain their performance levels and utilize this information to better their own.

Moreover, Kailong' (2019) establishes a positive correlation between performance in secondary education examinations and the processes of planning, data collection, data analysis, and the implementation of academic benchmarking reports in schools. Kailong' (2019) advocates for adopting Deming's cycle model of benchmarking when undertaking ABM with other schools. This sentiment echoes Darling-Hammond and Wentworth (2010), who depict ABM as a reference point. Specifically, ABM creates a good learning environment for both students and teachers for higher and equitable achievement. These studies indicate that the question of quality education can be achieved by combining and comparing ABM best practices to improve own educational practice (Kosor et al., 2019). However, the studies did not establish the best practices that need to be adopted due to contextual differences. On the contrary, ABM is unknowingly practised in secondary schools, thereby the lower-performing secondary schools' ABM higher-performing government and private secondary schools in their national examination as an indicator for quality improvement (Silva et al., 2020). It was thus anticipated that the exchange of information, experiences, and practices between schools would serve as a beacon for refining teaching and learning processes, as well as leadership and managerial strategies, ultimately benefiting both students and teachers

MATERIALS AND METHODS

Educational Context and Research Design

The study took place in two municipalities: Ilemela (Mwanza Region) and Morogoro (Morogoro Region) in Tanzania, centring on the top ten secondary schools (five from each municipality). Secondary schools were chosen equitably, with five private and five government institutions. These schools were pseudonymously labelled 1-10, with numbers 1-5 representing private schools and 6-10 signifying government schools. Given that ABM was conceived to compare top performers (Al-Khalifa, 2015), these schools were engaged in adopting best practices. Particularly, schools such as 1 & 6, besides being top achievers in their respective municipalities, also serve as resource centres for other secondary schools seeking benchmarking opportunities. Moreover, the chosen secondary schools outperformed others based on results from the National Examinations Council of Tanzania (NECTA, 2020 and 2021). The location selection was influenced by convenience factors, such as proximity, familiarity with the area, and the participants' willingness. Similarly, a cross-sectional survey research design, employing various data collection methods, was utilised.

Research Participants and Samplings

The study involved 188 respondents and key informants. The respondents consisted of 130 teachers selected using the simple random technique through the lottery method. Others who were purposively selected included ten heads of schools (HoS), ten deputy HoS, ten academic teachers (ATs), two secondary school education officers (SEO), two secondary school academic officers (SEAO); 20 school management committee members (SMCM) and four Quality assurers (QAs). Using the lottery method, numbers were inscribed on pieces of paper and folded according to the required sample size. These were then mixed up, and every teacher willing to participate in each school selected one at random. Those who drew numbers between 1 and 13 were chosen as respondents. This procedure was adopted to ensure every teacher had an equal opportunity to be part of the study. Similarly, HoS, deputy HoS, ATs, SEO, SEAO, SMCM & QAs were purposively selected because they possess adequate information on the types, roles, and practices of ABM that need to be enforced for enhancing the provision of quality education in secondary schools. Furthermore, all six sampled schools were formally committed to ABM since the use of ABM in Tanzania secondary education is subject to the implementation of quality assurance processes and procedures (URT, 2014; 2017b). In this sense, the use of ABM among secondary schools is one of the focal points addressed in SQA.

Research Instruments

The study used self-developed instruments with insights from the literature (Magutu et al., 2011; Nyaoga et al., 2013; Ettorchi-Tardy et al., 2012). Questionnaires were developed for teachers, ATs, and deputy HoS via an exhaustive process that involved several steps (cf. choosing and evaluating appropriate items for the ABM types and the roles of ABM; pre-testing and revising of the instruments). The questionnaire consisted of two sections - A and B. Section A addressed respondents' demographic physiognomies such as the number of years at the schools, school establishment, school performance, types of schools, and gender; Section B included questions about the types of ABM, such as "what types of ABM are performed in this school," as well as questions about the roles of the ABM process, such as "ABM enables the schools to set appropriate standards," "ABM use external forces to school improve internal undertaking," and "influence and shapes schools' decisions and thus quality education." the item statements used positive and negative indicators to ensure reliable responses.

The questionnaire was administered before conducting the interviews. Interviews were conducted with instruments to guarantee consistency and increase the validity and reliability of the research instruments; pre-testing was conducted in two schools in two phases. Some interview questions include the following: "Please describe to me what ABM means to you and this school", "I would like to know what types of ABM are in this secondary school," and "as the school's academic officer, explain to me the process of ABM for quality education improvement."

Research instruments were tested and revised based on the first school in the first phase. Since respondents appeared to be more conversant in Swahili, the language used was translated from English to the Swahili language during the revision process. Besides, the phrase "academic benchmarking" seemed new to some of the respondents (cf. school management committee members), irrespective of English being used as a medium of instruction in Tanzania's secondary schools. Phase two involved testing revised research instruments in the second school as researchers looked for uniformity in response as provided compared to the first phase of testing in the first school. When the term "academic benchmarking" was translated in Swahili as "viwango vya kitaaluma", respondents connected it with "academic standards-setting". This notion warranted the continuation of the research study because they signified the same thing as "academic benchmarking" conducted in secondary schools.

The study employed the back-translation method to guarantee gathering valid and reliable data (Eremenco et al., 2005) and to achieve semantic consistency between the source and target languages (Duffy, 2006). This enhanced the dependability and applicability of the research instruments. Apart from obtaining written consent from participants, researchers sought oral consent before beginning these interviews and recorded the verbal agreement on a mobile phone. Furthermore, qualitative data were gathered through interviews, and a thematic analysis framework was used. The study utilised the theme framework to evaluate collected data. The analysis adhered to Creswell's (2014) approach wherein data were manually transcribed, themes were identified, and findings were presented and interpreted based on these established themes. Two research assistants also helped with data collection and classified the material independently. Researchers then analysed the recorded transcripts, coded sub-themes, and charted the data subcategories and categories to reach critical conclusions. Next, researchers read the transcript line-by-line, applying specific codes (namely, functional, process, strategic, competitive, generic, and internal) that characterised what was deemed significant in each segment. Finally, the data from the structured questionnaire were subjected to descriptive statistical analysis.

RESULTS

Types of ABM Used in Secondary Schools

This study traced six types of ABM, including process ABM, internal ABM, competitive ABM, functional ABM, strategic ABM, and generic ABM, for the respondents to identify based on benchmarking activities or exercises they frequently perform in their respective schools. The question asked *was, 'Which of the following types of ABM are used in this secondary school to influence the provision of quality education?'* Because the study intended to get types of ABM used in schools, respondents were required to select appropriate types of ABM by providing a tick "√" to either yes or no to their exact choice; multiple selections were allowed. The results are presented in Table 1.

S/N	Types of ABM	(Provide "√")	
		YES - F (%)	NO - F (%)
1	Process ABM (admission, dropout, assessment, and teaching-learning, evaluation, graduation rate)	140(93.3)	10(6.7)
2	Internal ABM (comparison between departments and comparison between secondary schools)	121(80.6)	29(13.4)
3	Competitive ABM (compare results against best performers/ contestants) in municipals	136(90.7)	14(9.3)
4	Functional ABM (to become the best in process and technology, compare the technology /process in one's school, coping strategies)	114(76)	36(24)
5	Strategic academic benchmarking (focus on services provided by the school)	77(51.3)	73(48.7)

Table 1: Teachers, Academic Teachers, and Deputy Head of Schools Responses on Types of ABM Used in Secondary Schools

Table 1 shows the six types of ABM utilised in Tanzanian secondary schools, with the first four being the most common: process ABM, competitive ABM, internal ABM, and functional ABM. However, strategic and generic ABM appears to be applied less in most secondary schools and, as a result, was least established by respondents. In alignment with this, interviews conducted with school heads, members of the school management committee, and secondary education officers revealed that all interviewees appeared to know about ABM and the types used in several secondary schools. Further, the data disclose that, in context, ABM is practised in secondary schools. However, some interviewees are not aware that what they conduct is ABM with several types. The findings revealed that several ABM activities conducted in different schools influence the provision of quality education and that academic performance reflects mainly internal and competitive types of benchmarking. Table 2 summarizes results related to types of ABM used in Tanzania secondary schools.

Generated themes	Coded sub-themes	Interview extract "quotes"
Functional ABM	Policies, national examinations, school achievements	*There are various strategies carried out to ensure that our school performs well in the national examination; therefore, the school management knows it well (SMCM_SS1_28 May 2020)*
Process ABM	Process, strategy, quality assurance, school achievements	*Staff rely on the school action plan to ensure that our school performs well in continuous assessment and national examinations (SMCM_SS10 5 June 2020)*
	an action plan,	*Undeniably, every school should prepare its action plan to raise academic performance (SEO_2_28 June 2020).*
	academic success, assessment, share skills, exam score	*We have emphasized working hard, sharing teaching and learning techniques, emphasizing internal assessment, and using data to predict each student's score in the final examination. (SEO_1_5 June 2020).*
	Teamwork, assessment, quality education	*Our school is working as a team to assess our way of ensuring the provision of quality education (SMCM_SS7_5 June 2020).*
	Joint exams, activity, procedure, arrangement	*Our schools do joint-examination with higher-performing schools within our municipal and other schools in the region (HoS_SS7_5 June 2020)*
Competitive ABM	Assessments, leadership, examination, curriculum content	*The academic master leads teachers to accomplish their syllabus and make revisions to make students fit for the national examination (HoS_SS2_28 May 2020)*
	Quality education, internal assessments, School Committee	*The school has an internal school committee that is responsible for assuring the provision of quality education compared to other schools (HoS-SS3_28 May 2020)*
	competitive ABM, exams, best practices, best practices	*We usually compare ourselves in national examinations, and then we take measures to learn from our competitors the best methods to improve ours (HoS_SS8_29 May 2020)*
Internal ABM	Management, school practices, assessments, academic performance	*The School Committee is responsible for making an internal assessment of school practices based on the education provided, academic performance, leadership, and school environments (SEAO_2_26 June 2020)*
	Student success, motivation, curriculum content	*In our school, every teacher is informed to cover the syllabus; therefore, we encourage school leadership, teachers, and parents to motivate students on school-related issues for their success (SMCM_SS5_5 June 2020).*
Generic ABM	Generic ABM, academic performance strategies, teamwork	*ABM in our school is conducted; however, in our usual understanding, we call it internal academic performance strategies as applied in other organizations (HoS-SS10_2 June 2020)*
Strategic ABM	Strategic ABM strategies, discipline, moral issues, academic performance strategies	*We share our strategies regarding academic performance, discipline, and moral issues with our neighboring private schools (HoS_SS6_7 June 2020).*
	collaboration, strategic, professional, leadership, strategic	*Our region (Morogoro) introduced Partnership in Excellence (PE), a program that calls for teachers to collaboratively work together, share teaching and learning information and leadership, and carry out professional prediction and comparisons (SEAO_1_18/05/2020)*

Table 2: Interviewees' Responses on Types of ABM Used in Secondary Schools

Generally, from different perspectives, the results disclose that six types of ABM are in practice in Tanzania secondary schools; however, four types are usually performed.

The Roles of ABM in Enhancing the Provision of Quality Education in Secondary Schools

The present study also sought to identify ABM's roles in enhancing quality education in secondary schools. A questionnaire with eight statements established to measure the role of ABM in secondary schools was used to collect data from respondents. Respondents were required to identify the level of agreement on the eight selected statements based on a five-point Likert scale, and the choices ranged from strongly agree to strongly disagree. Table 3 summarizes the results.

S/N	Statements (s)	Strongly agree F (%)	Agree F (%)	Neither agree nor disagree F (%)	Strongly disagree F (%)	Disagree F (%)
1	ABM increases school visibility and potential	85(56.7)	50(33.3)	5(3.3)	4(2.7)	6(4)
2	ABM improves schools' internal activities	52(34.6)	82(54.7)	12(8)	1(0.7)	3(2)
3	ABM promotes active learning	90(60)	44(29.3)	4(2.7)	6(4)	6(4)
4	ABM enables schools to set academic standards and evaluation criteria	80(53.3)	66(44)	2(1.3)	1(0.7)	1(0.7)
5	ABM enhances academic performance status	102(68)	27(18)	11(7.3)	3(2)	7(4.7)
6	ABM helps bridge the inefficiency gap in school management	5(3.3)	88(58.8)	53(35.3)	2(1.3)	2(1.3)
7	ABM influences and shapes schools' decision-making	4(2.7)	60(40)	56(37.3)	10(6.7)	20(13.3)
8	ABM stimulates instructional leadership	4(2.7)	19(12.7)	52(34.6)	15(10)	60(40)

Table 3: Roles of ABM Process in Influencing Quality Education in Secondary Schools

Generated themes	Coded sub-themes	Interview extract "quotes"
Enhances academic performance status	Academic status increased performance,	*ABM helps a school to maintain its academic performance status. The technique seems to ensure the rate of performance increases (HoS_SS6_27/05/2020)*
Enables school to set academic standards & evaluation criteria	Motivation, assessment strategies	*Through sharing techniques of teaching and assessment strategies with neighboring schools, our school commits to working hard to rescue its status (HoS_SS4_29/05/2020)*
	achievement, motivation, rewards	*Enhance students' competition to achieve high in their final examination as they are recognized and rewarded (HoS_SS2_28/05/2020)*
Promote active learning	Install competitive tendency, internal rewards, meet school goals,	*ABM installs competitive tendencies in our schools. We normally appraise our students to work by referring to the outgoing students' performance (HoS_ SS6_7/05/2020).*
Enhance visibility and potential	Partnership, joint strategies, visibility, academic excellence	*Our school has a partnership with other schools in both Morogoro and Dar es Salaam regions. We have joint strategies to raise academic excellence, notably interschool examinations and exchange in the marking process (SMCM_SS2_ 05/06/2020).*
	Academic success, hard work, school visibility	*ABM tactics force teachers and students to work accordingly for the betterment of themselves and the school as a whole (SEO_2_14/05/2020).*
	Partnership, academic excellence	*We encourage schools to visit other best performers to learn from their academic excellence and other administrative issues (QA1_SS2_15/05/2020).*
Stimulate instructional leadership and management	Achievement, leadership, management	*Many schools in this municipal area have benchmarked some tactics from two high-achiever schools due to their achievements (SEO_1_05/06/2020).*
	Achieve goals, managerial model	*ABM has helped us achieve our goals and is an excellent example in our municipal and beyond (SMCM_SS7_15/06/2020).*
	A culture of working hard, achieving school goals,	*ABM tactics help maintain the culture of achieving schools' goals, vision, and mission, hence fulfilling national educational objectives (QA2_2_13/06/2020).*
	Maintain status, hard work, leadership	*ABM forces us to rectify our techniques and emphasizes that teachers and students work hard to maintain our status (HoS_9_SS8_ 05/06/2020).*
	Achieve goals, visibility	*ABM is a tool for ensuring staff work to meet the school's set goals (SMCM_ SS10_28/05/2020).*

Table 4: Interviewees' Responses on Roles of ABM in Secondary Schools

The assumption was that the influence of the ABM process on improving the quality of education in secondary schools is generally evident. Yet, when respondents were prompted to pinpoint the roles of the ABM process in enhancing the quality of education in their specific secondary schools, contrasting views emerged on the established roles of the ABM process, as depicted in Table 3. Notably, a substantial number of respondents, namely 56 (37.3%) and 52 (34.6%), respectively, were uncertain whether the ABM process bolsters instructional leadership or significantly impacts school decision-making processes. Overall, multiple roles of the ABM process contributed to improved educational standards in secondary schools. Likewise, interviews yielded five prominent themes regarding the roles of the ABM process, underscoring its potential to elevate the quality of education in secondary settings. The findings are consolidated in Table 4."

DISCUSSION

Types of Academic Benchmarking Used in Secondary Schools

This study aimed to explore the ABM process's roles in providing quality education in secondary schools. The results show that six types of ABM (i.e., process ABM, competitive ABM, internal ABM, functional ABM, strategic ABM, and generic ABM) are used in secondary schools to influence the provision of quality education. Further examination indicates that, among six types, only processes ABM, competitive ABM, and internal ABM are commonly practiced in secondary schools. This suggests that teachers, academic teachers, and deputy HoS are more likely to use the most practiced ABM types to provide quality education than the functional ABM, strategic ABM, and generic ABM. These findings closely align with those of Al-Khalifa (2015) and Magutu et al. (2011), who determined that internal benchmarking formed connections between schools undertaking similar operations, functions, and activities, aiming to elevate best practices within those institutions.

Additionally, the findings indicated a prevalent use of competitive benchmarking in secondary schools. However, it was discerned that competitive ABM is especially widespread in private schools, where the commitment to high-quality performance is unquestionable. This means secondary schools conduct competitive ABM accomplishments that aim to compete over others in quality education in terms of academic performance, results, and other services rendered by the school. Such an approach to ABM is apt to drive schools to enhance the provision of quality education because they need to compare their performance with their competitors (Hughes et al., 2020). This motivates the interest and desire of non-performing schools to adopt the practices to become competitive. The process of learning from the best has resulted in benchmarking among schools. These six ABM types further highlight the notion that each school formulates its action plan, incorporating the ABM process to ensure quality education. It was noted in the interview section of this research that most of the types of ABM call for teachers and stakeholders to work together, share teaching and learning information collaboratively and leadership, and carry out professional predictions and comparisons. This means that most ABM types are described as strategies aiming to improve the provision of quality education, notably academic results in the national examination and assessment.

Roles of ABM in Enhancing the Provision of Quality Education

Different roles of ABM were administered in relation to the provision of quality education. However, only the roles that ranked 50% and above reflected in the study area are discussed in the current study. It was established that ABM plays an essential role in increasing school visibility and potentiality in different aspects of enhancing the provision of quality education in secondary schools. In support of that, 90% of the respondents complemented the evidence from the interview. About the processes, the tool is taken as a model that needs to be implemented as a program involving the parts concerned. The results suggest that ABM provides opportunities for teachers, administrators, and students to learn from other best practices to enhance the provision of quality education in their respective schools. This means that most secondary schools are likely to increase enrollment due to the quality of education provided due to high performance and noticeable by the community. The school also evaluates its performance against the standard and quality education criteria. This aligns with Achama and Nwogu's (2013) assertion that benchmarking serves as a reminder to rectify or abandon traditional practices that may prove detrimental to an institution.

Besides, the study depicted other potentials, such as improving teachers' professional career development. ABM gives prominence to the application of data to establish the gap that exists in performance within and outside the school. Teachers have a great opportunity to crave their careers professionally for such reasons. This assertion is supported by Darling-Hammond and Wentworth (2010), who state that the adopted practices must be oriented to teachers as school-based professional development. Contrarily, if the adaptation is not aptly directed, it might face teacher resistance, as Booth (2013) suggested.

The findings also show the respondents agreed that ABM promotes active learning. This means that students, teachers, school management committees, and educational leaders work in tandem to enhance the provision of quality education in their schools by advocating best ABM practices. The findings complement the goal-setting theory that premises on result-oriented against the school goal, mission, and vision (Locke and Latham, 2002). It should be noted that quality education primarily strives to improve the active learning process for both academic and administrative excellence. This research aligns more with Hacker and Kleiner (2000), who argue that benchmarking enables one to correct one's own teaching and learning deficiencies for good academic results. The efforts carried out in education end in improving learning outcomes. As a result, benchmarking ensures that a school maintains consistency in a higher ranking in national examination results. The current study found that secondary schools in the study areas take counteractive measures that need every school to assess and evaluate their performance gap. The findings

align closely with Amunga et al. (2013), who asserted that benchmarking assists educational institutions in identifying performance gaps and formulating and executing potential solutions. Likewise, the strategies emphasize sharing success; thus, low-performing schools are obliged to do joint exams with higher-performing schools and set other criteria for raising academic performance. In addition, the findings report that ABM improves working habits and peer coaching. For such reasons, the school confers to greater continuity and cumulative impact for maintaining its status quo through upholding the ABM process (Achim et al., 2009).

The most significant part of this study is that, despite many respondents being inexperienced with the study topic, the data show that 62.1% acknowledge the importance of ABM in resolving inefficiencies. It is a fact that the benchmarking process involves identifying deficiencies prevailing in the school for relevant intervention. This may result from motivation to enhance the provision of quality education in their respective secondary schools compared to others. The identified deficiencies bridge the knowledge-performing gap that creates inadequacies in providing quality education. Perhaps this is why Kinman and Wray (2020) declare that benchmarking is a remedy for an inefficient system. ABM application is a scientific investigation of complex education problems that must be addressed. Echoing this sentiment, this study emphasizes the need to familiarise secondary school teachers with this approach, enabling them to confidently tackle educational issues with suitable interventions.

Implications, Limitations, and Areas for Further Studies

The present study highlighted that adopting ABM positively impacts delivering quality education in the surveyed secondary schools. First, the study implies that in the execution of ABM types, secondary schools were argued to change their mode of performing ABM activities because some types are practiced frequently while others are not. Therefore, it should be noted that each ABM type serves a different purpose. As such, secondary schools in Tanzania should utilize each ABM type based on its primary roles. Second, although strategic and generic types were least used among examined secondary schools, schools are argued to note that if properly utilised, they can offer positive outcomes based on their roles in influencing best academic performance, such as in the least performing subjects like Science, Technology Engineering and Mathematics, henceforward, provision of quality secondary education.

Another implication is that ABM plays a great role in influencing the provision of quality education by fostering instructional leadership and informed decision-making among school leaders, superintendents, directors, and educational officers. This means that secondary schools should undertake various ABM initiatives to ensure structured school activities that lead to quality learning. Doing so allows the studied secondary schools in Tanzania and beyond to establish academic standards and evaluation criteria. Consequently, the study suggests that educational stakeholders in other countries, notably secondary school teachers, adopt the ABM process to better their practices. Furthermore, the current study recommends that secondary schools apply ABM knowledge by first assessing their imperfections and strengths. Then, as part of the ABM process, arrange field trips or study tours to the best-performing schools to reskill, upskill, retool, and learn how to address their most significant drawbacks. Correspondingly, ABM knowledge should help Tanzanian and global education leaders and policymakers designate specific school programmes and goals for developing and strengthening teachers to successfully attain ABM outcomes for the provision of quality secondary education.

However, this study has its limitations. First, the study was limited to 10 secondary schools in two municipalities found within two regions in Tanzania and only those located in an urban context. This could potentially hinder the broader applicability of the findings. Therefore, future research should encompass a more diverse range of secondary schools and regions. Second, the study used only 188 samples with several characteristics; similar studies can be conducted using a large sample, comparing privately owned, operated, and maintained with government-operated secondary schools and using both semi-urban and rural areas. Lastly, an experimental approach could probe the efficiency and effectiveness of ABM in elevating the quality of secondary school education. In a comparative study, such research could elucidate the relationship between experimental schools (where benchmarking is applied) and non-experimental schools (those without the benchmarking intervention).

CONCLUSION

The current study concludes that the several types of ABM were practised in studied secondary schools. While some respondents viewed ABM as a novel concept, it is evident that each type of ABM plays distinct roles. Secondary schools and secondary educational practitioners need to set aside programs for deploying ABM to successfully provide quality secondary school education. Prominently, the findings of the current research study can be applied to similar educational contexts in Tanzania and abroad to improve the quality of secondary education. School leaders, school management teams, and education quality assurers can apply the ABM process and knowledge obtained through deploying the ABM process to their schools to heighten their roles in providing quality education in their secondary schools. In addition, activities and measures taken, such as field visits, study tours, and planning, are used to raise the provision of quality education in secondary schools. This insight into ABM is significant for understanding how its knowledge might be applicable in settings with similar characteristics.

Correspondingly, the study concludes that internal assessment and comparisons of its practices signify the competitive nature with higher performers, leading to the provision of quality education and good results in secondary education examinations. Thus, it is worthwhile to orient academic benchmarking practices in secondary to ensure the provision of quality education. These findings provide a potential mechanism for applying academic benchmarking activity among teachers and school management teams in other contexts to improve and enhance the provision of quality education. Further, the study concludes that ABM has

a significant role in ensuring quality education through internal assessment, comparisons, and adopting best practices from benchmarked schools. ABM creates avenues for mutual learning through sharing, collaboration, modelling, and competition. It can also be concluded that if ABM practices are collaboratively done with partner schools, there are possibilities of improving teachers' traditional practices to those that suit them best for positive impacts on academic performance in secondary schools.

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EVALUATION OF THE EFFICIENCY OF THE SUDDEN IMPLEMENTATION OF THE SYNCHRONOUS ONLINE COURSE: FINDINGS OF A MIXED METHOD STUDY

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ABSTRACT

Tragedies are neither sought nor requested. Unfortunately, they happen and affect all areas of life, especially education. However, they leave lessons that work to face new challenges. This study aims to analyze the transition from classroom classes to distance classes due to an earthquake that hit Mexico City in 2017, damaging its buildings and infrastructure, to find the necessary aspects for an efficient transition in these cases, using different Tecnologico de Monterrey's institutional data. Faculty members were interviewed about their views during the transition. The student's grades were also compared. Student responses were analyzed in the teacher satisfaction surveys. Challenges encountered by faculty during the sudden implementation of online courses were difficulties in the use of digital technologies, the amount of time spent preparing the class, the new ways of communication, the lack of use and knowledge of the online model, and the student's evaluation in online settings. The advantages mentioned by the faculty were flexibility, recorded classes, and the new tools that can be used for teaching. It was also observed that the student averages were higher in the semester after the earthquake. However, although young faculty with excellent technology management or experienced faculty with good use of technology and who are very well trained were the profiles that students better evaluated, no correlation was found between their teacher-associated variables and teacher performance indicators with the student averages. This experience served as a basis for meeting the contingency of 2020 with COVID-19. It represented itself as one antecedent in evaluating online education, allowing the establishment of a more expeditious and efficient online educational system.

KEYWORDS

Distance learning, educational innovation, higher education, online synchronous models, STEM

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Highlights

- *Teacher survey answers and recommendation levels in sudden online courses were evaluated.*
- *Good technology management and teaching experience are positive factors to success in online courses.*
- *Faculty training in digital technology is needed to transform from classroom to distance education efficiently.*
- *Given the uncertainty of these times, higher education institutions' investment in teacher education is a responsibility.*

INTRODUCTION

Catastrophes are unplanned; they may suddenly arise and completely transform the everyday life of society. In 2020, the World experienced a health emergency that forced the population to take shelter at home. The consequences of these actions are evident in the economy and society in general. Universities had to implement strategies to continue their courses. In general, many classes had to migrate to the digital mode; however, this required many parameters to comply with so that the course quality, frequency, and length were unaffected. Studies of similar implementations help us understand, design, and efficiently face contingencies of different magnitudes, affecting the course of university education as little as possible. A similar case happened in September 2017. A 7.1 magnitude

earthquake in Mexico City damaged the infrastructure of the Mexico City campus of Tecnologico de Monterrey. At that time, the science department offered 118 courses in 21 different subjects (Physics (6), Mathematics (11), and Statistics and Probability (4)) for 3,068 students. The department had 45 faculty members, both full-time and part-time. At the time of the earthquake, the students were in the fifth week of the fall semester and faced the campus's inability. The science department faced the challenge of ending the semester (9 remaining weeks) without physical facilities. After considering different possibilities, it was decided to use an online synchronous model for the courses. However, is distance learning as efficient as classroom learning? (Bernard et al., 2004). If so, what are the elements that made it efficient? We intend to answer those questions using available institutional data in this work.

Literature Review

Access to information and distribution of educational content facilitated by the World Wide Web and the advancement of technology in the digital age helped the emergence and establishment of distance education (Fidalgo et al., 2020). Whether synchronous, asynchronous, blended, massive online open courses (MOOC), or open scheduled online classes, there has always been a need to compare their efficiency with formal face-to-face education.

Al Lily et al. (2020) developed a conceptual framework for distance education in times of catastrophe composed of procedural, logistical, social, cultural, pedagogical, and psychological ramifications. These authors identified that distance education forced by the pandemic dissipated from traditional distance education in many aspects: abruptness, international interest, popularization, expansion, and imposition. In their research, they concluded that in times of crisis, there is a political dynamic between technology and society that depends on cultural perspectives.

Similar studies of distance education with face-to-face education have concluded that the relationship between student and instructor is the central differential (Bernard et al., 2004). However, this can also be achieved through synchronous courses. On the other hand, distance education can be more constructive and effective through students' and teachers' correct use of technology (Bernard et al., 2004). These elements are included in Moore's (1993) traditional theory of distance education: interaction, structure, and autonomy. These comparative studies have increased emphasis on institution preparation, skills development, instructor training, and the offering of blended learning courses to familiarize students with distance education in disasters (Fidalgo, 2020).

A literature review conducted by Bernard et al. (2004) examined students' achievements, attitudes, and retention rates in distance education compared to traditional classroom instruction. The authors found that the two modes of instruction were comparable in terms of study features and outcomes. However, there were differences in achievement and attitudes between synchronous and asynchronous distance education. Synchronous outcomes were better for classroom instruction, while asynchronous outcomes were better for distance education. Attitudes towards both modes of instruction were negative, but the difference was more significant for synchronous distance education, where classroom instruction was preferred. Retention rates showed the opposite outcome, with asynchronous distance education having a higher dropout rate than synchronous distance education.

Lynch and Dembo's (2004) research on distance courses used students' final grades to measure their online academic performance. The study found a positive correlation between self-efficacy, verbal ability, and course grades. This work suggested that these variables may impact performance in online, blended learning contexts. However, the authors suggested additional research to validate this relationship.

In another study, the question of distance education effectiveness was answered through interviews with students and teachers. Koçoglu & Tekdal (2020) proposed that it could be improved by various means, for example, parent participation through teacher-parent communications, internet, and technological material support, monitoring student participation, conducting online exams in different intervals, informative instruction on distance education, rich content support to motivate students, temporal freedom in participation, development of face-to-face education platforms, learning interaction, and development of advanced software.

With this in mind, the speed of transition in times of crisis depends on the efficiency of the university's information system, which differs whether it is a public or private school (Bojovic et al., 2020; Korkman & Toraman, 2020). In fact, before the pandemic, much of the research on efficiency in distance education was related to it (Vadnere, 2018; Cacheiro-Gonzalez et al., 2019; Samoylov & Budnik, 2019). Now, efficiency is also measured in the pedagogical field, such as using technology to achieve efficient curriculum delivery. In this regard, Cacheiro-Gonzalez et al. (2019) have mentioned that an educational model that effectively utilizes transdisciplinary knowledge is necessary; to achieve this, the basic tools of the learning platform, such as forums, chat, and web conferences, must be creatively and rationally utilized. Creating future universities is not solely a technological challenge but also an epistemological, discursive, and ideological one, for which it is vital to develop strategies for educators' initial and continuing training.

In the case of the COVID-19 transition from face-to-face to hybrid classes or totally online, there are different opinions regarding students' satisfaction with teaching. There were critiques about the lecturers´ computer use, implying that some lecturers graded the students' works without reading them, or others considered that even with high grades, it did not mean that students fully understood the subjects (Uluöz, 2020). In other work, it was suggested that instructors should use peer group grading since no difference was seen between peer group and instructor grades for hybrid and online courses pre- and post-COVID-19. Students found peer group grading fair in both course formats, considering it a confident, fair, and time-saving assessment tool (Vander Schee & Birrittella, 2021).

Themes emerged, including changes to human interaction, modifications to assessments to prevent cheating, challenges with technology and institutional policies, and advantages such as inclusivity, flexibility, and faculty skill enhancement

(Khan et al., 2022). Recommendations included grading class participation, providing clear assessment guidelines, and utilizing communication methods and recorded sessions. In some cases, it was found that web-based distance education can be less effective than face-to-face courses, especially for applied subjects; also, technical issues can disrupt learning (Ozer & Unstun, 2020).

During COVID-19, grades were the biggest concern among students (Meccawy, 2021). Udeogalanya (2022) argues that during the COVID-19 pandemic, the transition from classroom to online education proved challenging for students, especially those whose future success depended on their academic performance. When students were asked to identify the main drivers of academic success, they cited hands-on instruction (83%), faculty quality (81%), and technology availability (87%). Thus, the author recommends that educators increase their understanding of student performance by regularly checking student grades before and during pandemics to ensure that fears and concerns about grades are justified. She argued that to teach and learn online effectively, there is a need to develop a reliable educational system.

On the other hand, most faculty prefer online assessments for convenience and auto-correction but not for practical or skill-based subjects (Meccawy, 2021). However, cheating was the biggest challenge from the faculty members' point of view due to a lack of proper invigilation as the main cause. This led to grade inflation and did not reflect the actual student performance. It positively influenced interaction but negatively affected attendance (Meccawy, 2021). In the same way, not all faculty members were found competent in online teaching for student engagement, instructional strategy, technical communication, and time management skills (Sarfaraz et al., 2020). Due to the sudden pandemic, teachers were not provided with professional training in ICT, which put many students at risk. This led to excessive pressure on teachers to achieve educational attainment. In some cases, despite their efforts, challenges such as insufficient coordination and little investment in technology hindered the adoption of digital platforms for teaching (Akram et al., 2021). Research has demonstrated that using information and communication technology (ICT) tools, specifically improving digital teacher competence and providing opportunities for teachers to learn digital skills, is key to successfully transitioning to online teaching during unexpected events such as COVID-19 school closures (König et al., 2020). This has significant implications for teacher education and the integration of ICT into teaching practices.

Nonetheless, there are a few studies on using distance education after an earthquake. One study of this kind suggested using social networks to support collaboration in higher education contexts (Dablner, 2012). In another case study, in which the framework of readiness, response, and recovery matrix for disaster management is used, it was found that despite different crises, such as seismic events or tsunamis, the transition from the classroom to distance education has not been an immediate event, but has taken some time (Ayebi-Arthur, 2017). The analysis of case studies allows for generating recommendations about the best practices, in this case, to make an efficient change from the classroom to distance education and find the appropriate conditions that allow efficient use of technology in the completion of this task (Sun & Chen, 2016; Fadde, 2014).

Study Objective

None of the works in the literature review employed institutional data to prove their asseverations. This work aims to evaluate the efficiency of the sudden implementation of synchronous online courses after an unexpected catastrophe (an earthquake), comparing institutional data from courses previously taught in the classroom model with their hybrid counterpart. As the class contents and professors were the same, our null hypothesis is that the analyzed institutional data (students' grades and teaching satisfaction survey results) are equal. However, faculty training data may reveal hidden differences.

METHOD

A comparative statistical study of partial and final grades was carried out on the two models. The faculty profiles and their relation to their evaluation by the student and the student's final grades were also examined. This document describes the general methodology used for these online courses and presents the advantages and disadvantages of the synchronous online model, expressed by the teachers and students involved.

The research had a mixed design (qualitative and quantitative). For the qualitative analysis, an anonymous survey was sent to all 45 faculty members involved in the study. Some questions were on a Likert scale of 1 to 10, where 1 means strongly disagrees and 10 means strongly agrees, and others were open-ended questions. The questions of the survey are shown in Table 1.

Question	Scale
I can adequately teach the contents of the course in this model	1 to 10
The model allows the students to develop the competencies established for the course	1 to 10
The model encouraged discussion, learning, evaluation	1 to 10
I find the model very interesting; I would like to use it in the future	1 to 10
Compared to other semesters, I believe that the learning of the students in my course was	Well below average, below average, average, above average, well above average
What are the main challenges of the implementation of the new model	Open-ended
What are the main advantages of the model	Open-ended

Table 1: Questions of the survey applied to faculty after a hybrid semester.

Another instrument was the Student Opinion Survey (SOS or ECOA in Spanish), an institutional tool consisting of 9 questions regarding the student's perception of the course teaching. Table 2 shows the texts of three questions of the ECOA survey applied to students. After evaluations, students are asked to leave comments about the course.

Number	Text Question	Scale
5	Regarding the level of intellectual challenge (it motivated me and required me to give my best effort and comply with quality for the benefit of my learning and my personal growth), the course was:	From 0 (bad) to 10 (exceptional). "I do not have elements to evaluate" is also possible.
6	Regarding its role as a guide to learning (it inspired me and showed commitment to my learning, development, and integral growth), the teacher was:	From 0 (bad) to 10 (exceptional). "I do not have elements to evaluate" is also possible.
7	Would you recommend a friend take this subject with this teacher?	From 0 (bad) to 10 (exceptional). "I do not have elements to evaluate" is also possible.

Table 2: Questions from the student opinion survey (ECOA).

This investigation only analyses the results of question 7, which concerns the recommendation to take courses with the same teacher in the future (REC). The weighted average of questions 5, 6, and 7, together grouped into the concept "inspiring teacher" (INSP) that has to do with the challenge of being in the specific class and how much the teacher is a guide, an inspiring mentor to follow their studies with passion. Both sets of teacher performance indicators questions were analyzed in the fall courses of 2016 (face-to-face classes) and the fall courses of 2017 (courses that started in person and, due to the contingency, became hybrid).

The quantitative analysis was carried out by comparing the institutional records of two partial grades and the final grades of the students of 21 subjects of the Science Department for the Fall Terms of 20015, 2016, and 2017. The fall term of 2017 was when the earthquake happened, and the fall term of 2016 was the semester of the previous year that the catastrophe occurred. The comparison was made with the same subjects and the same teachers. This was considered a quasi-experimental design because the students who enter these courses have the same requirements but may differ in number. We must stress that we are comparing the results of regular face-to-face courses with a group of "forced hybrid" courses that experienced five weeks of regular teaching and nine sudden synchronous online sessions.

This work mainly presents descriptive statistics. Moreover, the student marks of the second semester (P2) for the years 2016 and 2017 at the Basic Sciences department (Math and Physics) were used to analyze the effect of the seismological event on student performance through a t-student test with a significance level of 5%.

A first test was done using the whole department's marks. After that, individual nonparametric Mann-Whitney tests were performed for each one of the sixteen subjects (Mathematics Introduction, Mathematics I, Mathematics II, Mathematics III, Differential Equations, Applied Mathematics, Advanced Mathematics, Mathematics for design, Probability and Statistics, Statistics for Research in Social Sciences, Statistics II, Physics I, Physics II, Physics introduction, Electricity and Magnetism, Physics for design). The null hypothesis established that the average mark for the second partial mark was similar for both years (2016 and 2017), while the alternative hypothesis established the difference between the two partials of both years. All the analyses were performed in Minitab® Statistical software 21.4, 2023. A multi-vary chart for the second partial period marks was generated for all the subjects. Once the differences between the marks of the compared two years were verified, a correlogram was created using distinct variables (year (2016 or 2017), professor age, experience (EXP - semesters of teaching experience in the institution), training of teacher (TRA - the percentage of courses approved in didactic techniques and educational model), teacher use of technology) to verify possible correlations. In the same way, the influence of the second partial mark on the satisfaction survey of students about teachers was investigated through the teacher recommendation data in both years, building the corresponding multi-vary chart. All this information was obtained anonymously from the Science Department of Campus Mexico City at Tecnologico de Monterrey, so no ethical approval was required for this analysis.

FINDINGS

The faculty survey was applied to teachers after the Fall term of 2017 to respond anonymously, and 35 of the 45 teachers involved in the study answered it. Figure 1 shows that 91% of faculty considered that the synchronous online model allowed the topic's content to be adequately transmitted (rating equal to or greater than 8). In contrast, none considered it inappropriate to transmit the knowledge (Panel 1A).

As observed, 74% of the teachers stated that the rapidly adopted model allowed students to adequately develop the competencies established from the beginning of the course, and none considered it inappropriate for developing competencies (score equal or greater than 8; Panel 1B). About 91% considered that the model promoted reflection on learning assessment (score equal or greater than t 8; Panel 1C), and 77% of teachers considered the model exciting and wanted to continue using it (score equal or greater than 8; Panel 1D). Interestingly, 89% thought that students learning under this new model was equal to or greater than average (Figure 2).

When teachers were asked what the main challenges of implementing the new model, the answers can be summarized in five topics:

- Teachers are digital migrants. Teaching digital natives is a tough challenge for digital migrants; it requires preparation, knowledge of technologies, and access to good enough connection conditions.

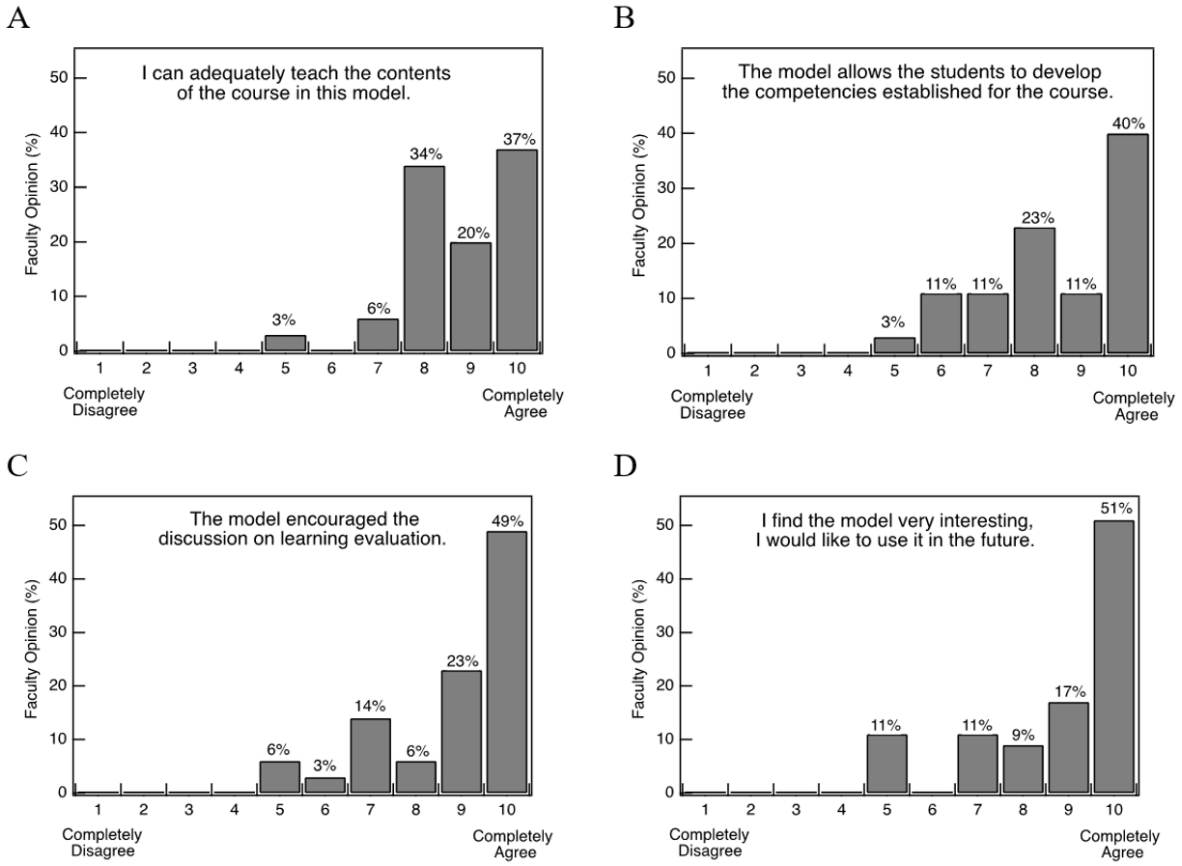

Figure 1: Results of the qualitative survey applied to the faculty on implementing the distance model during the Earthquake at Tecnologico de Monterrey, Mexico City campus in 2017.

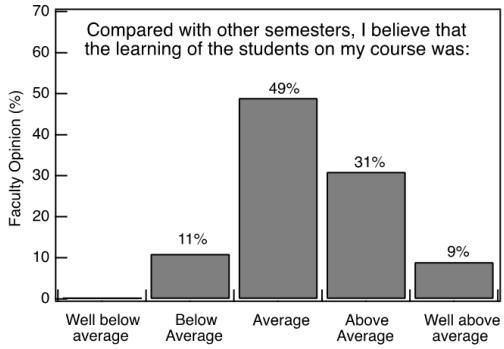

Figure 2: Faculty perception about learning of the students on the distance model.

- The time spent preparing the class. The teachers felt that the planning was different, and the magnitude of the time and effort involved much more time than the one already designated for the classroom.
- The new ways of communication. The interaction between teacher and student and between students was a challenge. Keeping attention, observing gestures, giving so much information to the teacher about the student's understanding, and keeping the students' attention is a more complicated task. In their judgment, the students showed little interaction with each other.
- There was a lack of use and knowledge of the online model. Teachers and students were suddenly confronted by a model that was not their choice or prepared for. They were learning on the go.
- The evaluation. Teachers had to find suitable assessment methods because individual classroom tests were no longer an option. A frequent concern was how to evaluate them so that academic integrity was not a concern. Online assessment tools in science are not well developed, particularly when cognitive analysis is required, so mathematical symbology makes the evaluation more complex.

Teachers were also asked what the main advantages of the model were. The answers can be summarized in three categories:

- Flexibility. Teachers and students can connect from anywhere with a good internet signal.
- Recorded classes. Since all the classes were recorded, students could review them when necessary. If the students did not understand something, they could see the explanation again and understand it or find what they did not understand.

- Several tools can be used. To improve the teaching-learning process, there are tools that they would not have known without this experience. These include tools to display content and perform evaluations that can be used synchronously and asynchronously.

Figure 3 shows the results of the means of the REC and INSP. The students of face-to-face courses of the Fall 2016 Semester rated their teachers with 8.07 (REC) and 8.48 (INSP). In contrast, students in the course who underwent a sudden change in a contingency in the Fall of 2017 scored 8.19 (REC) and 8.63 (INSP). Teachers, in general, consistently obtained the same or better evaluation with the online model (Figure 3).

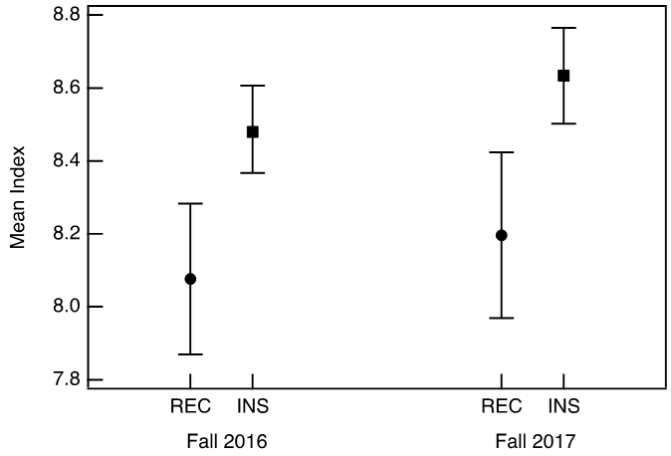

Figure 3: Comparison of the REC and INS indexes of ECOA.

Regarding the students' comments in the ECOA, it was noticed that most comments were about the teacher's performance but not the implementation of the online model. Comments where the online model was mentioned can be grouped into the following answers:

- The teacher is good in class but not online. He does not know how to use technological tools properly.
- The teacher adapted well to the online model. The model favored the class.
- The best thing about the online model is that it allows you to record videos of the classes and review them.
- Editorial platforms for online assessment aided in learning the topics.
- The online model is good, but not for all teachers or all the time. In-person teacher-student and student-student interactions are required.

The students´ grades from the fall semesters of 2015, 2016, and 2017 were compared. The evaluation percentages in the different activities, such as exams, assignments, and research projects, are similar for the 2015 term but the same for the 2016 and 2017 terms studied. Therefore, this analysis allows the grades comparison of three models: a traditional one (2015), one where active learning is emphasized (2016), and the last one, a hybrid model with an initial face-to-face period and a final online segment (2017). The average final scores were 77.19 in 2015, 78.7 in 2016, and 80.7 in 2017.

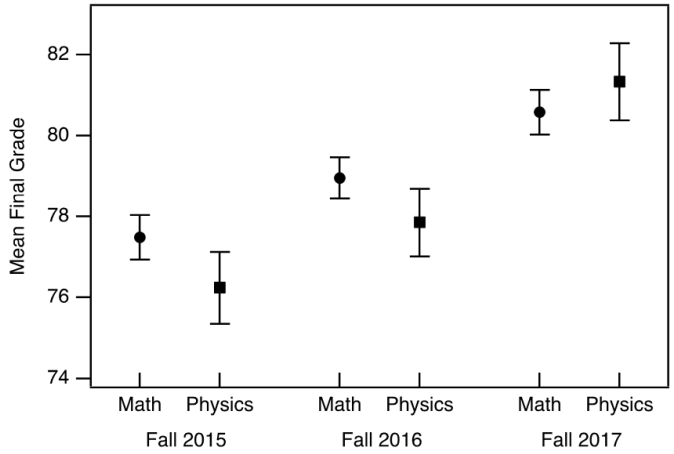

Figure 4: Comparison of mean final grades for the Mathematics and Physics courses.

Concerning the first and second partial grades reports, the average in 2016 was significantly higher than the other two, which do not present significant differences. For the 2017 case in partial 1, the implementation of the online model had not yet started. However, in partial 2, it had already been implemented. Surprisingly, the second partial grade average in 2017 was higher than the previous two years (Figure 5).

From here, we decided only to compare the grades from the second partial of the 2016 and 2017 terms. To this end, we consider that both groups of students (2016 vs. 2017) are

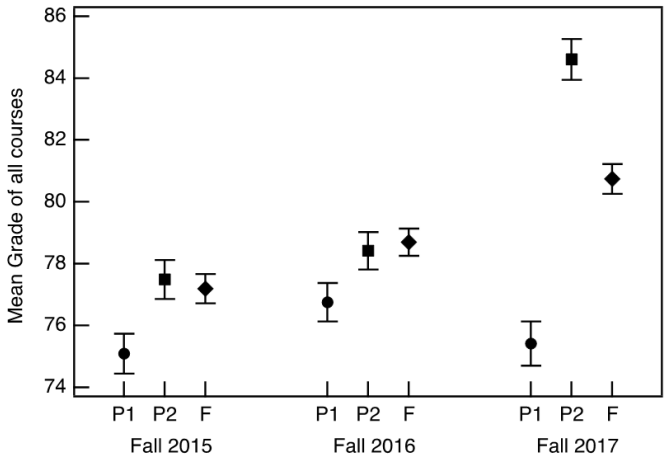

Figure 5: Comparison of mean grades for all the Science Department courses considering the first partial (P1), second partial (P2), and final (F) evaluations.

independent since students with similar characteristics (full academic load, meet the requirements of the subject considering previous years) are randomly assigned to each group, while the instructors are the same, the subjects and their contents are the same, the only thing that changes is the educational model. In 2016, they were taught in a traditional face-to-face classroom setting. In 2017, the subjects were taught in hybrid mode (the first part was face-to-face, and the second part was online in distance mode).

To compare two independent samples, the groups of the subjects analyzed alone did not have a normal distribution (either Anderson-Darling, Ryan-Joiner, Kolmogorov-Smirnov). Therefore, the results were analyzed using a nonparametric Mann-Whitney test since they did not pass the normality test. Table 3 indicates the results for evaluating whether there was a change in the marks/performance of the students after the September 2017 earthquake compared to the 2016 term at campus Ciudad de México for 16 courses.

Knowledge area	Set of subjects or subjects	*p*-value*
Physics	Physics II	0.000
	Elementary Physics	0.000
	Physics for design	0.000
	Electricity and Magnetism	0.023
	Physics I	0.000
Mathematics	Differential equations	0.000
	Applied Mathematics	0.860*
	Advanced Mathematics	0.709*
	Mathematics III	0.000
	Mathematics for design	0.001
	Introduction to Mathematics	0.250*
	Mathematics I	0.000
	Mathematics II	0.105*
Statistics	Statistics II	0.000
	Statistics for research in social sciences	0.000
	Probability and Statistics	0.004

**Significant difference at $p \leq 0.05$*

Table 3: Performed Mann-Whitney test to compare P2 marks in 2016 and 2017 by subject.

As observed, most of the analyses were significant, showing a difference in students' marks in the second partial of 2016 and 2017, indicating an earthquake effect by subject, except for some math subjects (Applied Mathematics, Advanced Mathematics, Introduction to Mathematics, and Mathematics II). This result in mathematics subjects has been observed in other works (Abd Rahman et al., 2022), where no significant difference has been observed when comparing teaching in face-to-face modalities vs teaching in distance modalities. The reason that there was no difference has been attributed to the fact that these mathematics subjects may require more time for preparation and learning than other areas of study (Banjević et al., 2021).

The average marks of the second partial of 16 courses in 2017 were greater than in 2016 (Figure 6).

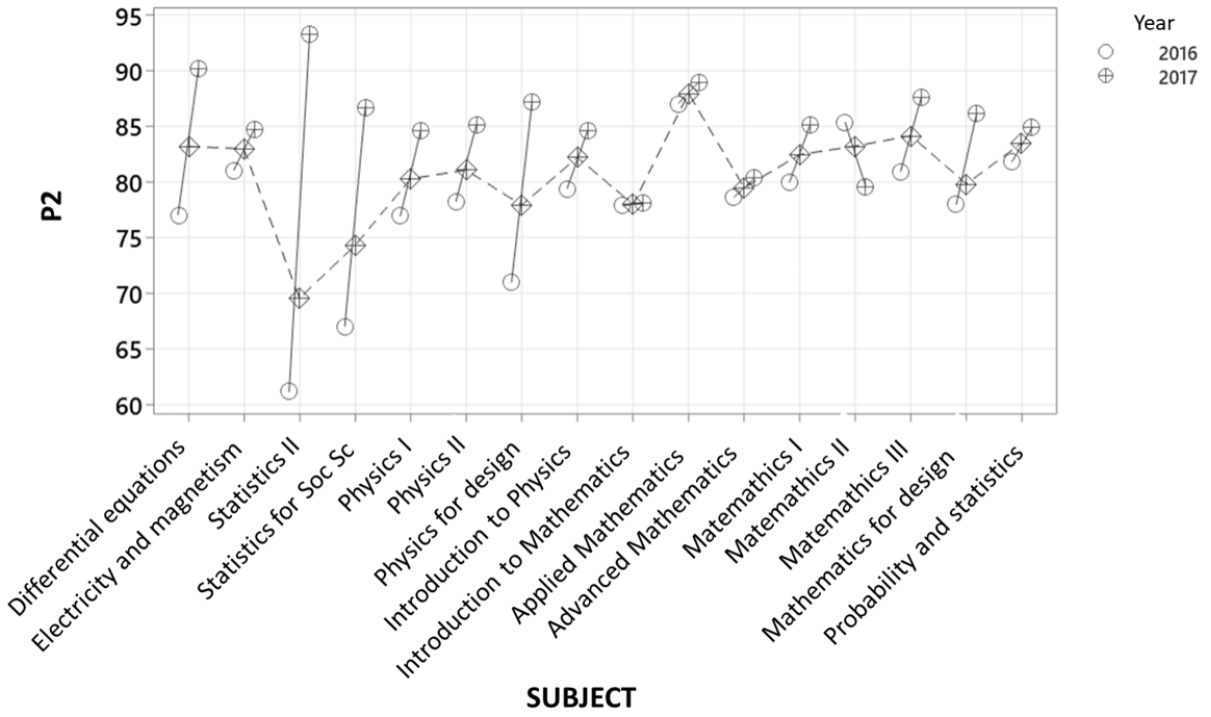

Figure 6: Multi-chart for student marks of P2 by year-subject.

Figure 7 indicates the degree of correlation between some variables measured in both studied periods, some of which are associated with the teacher profile, such as age, experience, use of technology (TECH), and training (TRA).

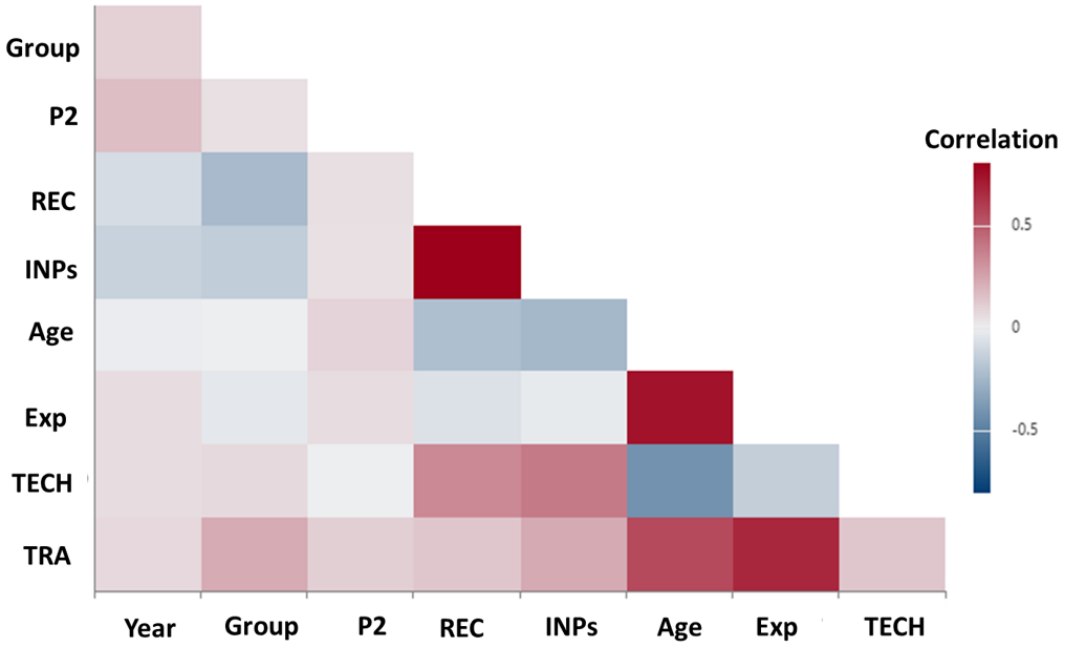

Figure 7: Correlogram showing the relationship between each considered variable: P2 mark, teacher performance indicators, and teacher-associated variables.

The correlogram reinforces the effect of the year on the P2 marks as a direct correlation. At the same time, it is observed that REC and INPs are weakly correlated (values less than 0.5) with other variables, for example, age, technology use, and training, without having a strong or significant impact, which it seems to indicate that these do not influence completely at all in the high marks gotten for P2 in the year 2017. In the same way, intense correlation is denoted among the subgroups of variables but not with P2 or teacher performance indicators (REC or INPs). To check for some trends by year in teacher evaluations by students, a multi-chart for REC by year-subject was generated (Figure 8). No relationship was found since some teachers were evaluated differently in both years. In about four subjects, REC was more favorable in 2017 than in 2016, but in about four subjects, REC was more favorable in 2016. In the rest of the subjects, REC stayed equal.

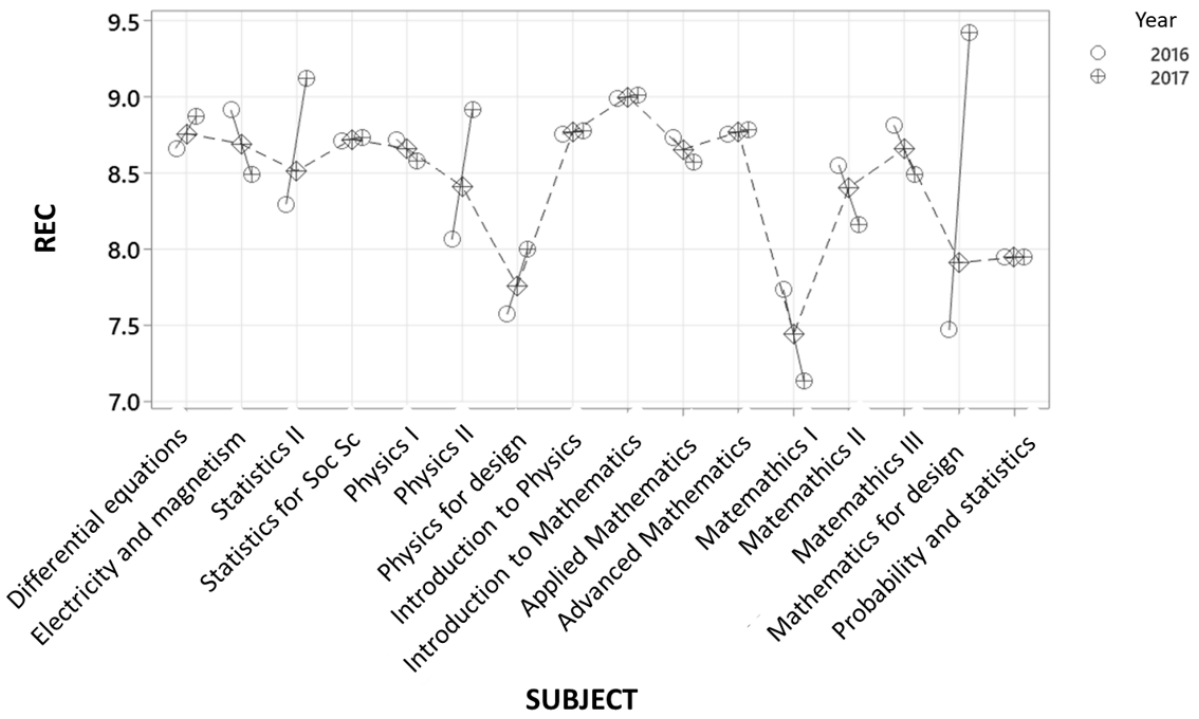

Figure 8: Multi-chart for REC by year-subject.

DISCUSSIONS AND CONCLUSION

In 2020, we experienced a health emergency that forced education to change its teaching models radically. The sudden change from one educational system to another implied a sudden and forced adaptation for teachers, as they did not have physical classroom spaces. Many universities suspended their courses, and others had to assume a new teaching system: distance classes with students at home. Only those institutions that have been training their teaching staff on using new technological tools have chosen to follow their courses online. For this reason, analyzing previous experiences helps establish application parameters of emergent situations in education.

As presented, in this case, in the study of the implementation of an online model in 2017 for the basic sciences department of Tecnologico de Monterrey, Mexico City Campus, during an earthquake catastrophe, Faculty indicated that the contents and competencies could be reached for the students in this online mode and that the student performance was better in it respect to the traditional model. This last declaration agrees with the subsequent comparison of average marks of the obtained partial marks (P2) for the students during the catastrophe, compared to the corresponding partial in 2016. Even teachers were inclined to use the model in the future. Although, in other Universities hit by earthquakes, such as the University of Canterbury, New Zealand (2011) and the Kathmandu University in Nepal (2015), the satisfaction degree of the students concerning online learning courses has been measured (Wright & Wordsworth, 2013; Joshi et al., 2018), not quantitative evidence is given about their learning achieved as provided in this work.

The advantages for teachers in their comments (flexibility, recorded classes, and online tools) have already been mentioned in other works (Arkorful & Abaidoo, 2015; Kahigi, 2022), particularly recently during the pandemic. However, these teachers also manifested some challenges of online education, such as digital migration, a major demand for time for class preparation, the use of new communication alternatives, and insufficient knowledge and use of online education on their part before the implementation. These comments were presented in similar studies even during the COVID-19 emergence (Visser, 2000; Adedoyin & Soykan, 2020). As said in the literature, for the online model to be efficient, teachers need to be adequately trained and comfortable with technology (Rehn et al., 2016). It is evident that teachers take much longer to prepare their classes in this format at the beginning because they had to rethink the way of evaluating the student and change some methodologies and didactic techniques (Visser, 2000) to allow different interactions between them: teacher-student and student-student, the situation also observed when other learning formats are used such as inverted classroom and active learning.

Concerning the challenge of the little knowledge of educational models and use, it allowed us to distinguish that there was an important population of teachers not linked to online learning, around 50% of the Basic Science Department. However, the other 50% have been involved in educational technology and innovation projects, designing simulators, games, augmented reality applications, virtual environments, e-books, educational videos, and online assessment systems (Medina et al., 2018). Fortunately, Tecnologico de Monterrey has promoted this technology immersion with the TEC-21 educational model since 2012, which highly demands educational technology, continuous assessment, active learning, and novel didactic techniques (Membrillo-Hernández et al., 2018; 2019). Online courses require the teacher to know and manage the tools for a virtual classroom (Wallace, 2003; Martin & Parker, 2014).

The approach of these online system tools enables the teacher to speak, show, demonstrate, explore, and even be attentive to a particular student during the class (Wallace, 2003; Wandler & Imbriale, 2017; Yu & Kuang-Chao, 2015). Here, it is important to consider a change in the educational systems to cope with the technological advances of the digital world.

When the marks of Basic Sciences Department students were analyzed, our data concludingly indicated that the marks of the P2 2017 students were higher than those of the students in the P2 2016, the difference evident even for each subject of the department, supporting that much difference in the average marks is not only for a certain area (mathematics or physics) or topics. Again, this observation about 2017 marks reinforces teachers' comments about these students' performance. The analysis to review a possible relationship between teacher performance indicators and teacher-associated variables on student marks (P2) or teacher-associated variables with performance indicators does not identify significant correlations; only age, use of technology, and training are weakly related to REC or INPs (less than 0.5). Deeper research will be required to test these relationships. We suggest researching other factors affecting the basic sciences student performance at Tecnologico de Monterrey in this online model learning after the 2017 earthquake in Mexico City. Examples of these factors may be the emotional state of the students, the different pedagogical strategies adopted by the faculty during the online education system, and the ethical implications, such as the cheating issues suggested by Meccawy (2021).

The García-Castelán et al. (2021) study explored the advantages and disadvantages of in-person classes versus online training sessions for engineering courses during the same earthquake but using different instruments. The study surveyed 396 engineering students from the Campus of Mexico City using a 25-item survey focused on human interaction, self-discipline, and academic performance. The results showed that most students felt that face-to-face classes were more conducive to their learning process and facilitated better communication with teachers and peers. Lack of human contact, outdoor activities, and difficulty forming new friendships were cited as factors against distance learning. The study also found that online learning increased distractions, depression, and stress. However, from an academic standpoint, student performance remained consistent between face-to-face and online learning, as observed in our work (García-Castelán, 2021).

This experience was a precursor for online education during the Covid-19 at Tecnologico de Monterrey. Sayeg-Sánchez et al. (2021) found empirical evidence during the COVID-19 pandemic from 108 students in a Business Mathematics course from Tecnologico de Monterrey showing a statistically significant decrease in students' stress levels when using Guided Learning Sequences as a content delivery strategy which allows the student to receive information, think about its meaning, put it into practice, and receive instantaneous feedback to reinforce their learning process. Also, a pre-test and post-test analysis of 45 students showed evidence of a positive impact on students' performance.

This implies that only accounting with well-prepared teachers is insufficient to obtain good student performance when changing from a face-to-face to an online environment due to a sudden event. Amidst the COVID-19 pandemic, Gao et al. (2020) discovered that students enrolled in chemistry laboratory courses favored in-person instruction over virtual laboratory exercises despite achieving lower performance scores in face-to-face labs than in online classes. The study suggests that combining in-person teaching with computer-assisted grading and assessments could hold potential for the future (Gao et al., 2020). Delgado et. al. (2021) suggests that to relate the course design and teacher support with the student performances, actions are necessary, such as preparing several channels for the delivering, keeping in touch, considering the learning styles, supporting the challenge resolution creatively and to keep coordinated with teacher partners for success in the delivery in the same (COVID-19) contexts.

The results of this experience suggest that the sudden transformation from one model to another implies more outstanding preparation and updating of teachers, a willingness of students to use technological tools, and a global commitment to 100% digital communication. The studies of the educational transformation in 2017 generated a solid basis for having a group of expert teachers transform face-to-face courses into online ones in the Mexico City Campus of Tecnologico de Monterrey. In this Campus, the digital transformation in 2020 was much smoother than the one described in this study. In this regard, it is important to note that a limitation of this work was that a student satisfaction survey could not be obtained because the implementation of the model was unexpected or abrupt. On the other hand, from the teacher´s perspective, the model allowed the course content to be transmitted appropriately and allowed students to learn and develop competencies.

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Full research paper

GENDER DIFFERENCES IN FACULTY EXPERIENCE WITH START-UP PACKAGES: A CASE STUDY FROM A PUBLIC UNIVERSITY IN THE SOUTHEASTERN U.S.

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ABSTRACT

Start-up packages are a tool for a successful transition to an academic career. This institutional case study examined the faculty experience with start-up packages at one public university in the Southeastern United States, including gender differences, content, negotiation, and perceived outcomes. A mixed-method research design was utilized to answer the study research questions. Data were gathered through an online survey with quantitative and qualitative questions. Data from 121 participants were analyzed using descriptive statistics, chi-square tests of independence, and thematic analysis. Most start-up package agreements included moving expenses, personal computers and software, and start-up funds. Conversely, child daycare, guaranteed junior sabbatical, and salary advancement were the most missing benefits in the agreements. Male faculty obtained, significantly more often than female faculty, a specific number of years for secure funding, laboratory space, and student or postdoc funding in their agreements. Faculty, in general, were not well prepared for the negotiation process and were not aware of what they needed to establish a successful research program. Universities should focus more on the influence of start-up packages on faculty careers because perceived unfair treatment during the negotiation process or administration can influence faculty performance and turnover intentions.

KEYWORDS

Faculty hiring process, faculty negotiation, gender differences, job resources, start-up packages, university working conditions

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Highlights

- *A mixed method case study exanimating the faculty experience with start-up packages involving 121 participants from a university in the U.S.*
- *Start-up packages mostly included moving expenses, computers, and start-up funds. Childcare, sabbatical, and salary advancement were the most absent.*
- *Male faculty, more often than female faculty, were able to obtain a specific number of years for secure funding, laboratory, and student funding.*
- *Faculty were not well prepared for the negotiation process and unaware of what they needed to establish a successful research program.*

INTRODUCTION

Start-up packages are temporary funds or materials that are offered by universities for new faculty (Hamann, 2013). Significant investments are allocated yearly for faculty recruitment and faculty start-up packages (Trower, 2012). Start-up packages can include some combination of office and laboratory, research funds, equipment, materials, software, summer salary, technicians, students, postdocs, teaching release, travel money, fieldwork funding, flexible scheduling, patents, and publications fees, access to databases, memberships in professional associations, grant-writing assistance, reduced committee responsibilities, consulting, early tenure consideration, tuition benefits, accessibility to parking, release time, moving expenses, cost of additional

visits to the area, retirement contributions, spousal hiring, health insurance, and life insurance (Andrade, 2008; Ehrenberg et al., 2003; Farrell and Geraci, 2017; Hamann, 2013; Höfrová and Moore de Peralta, 2019; Office of Career & Professional Development 2012; Vick et al., 2016). Start-up packages and a combination of their benefits are structured differently and may vary significantly across disciplines and institutions (Farris et al., 2023).

Because the success of a university is premised on the success of faculty, understanding the role start-up packages play in providing sufficient job resources and facilitating academic career transitions is important (Hardré and Cox, 2009, Murray et al., 2009, Rancourt, 2010). The lack of competitive start-up packages can negatively influence university recruitment efforts (Hill et al., 2011), and more resources in start-up packages can pull faculty to accept an offer from another university (O'Meara, 2015). Greater access to job resources is positively associated with faculty motivation, satisfaction, and performance and negatively associated with faculty turnover (Bakker and Demerouti, 2017). In addition, fewer resources obtained in the start-up package agreement can influence faculty's perception of the contribution of the start-up package to their professional development (Höfrová et al., 2021).

Maximizing the benefits of successful negotiation of start-up packages benefits faculty as well. It is not uncommon for faculty to be unprepared for effective negotiations (Sambuco et al., 2013). Unsuccessful negotiation can lead to limited access to resources and resource inequities that can negatively affect junior faculty advancement (Holliday et al., 2015; Lalani et al., 2019).

Women are especially at risk (Sege et al., 2015) as they tend to rate negotiation skills as less important than male faculty (Sarfaty et al., 2007). One study conducted among 427 general surgery residents found that females were more likely to have a negative view of salary negotiation and were less likely to believe that they had the tools to successfully negotiate an appropriate salary (Gray et al., 2019). Results of a study conducted by Settles et al. (2013) showed that female faculty more often perceive gender mistreatment due to unequal access to resources such as salary, promotion, space, equipment, administrative staff, and graduate students. Understanding the gender disparities in access to resources is important because resource allocation can impact the ability to successfully conduct research, typically quantified by faculty publication rates (Duch et al., 2012). Understanding the influence of gender on negotiation is critical for achieving fairness in the workplace (Amanatullah and Morris, 2010), especially considering that job offer negotiation outcomes can influence an employee's job satisfaction and turnover intentions even a year after the negotiation (Curhan et al., 2009).

Although start-up packages are crucial for faculty careers, there is little research on start-up packages, with most simply offering negotiation guidance (Berman and Gottlieb, 2019; Ford, 2012) or focusing on a single discipline (Sambuco et al., 2013). To fill this gap in the literature, this study explored faculty experience with start-up packages by focusing on content, negotiation, gender differences, and perceived outcomes. Specifically, the research is guided by the following questions: (1) What is the content of start-up package agreements?; (2) What are important aspects of start-up packages?; (3) What gender differences exist in the start-up package agreements?; (4) What is the faculty experience with the start-up package negotiation process and strategy?; and (5) How does the start-up package experience influence faculty careers?

MATERIALS AND METHODS

A mixed method approach was used as neither quantitative nor qualitative methods were solely sufficient to capture the complexity of faculty experience with start-up packages (Creswell and Poth, 2013; Yin, 2017). Because this study aimed to understand faculty experience with start-up packages at a particular university, a single case study approach was used (Johnson and Christensen, 2017).

Data Collection

The data for this case study were part of a larger organization-wide initiative to assess faculty satisfaction with start-up packages at a public land-grant, doctoral-granting university located in the Southeastern United States. The research design was approved by the Institutional Review Board. The research team conducted a survey pilot test at one department in February 2018, obtaining responses from 13 faculty. Revisions to the survey instrument were made based on the feedback from this pilot study. The data collection took place across three months, from April 2018 through June 2018. Participation in the study was voluntary, and participants received no incentives for being part of the study. An email with an anonymous link to an online Qualtrics survey was sent to all the university's 931 tenured and tenure-track faculty. A random sample of 300 tenured and tenure-track faculty received an email reminder to participate in the study in May 2018.

Instrument

Data were gathered through an online survey with quantitative and qualitative questions. For the present study, the quantitative data provided a general picture of the content of start-up packages and gender differences in their content, whereas the qualitative data refined and explained those numerical values by exploring faculty views regarding their start-up package experience in more depth. We used the following questions to gather the quantitative data presented in this study:

1. Please indicate whether the benefit was initially offered to you when you joined [university]. If the benefit was not initially offered to you, indicate whether the benefit was obtained through your negotiations with [university]. (yes/no/I don't remember, N/A response). A list of 19 benefits was created based on the literature (see Table 1).
2. Looking back, would you negotiate your start-up package differently if you could? (yes/no response)

The survey also included a gender-related question as follows: How would you describe yourself? (female/male/transgender/ I do not identify myself with any of the above/ I prefer not to answer).

The two open-ended or qualitative questions were identified through a literature review and were intentionally included to promote participants' reflections on the start-up package negotiation process. Results from the pilot testing suggested that these questions would help uncover relevant aspects of

the gender-related thought and decision-making processes of study participants when negotiating their start-up packages. The two open-ended questions were as follows:

1. How would you negotiate differently?
2. Finally, please provide any additional comments or observations about your experience with the start-up package process.

Participants

127 faculty members accessed the survey, and the response rate was 14%. Data from six participants who did not obtain a start-up package or had more than 50% missing data were excluded from the analyses. A total number of 121 participants (13% response rate) were included in further quantitative analyses. We asked two open-ended questions in the qualitative portion of the study. Ninety-two (76%) participants responded to the first question, and 68 (56%) responded to the second question. At the end of the survey, faculty were reminded that they were not required to answer demographic questions to secure their confidentiality. However, 96 participants responded to the gender-related question, which was key data for the analysis.

Data Analyses

Quantitative data were analyzed using the statistical software IBM SPSS Statistics Version 27.0. Descriptive statistics were used to characterize the study population and describe the content of the start-up package. Chi-square (χ^2) tests of independence (King et al., 2018) were performed to examine the relation between gender and other demographic questions, as well as gender and each benefit in the start-up package agreement. Type I error (α) was set at.05. To assess the strength of the relationships, the phi coefficient (φ) was used as an index of effect size (King et al., 2018). Cohen's (1988) conventions for small (.10), medium (.30), and large (.50) were used.

Thematic analysis was used to analyze the open-ended questions. The responses were imported and analyzed using NVivo 12 Plus. Inductive coding was utilized, which involves deriving themes and categories directly from the data rather than imposing pre-existing hypotheses or theories (Braun and Clarke, 2006). This exploratory approach was particularly appropriate given the limited previous research on start-up packages. Consequently, the original study research questions were reshaped as new themes emerged during the inductive coding process.

Following Braun and Clarke's (2006) guidelines, similar ideas were grouped together to create preliminary themes. Line-by-line coding was then used to create codes and their descriptions. After developing the initial codes, redundant themes were recoded to eliminate redundancy.

Data coding was carried in two phases to ensure clarity and thoroughness in the development of the thematic structures. Initially, two researchers performed it separately, a doctoral student and an assistant professor. Although both researchers were aware of the study's objectives, the inductive and phenomenological approach used for the analysis implied reading participants' responses line by line to uncover codes and subsequently grouping these codes into themes. The initial codes and derived themes identified independently by each researcher were then discussed in two subsequent meetings to reach a consensus and increase the level of intercoder reliability.

During this thematic consensus development process, the researchers adapted and/or identified alternative themes. This iterative process was crucial in validating the themes and categories that emerged from the data. The involvement of two researchers in analyzing the data helped minimize biases in the data analysis process, thus enhancing the construct validity of the results.

RESULTS

From the sample of respondents, 49 were male (41%), 80 (66%) were white (non-Hispanics), 45 (37%) were Assistant Professors, 55 (46%) were from science, technology, engineering, and mathematics (STEM) disciplines, and 27 (30%) held a postdoc position prior to joining the university. Female faculty were less likely to be in STEM disciplines than male faculty (67% versus 33%), $\chi^2(1) = 8.77$, $p = .003$. There was no relationship between gender and faculty rank ($\chi^2(1) = .51$, $p = .776$) or gender and race/ethnicity ($\chi^2(1) = 2.06$, $p = .151$) across genders.

Respondents were asked if they would negotiate their start-up package differently if they could. A total of 95 (79%) respondents would negotiate differently, and there were no significant differences in faculty attitudes regarding the potential re-negotiation of their start-up packages across genders, $\chi^2(1) = 2.43$, $p = .119$).

Six major thematic clusters were identified by the two researchers' consensus in the qualitative data, including the content of start-up packages, faculty perception of important aspects of start-up packages, gender differences in the start-up package agreements, faculty experience with the negotiation process, faculty experience with the negotiation strategy, and faculty perception of the influence of the start-up package experience on their careers. The following section of the results is organized by our research questions and includes both quantitative and qualitative findings. Participants' disciplines were categorized by the National Science Foundation's requirement for data reporting (STEM = science, technology, engineering, and mathematics; SBE = social, behavioral, and economic sciences; Non-S&E = non-science and engineering; Professional/Other, (e.g., communications, parks/recreation/leisure/fitness).

Content of Start-up Packages

To gather information regarding the content of the start-up packages, participants were asked to indicate if they were initially offered a specific benefit or obtained that benefit through negotiations. Some participants who were offered a specific benefit also indicated if they negotiated for the same benefit. Therefore, the count for the total number of faculty who obtained a specific benefit included those faculty only once. Moving expenses were offered to 96 (79%) faculty, indicating it was the most often offered benefit. No faculty were offered child daycare

(0%). The most obtained benefit through negotiation was computer and software, which was obtained by 14 (12%) faculty. No faculty obtained parking (0%) or child daycare (0%) through negotiation. Overall, 101 (84%) faculty obtained moving expenses, representing the most obtained benefit in the start-up package agreement, and no faculty obtained parking. For more information about specific benefits, see Table 1. The qualitative data showed that some faculty received a lump sum of money to purchase specific benefits. "*I was offered startup funds from which I could (and did) purchase computer equipment. But I was not offered computer equipment, per se*." (Male, STEM)

Benefit	Initially offered (*N* = 121)		Obtained through negotiations (*N* = 121)		Total (*N* = 121)	
	n	%	*n*	%	*n*	%
Start-up fund (salary)	71	59	9	7	76	63
Number of years for secured funding	44	36	10	8	51	42
Summer salary	57	47	11	9	64	53
Salary advance	1	1	2	2	3	3
Tenure expectations	58	48	9	7	59	49
Junior sabbatical	1	1	1	1	2	2
Release time	53	44	10	8	57	47
Computer/software	75	62	14	12	83	69
Specialized equipment/software	26	22	10	8	34	28
Lab space	52	43	7	6	55	46
Moving expenses	96	79	13	11	101	84
Paid visit to look at houses	39	32	6	5	44	36
Parking	13	11	0	0	13	11
Child Daycare	0	0	0	0	0	0
Spousal position	7	6	11	9	16	13
Conference & travel	48	40	7	6	50	41
Submission & publication	9	7	3	3	11	9
Administrative support	16	13	4	3	18	15
Student/postdoc funding	47	39	11	9	54	45

Table 1: Specific offered and negotiated benefits in the start-up package offer (source: own survey)

Faculty Perception of Important Aspects of the Start-up Packages

Faculty expressed that the start-up packages should be based on their actual needs to help them establish their research and assist them in becoming experts in their discipline.

> "*I was thrilled to get a start-up package. It seemed to me that it was my responsibility to fund my own research, so the fact that [name of the university] gave me funds to help was excellent. But I think we could better match funds to actual needs* today." (Male, STEM)

Few faculty members believed that a job description, anticipated performance, and performance evaluations should have been part of their start-up package agreement to avoid any miscommunication later in their careers. "*It was never clear my exact expectations in my hiring of [tenure track] position. I was expected to be productive in my scholarship, but that was ill-defined as well*." (Female, Non-S&E)

A few faculty members felt the duration of the start-up package should be more flexible or the period of time during which they could use it should be longer.

> "*Duration of startup funds is far too short and does not accommodate funding success. Why would I lose the only source of flexible funds I have to support my research if I successfully get a grant, which I then need to focus on using*?" (Female, STEM)

One participant indicated that the restricted duration of the start-up packages can lead to inappropriate spending of the financial resources.

> "*[Chair] didn't see it as a "savings account" that you could hold on to for when things come up down the road. It caused me to make some purchases that I really didn't capitalize on; it was wasted money. Had I been allowed to hold on to the funds and spend down gradually, I could have made better use of it*." (Male, STEM)

One faculty member felt that the university's return on investment from start-up packages is significant. On the other hand, other faculty members felt that the return on investment has changed over the years and is currently low.

> "*Current start-up packages are not in line with expectations. The payback period on my start-up was short (Departmental overhead return from my efforts has paid back my start-up by a fact of >15x). Our current junior faculty cannot pay back their startups, assuming departmental averages (and no corrections for inflation) within 30 years. This is not a good use of resources*." (Male, STEM)

Gender Differences in the Start-up Package Agreements

Table 2 presents how female and male faculty obtained the benefits in the start-up package agreements. Male faculty were offered almost all the benefits more often than female faculty; however, only laboratory space ($\chi^2(1) = 4.30$, $p < .05$, $\varphi = .21$) and student/postdoc funding ($\chi^2(1) = 6.42$, $p < .05$, $\varphi = .26$) were offered significantly more to male faculty than to female faculty, both with medium effect sizes, indicating a moderate association between gender and the likelihood

of being offered these benefits. In terms of benefits obtained through negotiation, the only significant difference between genders was found in a specific number of years for secure funding. Male faculty were more often able to obtain a specific number of years for secure funding ($\chi^2(1) = 4.64$, $p < .05$, $\varphi = .22$) in their start-up package agreement through negotiation than female faculty. The medium effect size indicates a moderate association between gender and the likelihood of obtaining this benefit through negotiation. Overall, male faculty more often than their female counterparts obtained almost all the offered benefits; however, only a specific number of years for secure funding ($\chi^2(1) = 4.30$, $p < .05$, $\varphi = .21$), laboratory space ($\chi^2(1) = 5.09$, $p < .05$, $\varphi = .23$) and student/postdoc funding ($\chi^2(1) = 5.09$, $p < .05$, $\varphi = .23$) were obtained significantly more by male faculty than female faculty. All these benefits had medium effect sizes, indicating a moderate association between gender and the likelihood of obtaining these benefits.

Benefit	Initially offered				Obtained through negotiations				Total			
	Female % (*N* = 47)	Male % (*N* = 49)	χ^2	ϕ	Female % (*N* = 47)	Male % (*N* = 49)	χ2	ϕ	Female % (*N* = 47)	Male % (*N* = 49)	χ^2	ϕ
Start-up fund (salary)	53.2	67.3	2.01	.15	12.8	6.1	1.25	.11	59.6	71.4	1.50	.13
Number of years for secured funding	31.9	46.9	2.26	.15	2.1	14.3	4.64***	.22	34.0	55.1	4.3***	.21
Summer salary	44.7	55.1	1.04	.10	6.4	12.2	.97	.10	48.9	61.2	1.47	.12
Salary advance	0	2.0	.97	.10	2.1	0	1.05	.11	2.1	2.0	.00	.00
Tenure expectations	46.8	55.1	.66	.08	6.4	10.2	.46	.07	48.9	55.1	.37	.06
Junior sabbatical	2.1	0	1.1	.11	2.1	0	1.1	.11	4.3	0	2.13	.15
Release time	42.6	49	.4	.06	8.5	12.2	.36	.06	44.7	55.1	1.04	.10
Computer/ software	59.6	63.3	.14	.04	14.9	8.2	1.07	.11	72.3	67.3	.28	.05
Specialized equipment/ software	27.7	18.4	1.17	.11	6.4	14.3	1.61	.13	31.9	30.6	.02	.01
Lab space	34.0	55.1	4.3***	.21	8.5	6.1	.2	.05	36.2	59.2	5.09***	.23
Moving expenses	83.0	83.7	.01	.01	10.6	10.2	.01	.01	87.2	87.8	.01	.01
Paid visit to look at houses	38.3	38.8	.00	.01	6.4	2	1.13	.11	42.6	40.8	.03	.02
Parking	10.6	12.2	.06	.03	0	0	-	-	10.6	12.2	.06	.03
Child Daycare	0	0	-	-	0	0	-	-	0	0	-	-
Spousal position	4.3	4.1	.00	.00	6.4	12.2	.97	.10	10.6	16.3	.66	.08
Conference & travel	46.8	38.8	.63	.08	8.5	2	2.03	.15	51.1	38.8	1.47	.12
Submission/ publication	6.4	8.2	.11	.03	2.1	4.1	.30	.06	8.5	10.2	.08	.03
Administrative support	14.9	16.3	.04	.02	2.1	2	.00	.00	14.9	18.4	.21	.05
Student/postdoc funding	27.7	53.1	6.42***	.26	8.5	10.2	.08	.03	36.2	59.2	5.09***	.23

Note: All chi-square tests have df = 1.

**** p < .05.*

Table 2: Specific benefits in the start-up package agreements obtained by female and male faculty (source: own survey).

Qualitative data showed that some female participants knew that their male colleagues received more benefits in their start-up packages.

> "*It really was a horrible experience. Even though I am relatively happy with my job now, thinking back about what a bad deal I received (and a biased deal because of my sex and my field) makes me wish I had taken another offer*." (Female, other discipline)

Several female faculty members indicated that they had been treated at the university differently because of their gender.

> "*At the time of my job offer, I was satisfied with the start-up package. In retrospect, I should have negotiated for more. I was not aware that in the future, I would be penalized for being a female when raises were allotted. I did not anticipate being told each year that I would not be paid as much as such-and-such because "he was the breadwinner for his family." Starting with more resources initially would have compensated financially for some of this.*" (Female, STEM)

Faculty Experience with the Start-up Package Negotiation Process and Strategy

At this public university, faculty have had different experiences with the start-up package negotiation process. Multiple faculty members accepted the claim that the start-up package was nonnegotiable. "*I was told I could not negotiate by the chair at the time, which is rather unbelievable in retrospect*." (Female, SBE)

Some faculty asked for a specific benefit; however, their request was not fulfilled.

> "*I asked for a higher salary during the negotiation phase, which was refused. I asked for a visit to buy a house, which was refused. I asked for moving expenses and was given $3000. I explained that wouldn't even get me halfway to [the state], and the Dean laughed at me on the phone and said, "No way, we don't give more than that*."" (Female, other discipline)

On the other hand, one faculty indicated he received everything he asked for.

> "*I did not negotiate. When asked about the start-up needs, I provided what I needed (salary, $, equipment, time, space), and I was given this. I explained that this is what it would take to bring me here. There was no negotiation*." (Male, STEM)

A few faculty members were not satisfied with the negotiation process or the outcome of the negotiation. "*It was absurd. $10,000 and no immediate tenure for someone with 30+ years of experience. Out of the $10,000, I had to buy furniture and computer*." (Male, Non-S&E)

Several faculty members noted other people influenced the negotiation. Specifically, faculty pointed out that their negotiation was influenced by a departmental chair, dissertation chair, principal investigator, previous hire, or family member. "*I negotiated for a minimal amount of moving expenses. I was advised by my dissertation director not to ask for anything else besides a lecturing position for my spouse, which was granted. I feel now that this was bad advice*." (Female, other discipline)

Additionally, a few faculty members suggested that their negotiation process was influenced by the availability of resources at the university or by the job market.

> "*I was at the tail end of several consecutive years of hiring. Most negotiations were halted with the reply that - that's what we've been giving out for the past X years. I was not satisfied with the outcome of the negotiations, but it did not prevent me from coming. I didn't feel petty or personal, just that [university name] is severely resource-limited…*" (Male, STEM)

A few faculty members suggested that there might be differences in the start-up packages based on the date the start-up package was negotiated. "*I cannot find justification for the variability across offers other than "more funding was available to the dean/department chair/etc. at different times", and this seems sadly unfair to us as hires*." (Male, STEM)

Some faculty implied that they experienced problems administering some of the benefits promised in the start-up package agreement. "*I haven't had good advocacy from the chair for follow-through on things promised in the offer letter, or necessary for my success (lab space, access to land & greenhouses)*." (Female, STEM)

Faculty members who responded that they would negotiate differently were asked an open-ended question about how they would have navigated the negotiation differently. Therefore, most of the qualitative data obtained were related to a specific negotiation strategy.

A few faculty members who negotiated reported that they would ask for more during the negotiation, and some would negotiate more forcefully.

> "*I had to take a pay cut in my basic salary to move to [name of the town] -- attempts to get a salary match proved exhausting (and fruitless), and I ended up not negotiating much on the remaining part of the offer*." (Unknown gender and discipline)

Other respondents were more specific and explained what they would ask for in their start-up package. Specifically, faculty would ask for more financial resources, specific equipment, higher salary, more financial resources for graduate students, more office or laboratory space, more financial resources for traveling, more administrative assistance, money to cover their summer salary, more financial resources for a postdoctoral position, more financial resources to cover their moving expenses, less teaching load, eligibility for sabbatical, specific software, keep tenure from previous institution, job position for spouse, more mentoring, and a newer vehicle. "*I should have also negotiated more funds for competitive student support. The student years offered at the time were not competitive enough to attract top talent to the university*." (Male, STEM)

In addition to specific benefits, some faculty would negotiate to have more flexibility in terms of the duration of the start-up package and flexibility in terms of using their financial resources. "*I also would have put dates in because I was told it could carry over and then at the last minute that was rescinded*." (Male, STEM)

A few faculty felt that they were not prepared enough for the negotiation. Therefore, they would prepare by gathering more information about faculty needs, the negotiation process, salaries, and packages of other faculty.

> "*This was my first job out, and I didn't have a good understanding/ appreciation of what it would take to get my research program off the ground. I would have asked for more and come in with a specific plan for how it would build me towards becoming an expert in my field*." (Unknown gender and discipline)

Multiple faculty members felt it would be important to have all the aspects of the start-up package agreement in written form rather than only in verbal agreement. "*There were some things that were verbally agreed and that were missing in the final document I signed. I would carefully read through the entire document before signing it next time. I should not have trusted that all the information was there*." (Female, STEM)

Other respondents stressed that they would be more specific in defining specific terms of their start-up package agreement.

> "*They promised me "graduate student support," and I thought that meant I could recruit a student at a competitive stipend, which turned out to be "pick one of the students we already accepted as a TA at $9000 a year (when the going rate was $16,000)*." (Female, STEM)

Faculty Perception of the Influence of Start-up Package Experience on Their Careers

Participants commented on the influence of the start-up package on their careers. Their comments were coded as positive and negative reactions. Most of the comments indicated negative outcomes of the faculty start-up package experience.

A few faculty suggested that their start-up packages negatively influenced their job performance and made their everyday work challenging. "*Not even a single study is possible from this money*." (Unknown gender, professional other discipline)

> "*My chair negotiated hard with me. In hindsight, I see that as harming both the department and me. My productivity was adversely affected by insufficient graduate student support and insufficient cash for procuring equipment. Had I had more of those resources, my career would have grown more rapidly, benefiting myself and the department*." (Unknown gender, STEM)

"*I really need lab space to keep my equipment, run participants through studies, meet with my lab team, etc. I have hurt my back twice carrying things in and out of offices to use other people's spaces for lab work. Really difficult*." (Female, other discipline)

Multiple participants noted that if they negotiated their start-up package again, they would not accept the offer or that they would leave the university. "*It made me consider leaving and soured me on the institution a bit*." (Female, another discipline)

Other faculty members felt that the limited resources provided in start-up packages could result in the loss of the best faculty candidates during the hiring process and a bad reputation for the university.

"*We tend to lowball people on start-up packages, which means we lose a lot of good people to other institutions that are willing to invest in people. I was able to negotiate (not without some effort and a competing offer) a startup package that allowed me to get a reasonable start. But I almost went to another university (that was otherwise worse in all respects) because [name of the university] was stingy with resources*." (Male, STEM)

Numerous faculty members felt that they were not treated fairly during the negotiation or that the start-up package agreement was not honored during the administration of the specific benefits.

"*When I came to [name of the university], it was a free-for-all, and one's ability to negotiate was key. I had some advice from my PI about what to ask for, and I thought I got it, but when I arrived, it was the letter of the agreement and not the spirit. My only comfort was that others who arrived the same year had to threaten court and go to the university's president to enforce the terms of their start-up. [Name of the university] did not treat the start-up contract as a contract*." (Female, STEM)

"*Considering that the startup is CRITICALLY related to setting up a research program and that the results of our research program are critical determinants of our tenure process, I sincerely hope that unfairly low startups have not and will not cost any of my colleagues a fair chance at tenure*." (Male, STEM)

Other faculty, especially women, felt that they were treated unfairly because they received fewer financial resources or benefits in their start-up packages compared to other faculty, to other universities, to previous jobs, or compared to male faculty. "*When I got to [name of the university] in my first year, I found out that the male assistant professor hired into the same department and in the same year literally got 4X the start-up package that I did*." (Female, STEM)

Additionally, some faculty noted that their college does not offer start-up packages or does not offer sufficient start-up packages.

"*I also feel that [name of a department] was/is not given enough resources by the university to allow the department to properly sponsor our development as scholars in the way that a start-up package would, although the expectations for our scholarly production are commensurate with many R1 institutions*." (Female, other discipline)

Some faculty expressed a concern that their start-up package was insufficient and did not fulfill its purpose. "*Start-up package was inadequate to quickly initiate a successful research program*." (Unknown gender, STEM)

For others, insufficient funds lead to the need to obtain finances from different resources.

"*When my start-up package was cut, I had to spend my travel budget money to buy software, and I had to write several grants just to get the basic equipment to do my research, and I couldn't offer a lab class for a couple of years until I was able to win enough grant money to buy supplies*." (Female, SBE)

Few faculty members perceived that their experience with start-up package negotiation and administration was fair and positive. "*I was very pleased with my negotiations coming in. I felt the process was transparent & fair*." (Female, other discipline)

DISCUSSION

This study examined faculty experience with start-up packages at one public university in the Southeastern U.S. Regarding the content of start-up package agreements. Most faculty start-up package agreements included moving expenses, personal computers and software, and start-up funds. A few faculty members indicated that their start-up package agreement had a lump sum of money, and they could spend it as needed. This is unsurprising as most universities typically have limited resources for actual start-up money and instead typically provide equipment and specific benefits (Hamann, 2013). The least common benefits were child daycare, guaranteed junior sabbatical, and salary advancement. The lack of offered child daycare can disproportionally influence female faculty (Holley and Young, 2005). A study conducted by Tower and Latimer (2016) showed that childcare issues influenced female faculty's ability to travel to conduct research, attend conferences, and give invited talks. Overall, because the content of start-up packages differs among universities and disciplines (Eisenberg, 2011), comparisons are limited, though this study can serve as the baseline for other universities.

A critical goal of start-up packages is to help faculty establish their research projects until they can secure further funding (Rancourt, 2010). Faculty affirmed that their start-up package should be based on their individual needs to establish their research programs. Whether the amount of money invested by the university into the start-up packages can be generated back in the grant revenue by the faculty is an open question. Ehrenberg et al. (2003) examined the five-year return on investments for 25 newly hired faculty into basic science disciplines. They concluded that the faculty could not generate enough revenue from grants to cover their start-up packages in five years. Although this study did not examine the return on investment, faculty expressed various views on whether this was realistic within short time frames.

Several gender differences were found. Male faculty were able to obtain three of the benefits significantly more often than female faculty: a specific number of years for secure funding, laboratory space, and student or postdoc funding. This result corroborates previous research that showed female faculty receive less laboratory and office space, have less access to graduate students, and have less administrative support (Park,

1996). All three benefits that were received more by male faculty are crucial for faculty successful careers. As O'Meara (2015) pointed out, insufficient laboratory space can be one of the factors that influence a faculty's decision to look for and potentially accept an outside job offer. Once known, over time, this type of perceived injustice and favoritism can influence job outcomes such as faculty satisfaction, job performance, and turnover intentions and can undermine faculty trust in the university (Graso et al., 2014; Howard and Cordes, 2010; Ismail et al., 2015; Williams et al., 2006).

Overall, there were no consistent experiences with the start-up package negotiation process. Some participants realized that they were treated unfairly during the negotiation after they gathered more information about start-up packages offered to other faculty or by other universities. Part of this disgruntlement likely comes from the participants' perceptions that they could not negotiate. Other studies have pointed to possible reasons new faculty fail to negotiate more successfully and suggest strategies including understanding the job market (Berman and Gottlieb, 2019), considering external job opportunities when considering departure (Daly and Dee, 2006), and having a greater understanding of the resources necessary for career advancement (Lalani et al., 2019).

Regarding the influence of start-up packages on faculty careers, participants perceived both positive and negative outcomes with the start-up package negotiation process. Some participants indicated that their start-up package was insufficient to conduct research, which prompted them to secure external funding. An alternative is to implement research that requires only minimal funding, which can potentially lead to a decrease in research at the university (Toews and Yazedjian, 2007). Finally, several faculty members felt that the start-up package influenced their job performance and turnover intentions. Although inquiring further was beyond the scope of this study, de la Torre-Ruiz et al. (2019) found that benefit determination and benefit administration satisfaction influence turnover intentions through perceived organizational support. Previous studies showed that space allocation, salary, travel funds, release time, and sabbaticals influence faculty turnover (Rosser, 2004).

Limitations

This study has many strengths, including its detailed narratives obtained from faculty across disciplines. However, this study has some limitations. Data were collected from a single university situated within a specific geographic context; therefore, the ability to generalize the results to other higher education institutions is limited. In addition, the institutional approach to start-up packages varies across different systems (tenure and non-tenure), types of institutions (public, private, and research), faculty responsibilities (research, teaching, public service, and administration), and faculty rank (assistant, associate, and full). Moreover, start-up packages may be influenced by how aggressively universities pursue various institutional goals related to mission priorities such as diversity and status.

Future Research

Future research should examine in more detail how start-up packages influence faculty careers differently based on the intersectional influence of variables other than gender (e.g., race) since previous research showed that the intersectional effect of gender and race can influence negotiation behavior (Toosi et al., 2019). Additionally, future research should focus on the return on investments for universities to define the most cost-effective start-up packages. Studies that would gather data from the actual start-up packages would be beneficial for a more accurate indication of the content of the start-up packages rather than self-reported data. Further research is needed to study the effect of different start-up packages on faculty careers longitudinally. It would be helpful to compare faculty performance with start-up packages with different contents or values. Exanimating specific benefits in the start-up packages can help the university better understand how to improve faculty performance and achieve higher investment returns.

Implications

Findings from this study suggest that administrators might benefit from taking steps to foster a positive experience with start-up packages for its faculty. People involved in the negotiation process (e.g., department chairs and administrators) should undergo training on negotiating mutually satisfying start-up package agreements that would help advance not only the new faculty but also fulfill the university research's mission and retain successful faculty at the university. The training should also reflect gender differences in the negotiation strategies (Amanatullah and Morris, 2010) and differences in the treatment of male and female negotiators (Bowles et al., 2007) to prevent a backlash against female faculty and to reduce gender bias in the negotiation.

As many future faculty members are unprepared for negotiating start-up packages, graduate students should be better prepared for the negotiation process. Students should be informed about faculty job responsibilities and job descriptions at diverse institutions, which would help them create a list of their start-up package preferences. Enhancing negotiation competencies is particularly critical for women and underrepresented minorities and can reduce disparities in compensation and resources available for junior faculty (Holliday et al., 2015).

CONCLUSION

In this study, start-up package agreements commonly included moving expenses, personal computers and software, and start-up funds for most of the faculty from one public university in the Southeastern U.S. On the other hand, child daycare, guaranteed junior sabbatical, and salary advancement were the most missing benefits in the agreements, which were relevant considering the importance of the child daycare benefit in facilitating equitable development for female faculty. Male faculty, significantly more often than female faculty, could obtain a specific number of years for secure funding, laboratory space, and student or postdoc funding. Faculty perceived that the start-up package should be based on the individual needs to establish their research programs. However, several faculty members reported that if they could renegotiate, they would do so for more specific benefits that better reflect their needs. Overall, faculty were not well prepared for the negotiation process and unaware of what they

needed to establish a successful research program. The start-up packages are important for faculty and universities, largely through the generation of grant revenue. Therefore, universities should focus more on the influence of start-up packages on faculty careers. Perceived unfair treatment during the process or the administration of the start-up package can have long-term impacts on faculty performance and turnover intentions.

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IMPROVING TEACHERS' PROFESSIONAL VISION THROUGH A VIDEO-BASED REFLECTION PROGRAM: A CASE STUDY IN MEXICAN PRIMARY SCHOOLS

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ABSTRACT

Teachers' professional vision (TPV) is an essential contributor to enhancing the quality of teaching-learning processes thanks to its potential effect on teachers' self-reflective skills. This is of particular importance in Physical Education (PE), due to the fact that this subject presents different challenges and more dynamic situations compared to others. One of the latest approaches for enhancing TPV is video-based reflection, allowing teachers to observe and analyze recorded lessons. This research aimed to test the effect of a video-based reflection program on TPV in PE. Two teachers participated in a 3-step video-analysis program consisting of self-reflection, peer reflection, and expert feedback. Notable changes were found in TPV at the end of the 6-month intervention, both in terms of teachers' selective attention to classroom events and their knowledge-based reasoning. Our findings suggest that video-based reflection interventions could represent an important component of any teacher training program aiming to increase PE teachers' ability to evaluate and respond to a variety of in-class situations.

KEYWORDS

Knowledge-based reasoning, professional training, reflection, selective attention, video technology

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Highlights

- *An innovative intervention using technological tools for improving teachers' self-reflection skills.*
- *Research in the field of video-based reflection in Physical Education is lacking to date.*
- *Both selective attention and knowledge-based reasoning improved after the intervention period.*
- *Video-based reflection may be useful as an integrative component of pre-service and in-service teacher training programs.*

INTRODUCTION

Professional Vision in Education

Running a smooth, organized, and structured school class may sometimes be very challenging at any level of education. In this sense, teachers' professional vision (TPV) is argued to be one of the skills that allow teachers to feel and be more efficient in the classroom (Meschede et al., 2017; van Es & Sherin, 2010). The concept of professional vision was first introduced by Goodwin (1994), who investigated how professionals learn to look at phenomena in their expertise, how these skills change over time, and the extent to which they differ when compared to lay persons. Sherin (2001) adapted it and included it in teacher education. Since then, teachers' professional vision has been used as a key frame for designing and developing effective professional development programs worldwide (Lefstein & Snell, 2011). According to Sherin and van Es (2005), TPV is defined as teachers' cognitive ability to notice, evaluate, and interpret key teaching-learning moments via two interrelated skills: selective attention (SA), i.e., the ability to detect and respond to key events over others; and knowledge-based reasoning (KBR), i.e., the ability to reason about and interpret selected events using professional competences and knowledge. The extent to which a teacher is able to operate is believed to be dependent on one's amount of professional-related experience. Beginning and pre-service teachers often struggle more with the former than their experienced colleagues, with more attention paid to the teacher's actions

rather than to students and their learning (Meschede et al., 2017; van Es & Sherin, 2010). Moreover, these initial constraints are said to hinder observing classroom situations from a more professional perspective (Meschede et al., 2017; Wolff et al., 2015). Choosing and interpreting only those key processes that either foster or impede students' learning, as well as carrying out corresponding actions to support their growth, is thus key to teachers' professional competence and to constantly improving teaching (Sherin, 2007). Authors suggest that improved TPV may not only have a positive impact on teachers' quality of instruction (van Es & Sherin, 2010; Sun & van Es, 2015) but also on their students' achievements (Roth et al., 2011). Enhancing TPV may also be an effective strategy for pre-service and novice teachers due to its potentially positive effect on pedagogical knowledge (Kersting et al., 2010; Meschede et al., 2017) and classroom management (König & Kramer, 2016).

Professional Vision in the Physical Education Setting

Although there is no doubt about the impact of TPV on all actors in the teaching-learning processes across different areas, only a few studies were conducted on physical education (PE) and PE teachers. This might be due to the distinct characteristics it implies, PE being a movement-based subject, where active, physical engagement is required. Common features of any classroom environment, such as multidimensionality, simultaneity, immediacy, and unpredictability (Doyle, 1986), are even more apparent in PE since space and equipment are used more dynamically than in the traditional classroom, leading to a higher ratio of unexpected events compared to any other school subject (Barker & Annerstedt, 2016). Hence, PE teachers need to attend more classroom motion-based situations, as well as additionally observe and address students' heterogeneity and individual skill levels and developmental aspects of their movement skills. Another factor might be the use of spaces for the classes. Unlike other subjects, PE classes may occur in an open space or even in out-of-school sport-related facilities such as swimming pools or athletic rings. The choice of the classroom space may also be affected by seasons, environmental features, such as the presence of mountains, beaches, parks, etc., and a country's curricular plan. For that reason, the development of TPV may be more challenging due to the inner complexity of the PE subject.

Professional Vision and Self-Reflection

Self-reflection strategies are known to be among the most effective and used tools for developing and/or improving TPV. Using self-reflective tools may help teachers identify the kinds of changes that are necessary to better serve the individual learning needs of their students. With the advancement and accessibility to affordable technologies, video-based reflection (VBR), i.e., reflecting on one own's or other teachers' in-class performance by means of previously recorded videos of their lessons, has become a prevalently used strategy in teachers' development (Rich & Hannafin, 2009). Due to its benefits, in the last decade, many scholars in the area of educational psychology have studied the effect of video-based reflection on changes in TPV in both pre- and in-service contexts (Kleinknecht & Schneider, 2013; Luna & Sherin, 2017). This framework has been predominantly used in projects and studies within mathematics and science teachers' education using video-club contexts to enhance TPV in classroom settings (Seidel et al., 2011; Sherin & van Es, 2009); applying multifarious intervention programs such as designing self-reflective frameworks (Sherin & van Es, 2009); using facilitator-led discussions (Borko et al., 2008); or observing and reflecting on different video material (Kleinknecht & Schneider, 2013; van Es, 2012; Zhang et al., 2011). In order to enhance TPV development, research has focused on identifying the most effective nature of classroom videos in both pre-and in-service teaching contexts by comparing three common types of sources: videos of unknown experts, peers' classroom videos, and one's own recorded practices (Kleinknecht & Groeschner, 2016; Kleinknecht & Schneider, 2013; Santagata & Guarino, 2011). Reflecting on videos with peers has been suggested as a great way through which teachers engage more in comparative and critical thinking, as they found their colleagues facing similar teaching issues (Leblanc & Sève, 2012). Consequently, Borko et al. (2008) add that teachers become more comprehensive about the experiences they share, which in turn allows for faster changes in their classroom practices (Kleinknecht & Groeschner, 2016). However, as Zhang et al. (2011) pointed out, teachers are often reluctant to critically comment on their peers' actions. Thus, guiding a non-judgmental yet constructive discussion is critical to successfully benefit from this type of collaboration (Zhang et al., 2011). It is also essential to reflect on one's own practice since this is suggested to improve teachers' activation and motivation more than when they view videos of others (Seidel et al., 2011). Additionally, this strengthens their observational and interpretative abilities and aptness to adjust classroom practices (Coffey, 2014; Sherin & van Es, 2009). Nevertheless, this approach also has its pitfalls, as some teachers might feel uncomfortable being video-taped and/or viewed by others. As a consequence, some may even refuse to participate in such activities (Borko et al., 2008). Therefore, researchers must create safe, supportive environments that foster learning opportunities (Borko et al., 2008).

Self-reflection Practices in Physical Education

From the studies that were carried out in the PE context, Reuker (2017a) investigated how four groups with varying levels of expertise (coaches, PE teachers, pre-service PE teachers, and PE teachers-coaches) differ in reflection regarding their knowledge-based reasoning skills. As the results indicate, knowledge-based reasoning was found to be profession-related, i.e., PE teachers using more pedagogical-based knowledge and coaches providing more sport-specific expertise. Similar results were found in another study conducted by Reuker (2017b), investigating the relationship between professionalization and the depth of noticing. Firstly, the findings revealed that unlike in studies focused on different subject areas, the participants focused their attention predominantly on students' behavior rather than the teacher. This could also be explained by the nature of the context, where observing students' behavior is an inevitable part of any performance. Secondly, when executing expertise-related group comparisons, teachers and experts noticed significantly more in terms of methodological

and didactic approaches. Another interesting result is that novice teachers noticed fewer cues related to motoric behavior. Although both her works did not study the development of TPV but rather focused on the state of arts related to the level of professionalism, the results generally indicate that involving professionals from the area of sports sciences (PE teachers, athletes, or coaches) may result in an enriching environment, as each participant can profound his/her knowledge from different areas. This might be particularly useful in settings where PE curriculum is more sports- and competition-oriented rather than focused on games and basic motor development. Lonsdale et al. (2016) presented a more advanced experimental multi-level intervention using teachers' VBR followed by individualized feedback with the project facilitator. Two of the variables studied were the effect of changes in teachers' lesson planning and content delivery, to increase students' physical activity engagement and autonomous motivation towards PE. During the intervention, teachers were also provided with strategies and free material designed to support students' psychological needs. In summary, due to the need for a simultaneous development of all three domains (cognitive, affective, motor), more research is needed in PE to understand the current state and changes in TPV using more advanced techniques, such as VBR. Therefore, based on the structure of similar programs presented above and as an extension of a previously presented work (Cocca et al., 2019), this study aims to test the effect of a multi-step VBR approach consisting of 1) written self-reflection of own classroom video; 2) peer reflection with a facilitator-led discussion club including experts from the area of PE and sports psychology; and 3) experts' written feedback, on TPV of PE teachers from the primary school level.

METHODOLOGY AND METHODS

To evaluate the effect of the VBR program on the dependent variables, we employed a mixed qualitative-quantitative approach based on content analysis and a case study design.

Participants

The study sample constituted of two PE teachers: one of them (PET1) has been teaching PE in both pre-K and primary school for nine years and has obtained his bachelor's degree in the area of Sports Sciences; the other (PET2) has taught PE at the elementary school level for the last six years and is a graduate bachelor in the area of Sports Technology. At the moment of the research, they were teaching 155 children from the fourth and fifth grades of a primary school from General Escobedo, Monterrey (MEX). Due to time constraints and accessibility to school districts, our sampling technique was based on convenience. Detailed sample distribution is provided in Table 1.

Teacher	Grade	Age		
		Boys	Girls	Total
PET1	4th	*n* = 8 9.25 ± .46	*n* = 15 9.40 ± .63	*n* = 23 9.35 ± .57
	5th	*n* = 23 10.78 ± .79	*n* = 26 10.69 ± .74	*n* = 49 10.73 ± .76
PET2	4th	*n* = 12 9.25 ± .62	*n* = 14 9.29 ± .47	n = 26 9.27 ± .53
	5th	*n* = 23 10.52 ± .66	*n* = 34 10.88 ± .77	*n* = 57 10.74 ± .74
Total				*n* = 155 10.28 ± .96

Note: PET1 = Physical Education Teacher 1; PET2 = Physical Education Teacher 2

Table 1: Characteristics of the students participating in the study

Instruments

An adaptation of the categorical system proposed by Kleinknecht and Schneider (2013) was used to assess TPV (Sherin & van Es, 2009); in this framework, within the SA domain, teachers' focus is the main aspect to be considered. This can be either on students/teachers, on the learning processes, or on the topics presented. Within the KBR domain, the framework prompts teachers to use a 3-step analysis by which they (1) describe what has been selected from their own lesson's video; (2) explain perceived events based on previous knowledge of teaching and learning; and (3) evaluate and predict, in which the explanation is used to assess the situation and provide possible alternatives.

Procedure

The study was carried out at the facilities of a primary school from a disadvantaged zone in General Escobedo, Nuevo Leon (MEX) during a six-month period within the regular teaching schedule of both PE teachers. The principal allowed both participants to take 90 minutes/month off their regular working hours to take part in monthly meetings with the research team. Also, the principal considered those meetings as a part of their professional development training, which is required by the Secretariat of Public Education. The intervention also required the involvement of four experts (researchers/practitioners with a doctorate in the fields of Pedagogy and PE and at least ten years of experience), who were invited by the research team.

Pre-intervention Phase. Before the start of the second semester of the academic year, the research team organized a one-day workshop with both the participant PE teachers and experts involved in the study to explain the intervention procedure and introduce the framework that they would use to analyze their own lessons. Furthermore, both teachers were asked to send the information to students' parents and/or legal guardians to obtain their written consent regarding students' participation.

At the beginning of the workshop, both teachers were interviewed by the research team about their hopes, beliefs, and worries

about the intervention program. During the practical part of the workshop, participants were provided with a laptop and a memory disk containing framework guidelines. To facilitate the analysis and answer any questions or doubts that might have occurred, teachers and experts were asked to use the provided framework to analyze a short video clip of a PE lesson that we recorded specifically for this purpose. Then the workshop facilitator (the lead of the research team) led a discussion on the moments that both teachers and experts selected and reasoned about them, prompting teachers to exchange ideas and propose new strategies to attend the chosen events. This trial was used to create a friendly environment, make participants understand how the discussion club would work, and familiarize them with the analysis framework.

Furthermore, due to technical requirements, we also recorded a trial PE class of each teacher to make them get acquainted with a wireless microphone and a portable transmitter that they would have to carry during the entire lesson, as well as to set up the best distance to place the cameras to avoid hindering the regular carrying out of the lesson at the same time as every event could be captured properly. This procedure was essential because all PE lessons were carried out outside in an open space.

Intervention Phase. A total of two lessons from both PE teachers were recorded at the beginning of each month. According to the official school curriculum, these lessons last approximately 50 min each. The videos were then downloaded to both teachers' and experts' memory disks for self-analysis. PE teachers were then asked to observe and analyze their videos, write a self-reflection, and send it to the facilitator's email within a week of receiving the recordings. The experts were also asked to write a reflection on both PE teachers' videos and submit it within the same period. After receiving teachers' self-reflection, the experts and the facilitator gathered to create shorter video clips based on the commentaries, each lasting between 15-25 min. Finally, a "video club" was held (a larger meeting with all actors involved: teachers, experts, and facilitator), and the video clips were observed and discussed together. All video club meetings were recorded for further content analysis. All video club discussions generally had the same structure. As there were only two PE teachers, both video clips would be watched. The teachers would briefly introduce the recorded lesson context and content, stating both general and specific objectives, and explaining how these objectives were meant to be reached. The facilitator then led the discussion toward engaging both teachers and experts in a collaborative and critical discussion (Borko et al., 2008; van Es, 2012), allowing for multiple perspectives regarding the selected moments. At the end of the meeting, the teachers were provided with experts' written feedback and suggestions with different strategies regarding both pedagogical and practical aspects. In total, the video club met six times over a six-month period, during which 12 video clips were watched.

Post-intervention Phase. After the last video club meeting, teachers were interviewed to discuss the impact of each step (i.e., self-reflection, peer-reflection, and experts' feedback) on their TPV and pedagogical knowledge, as well as noticed changes in the classroom environment.

Data Analysis

Data analysis consisted of several steps and was conducted using ATLAS.ti version 8. Firstly, all meetings were transcribed so that in-depth content analysis could be carried out. Successively, all meetings and written reflections were segmented into idea units (Jacobs & Morita, 2002). To reveal changes in TPV in teachers' written and oral comments, we applied the above-mentioned adapted version of the categorical system proposed by Kleinknecht & Schneider (2013), which is based on the original work of Sherin and van Es (2009). An open-coding approach (Emerson, Fretz, & Shaw, 1995) was also used to identify and address other potential key issues. These issues were sorted into topic categories, as shown in Table 2.

Dimension	Codes
Motor engagement	• Task involvement, engagement time, dead time, resting time, intensity, performance issue, skill development
Motivational climate	• Motivation, emotions, boredom, lack of effort, autonomy, competition-based tasks
Behavior management	• **Social aspect** (e.g., social integration, respect) • **Psychological aspect** (e.g., attention, students' behavioral characteristics, disruptive behavior, student misbehavior)
Classroom management	• **Time management** (e.g., class organization, task involvement, timing, time constraints) • **Space and facilities management** (e.g., space issues, quality of facilities) • **Equipment management** (e.g., alternative equipment, equipment constraints) • **Group organization** (e.g., pair work, individual, teamwork, peer teaching) • **Other** (e.g., unexpected events, teacher position)
Context	• Culture, hygiene, student-teacher ratio, safety issue, lack of class time, lack of experience
Planning	• Backup activities, self-development, task variety, Objectives, transition between activities, monotonous tasks
Pedagogy	• **General** (e.g., teaching strategies, autonomy orientation, fostering previous knowledge, scaffolding, gender differentiation, task adjustment/individualization, student integration, brainstorming • **Instructional strategies** (e.g., reinforcement activities, task variance, clear instructions, adjusted task selection, self-evaluation) • **Teaching style** (e.g., critical thinking, creativity, free-exploration style, innovative instructional models, cooperation, collaborative learning)
Communication	• Feedback, T-S communication

Table 2: Content analysis of teachers' comments: Description of categories found through open coding

Finally, the relative frequencies of all TPV categories were calculated. This was followed by the creation of semantic models based on the identified categories, aiming to increase the understanding of the contents (Villanueva et al., 2016). All data was coded by two independent researchers. Coding reliability was assessed by calculating the inter-observer agreement, which was found to be 91% across data sources. Additionally, taxonomical representations (or semantic networks; Sowa, 1991) were created to determine how both positive and negative codes related to each other. Disagreements were resolved through consensus.

RESULTS

Results regarding the TPV dimension of teachers' SA are presented as relative frequencies of codes in three categories (table 3): 1) Focus on Actors; 2) Focus on Learning Processes; and 3) Focus on Topic. Regarding PET1, 57.1% of his comments focused on students' activities, with the remaining events being associated with his actions. On the other hand, most of the moments selected by PET2 focused on himself, whereas only a few events involved his students. Additionally, a total of 28.6% of the comments did not refer to any involved person. Post-intervention, both teachers' attention moved toward students' behavior (PET1 = 63.2%; PET2 = 65.0%). Regarding the second category of the SA domain (focus on learning processes), more than 50% of the events selected by both teachers were not concerned with any learning processes. Table 3 shows that at the end of the intervention, this focus changed, and more than 60% of the comments were directed to students' learning processes. In the last category of SA on focus on topics, there was a change in the number of events implying negative issues selected by both teachers: in fact, at the start of the intervention both teachers highlighted a lower number of positive events (PET1 = 24.8%; PET2 = 30.3%) compared to the last reflections (PET1 = 65.2%; PET2 = 68.5%). Topics addressing issues about *Motor Engagement* (PET1 = 33.2%; PET2 = 36.9%) and *Classroom Management* (PET1 = 25.2%; PET2 = 27.6%) initially represented the highest concerns, but both matters showed lower frequency at the end of the program.

Dimension	Categories Pre-test		PET1		PET2	
			Post-test	Pre-test	Post-test	
Actor-focus	No focus		0%	10.5%	28.6%	15.0%
	Focus on teacher's behavior		42.9%	26.3%	28.6%	20.0%
	Focus on student's behavior		57.1%	63.2%	42.8%	65.0%
Process-focus	Focus on learning processes		28.6%	63.2%	42.9%	70.0%
	No focus on learning processes		71.4%	36.8%	57.1%	30.0%
Topic-focus	Positive	Classroom management	21.4%	19.7%	12.1%	15.6%
		Behavior management	12.8%	8.0%	12.0%	5.9%
		Motivational climate	23.5%	10.8%	28.9%	20.4%
		Motor engagement	27.5%	22.6%	11.2%	22.2%
		Context	0%	2.3%	3.1%	0%
		Planning	13.4%	16.3%	5.4%	18.5%
		Pedagogy	1.4%	14.8%	18.7%	15.3%
		Communication	0%	5.5%	8.6%	2.1%
		Total positive	**24.8%**	**65.2%**	**30.3%**	**68.5%**
	Negative	Classroom management	25.2%	19.3%	27.6%	23.5%
		Behavior management	13.4%	11.2%	18.1%	13.3%
		Motivational climate	3.4%	8.5%	5.8%	6.4%
		Motor engagement	33.2%	25.8%	36.9%	23.6%
		Context	2.3%	7.6%	4.5%	5.1%
		Planning	6.4%	9.4%	3.1%	12.5%
		Pedagogy	11.9%	11.8%	2.7%	12.6%
		Communication	4.2%	6.4%	1.3%	3.0%
		Total negative	**75.2%**	**34.8%**	**69.7%**	**31.5%**

Note: PET1 = Physical Education Teacher 1; PET2 = Physical Education Teacher 2

Table 3: Content analysis of teachers' comments: Relative frequencies of codes regarding selective attention

Regarding the domain of KBR, the full 3-step (describe, explain, evaluate) analysis was used to reason about selected moments from the beginning of the intervention period (PET1 = 47.0%; PET2 = 35.2%). Nonetheless, about one-third of the teachers' comments were limited to the first step, i.e., describing (PET1 = 29.4%; PET2 = 31.3%), whereas less than half of the reasoning was conducted using the full 3-step analysis. On the contrary, at the end of the intervention, the full 3-step analysis reached 69.6% and 75.0% for PET1 and PET2, respectively. Furthermore, in dealing with negative events, both PET1 and PET2 were more focused on the simple perception of such events (PET1 = 53.2%, PET2 = 31.6%) rather than being engaged in a deeper analysis. At the end of the intervention, these frequencies shifted, with

comments on potential strategies and alternatives to negative situations being the most prominent category (PET1 = 61.6%; PET2 = 45.4%). Analyzing the category dealing with positive events, there are differences between the two teachers regarding the number of comments on no positive events (50.0% and 20.0%, respectively) and their evaluation (13.4% and 50.0%, respectively). At post-test, PET1 was more focused on discussing alternatives (36.2%), whereas PET2 tended to reflect slightly more on their consequences (24.4%). Table 4 provides detailed results on code frequencies regarding KBR.

Dimension	Categories	PET1		PET2	
		Pre-test	Post-test	Pre-test	Post-test
Reasoning process	Describe	29.4%	8.7%	31.3%	7.1%
	Evaluate	11.8%	8.7%	20.2%	10.7%
	Explain	11.8%	13.0%	13.3%	7.1%
	3-step analysis	47.0%	69.6%	35.2%	75.0%
Dealing with negative events	No negative events	10.0%	15.3%	10.5%	28.7%
	Perceive	53.2%	0.0%	31.6%	4.1%
	Evaluate	26.7%	7.7%	21.0%	7.7%
	Reflect on consequences	13.4%	15.4%	21.0%	14.1%
	Propose and reflect on alternatives	6.7%	61.6%	15.8%	45.4%
Dealing with positive events	No positive events	50.0%	16.7%	20.0%	21.1%
	Perceive	0.0%	0.0%	20.0%	10.5%
	Evaluate	13.4%	15.8%	50.0%	22.2%
	Reflect on consequences	23.5%	16.4%	10.0%	24.4%
	Propose and reflect on alternatives	13.1%	36.2%	0.0%	21.8%

Note: PET1 = Physical Education Teacher 1; PET2 = Physical Education Teacher 2

Table 4: Content analysis of teachers' comments: Relative frequencies of codes regarding knowledge-based reasoning

Concerning the semantic relationships between teachers' comments (code linkages), figure 1 shows the taxonomical representation of negative issues derived from the first reflection cycle and the open codes. Each category is represented by a rectangle labeled to others with arcs. Due to the complexity of the linkage network, the figure summarizes it by presenting the most recurrent codes, which belong to the categories of Classroom Management, Student Engagement, and Behavioral Management. All of the mentioned issues were further identified as being a cause of inappropriate Planning.

Teachers recognized students' engagement as composed of motor and affective aspects, the former affected by elements such as inappropriate intensity or the amount of unused (excluding planned breaks) time during sessions; the latter associated with amotivation and boredom. Other issues underlined in teachers' comments referred to their role, in particular their ability to provide proper feedback and their position during the activities concerning their ability to keep behavior under control. Teachers tended to focus on themselves rather than their students, pointing out topics such as group control fail, monitoring fail, or unclear instructions (Figure 1).

Figure 2 represents linkages between positive codes derived from the last reflection cycle and the open codes. The figure shows the most recurrent categories and their linkages. Several positive outcomes within the main categories (e.g., *Management, Engagement*) were either "associated with" or "cause of" improved *Planning*, which in turn is associated with students' engagement or enjoyment, amongst others.

Teachers' reflections showed more articulated connections between elements of the teaching-learning environment; in particular, the cognitive sphere was added as an extra component of students' engagement compared to the first reflection cycle, where only the motor and affective ones were emphasized. The focus switched to more autonomous, student-centered matters, such as self-evaluation and brainstorming and their relationship with cognitive development; collaboration and teamwork as components linked to affective development; or peer assessment, attention to individual needs, and focus on student, categories that were linked with improved fluency of activities and their transition, hence affecting the overall classroom management (Figure 2).

DISCUSSION

Our study aimed to analyze the effect of a video-based reflection program on TPV. A total of 370 units were analyzed during the six months of the intervention. As previous literature suggests, the extent to which teachers are able to use their SA and KBR is related to their experience (van Es & Sherin, 2010). Our findings suggest that both teachers showed positive changes in both domains from pre- to post-test. Initially, teachers focused mostly on learning and students, respectively, and their analysis involved the class as a whole rather than evaluating individualities within it. Indeed, previous research has highlighted that a more individualized focus is developed over time and is more commonly shown by experienced teachers (Jung, 2012). However, the literature is inconsistent in this sense: for instance, Reuker (2017b) found that different groups of experts focused primarily on overall students' behavior, which is in line with our findings. Just as in our work, Reuker's sample was composed of PE teachers. Hence, perhaps, the peculiar characteristics of PE may partially explain the difference with other studies in the field. In fact, one of PE curricula's main objectives is the development of the motor domain (Secretaría de Educación Pública de México [SEP], 2022). Therefore, teachers may be more naturally looking at the overall students' actions and whether the whole class is engaged or not.

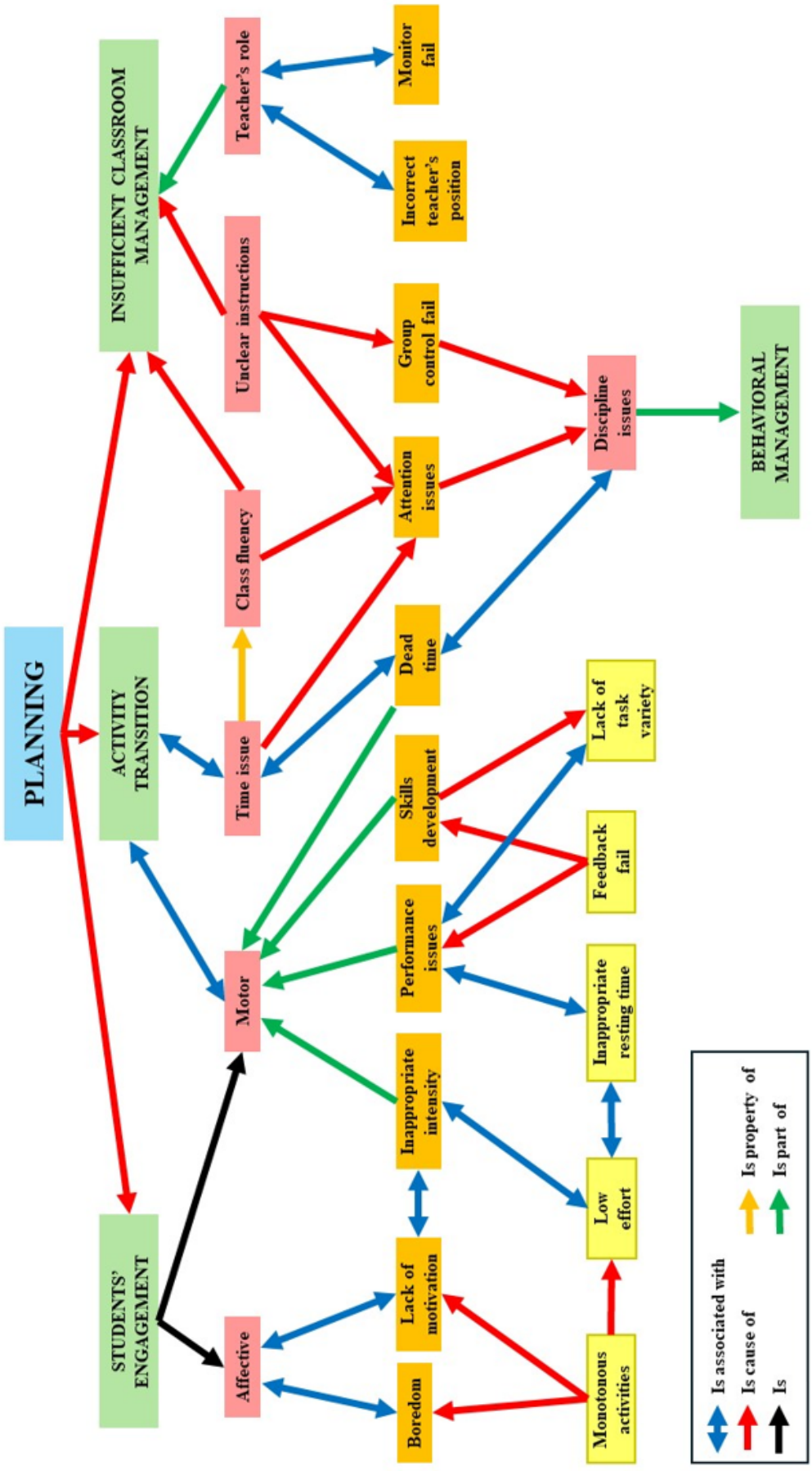

Figure 1: Taxonomical representation of code linkages at baseline

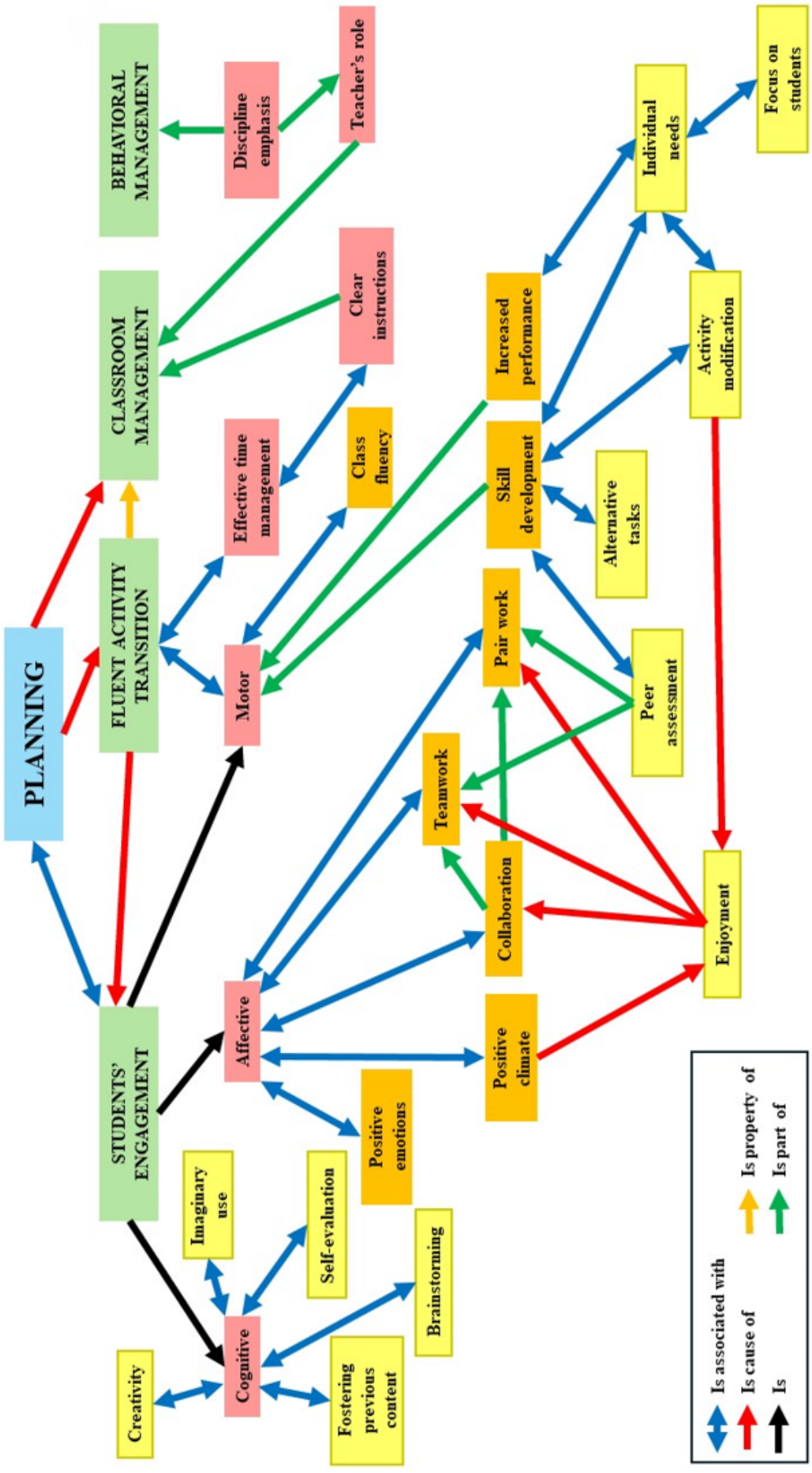

Figure 2: Taxonomical representation of codes linkage post-intervention

Reflecting on the different TPV domains more in detail, our findings show considerable changes in teachers' SA over time, with increased attention towards each student. This may suggest that at the end of the intervention, both teachers were more capable of extrapolating from their analysis matters related to individual learning (hence, attending to individual needs), while still maintaining an overall supervision of the entire class. Our taxonomical analysis may support this idea since teachers' latest reflections delved into how they could adapt certain activities to better fit students' individual characteristics and skill levels. Considering individual needs and each student's starting skill level is essential to PE teachers if they aim to provide benefits to all their students (National Association for Sport and Physical Education [NASPE], 2007): therefore, the changes shown in our participants in this sense should be considered as improvements. The importance of addressing individual needs and characteristics is further stressed by previous literature, suggesting that individualized tasks may provide benefits at both cognitive and physical levels (Kostecka, Bojanowska, & Stoma, 2017).

As per teachers' KBR skills, previous research highlighted the positive impacts of video-based programs and teachers' reflective skills development, particularly in terms of their reflections becoming more meaningful and more mindful of students' learning processes (Borko et al., 2008; Santagata & Guarino, 2011; Walkoe, 2015). In line with these studies, the teachers in our study initially showed more shallow reflections, with a high descriptive and evaluative character and no further reasoning, for instance, on potential solutions and adaptations that could be made to improve the learning process. The initial difficulties were confirmed in the analysis of the group meetings with peers, experts, and the facilitator, in which most ideas proposed by the teachers were disconnected and fragmented. However, by the end of the intervention, both participants had developed more thoughtful reflection strategies, this being stressed by the fact that, differently than in the beginning, they predominantly applied the full 3-step analysis for all the selected in-class events. At the same time, their discourse during the meetings was more logical, with ideas connecting to each other, allowing for not only more complex reasoning but also for more meaningful discussions between each other and with the experts. These outcomes are in line with previous literature on the development of KBR in schoolteachers (Walkoe, 2015).

Regarding the topics that our teachers tended to address in their reflections and their positive/negative evaluations of them, initially, the participants mostly evaluated the selected events as more negative than positive. Moreover, their evaluation was not followed by any proposed changes or potential alternatives that would help turn the negative events into positive ones. Two previous studies presented similar findings, as the involved teachers were less likely to identify consequences and alternatives when analyzing their own videos compared to those who reflected on peers' teaching performance (Kleinknecht and Schneider, 2013; Seidel et al., 2011). This is also one of the reasons why authors have suggested that in VBR programs, the presence of a facilitator who guides the discussion may be beneficial (Santagata & Guarino, 2011). At the end of the intervention, the PE teachers showed more frequent reasoning on consequences and alternatives for the selected events, and they were able to balance the detection of positive and negative events in their recorded classes. Beyond the positive impact of the presence of a facilitator in the meetings (Santagata & Guarino, 2011), other elements that could have had an impact on this change are the creation of a collaborative environment with peers and experts: for instance, Reuker (2017a) and Sherin and van Es (2009) mention that environments stimulating cooperation and mutual exchange of ideas allow for more profound analyses, since there is a higher chance that the teachers share their own experiences and bring different perspectives. Furthermore, the consistency of our sessions, with the 3-step cycle of self-reflections, teacher club meetings, and expert feedback repeated regularly on a monthly basis for six months, may have also helped by creating a positive reflective routine (Kleinknecht & Schneider, 2013; Zhang et al., 2011). Regarding the most addressed negative events (figure 2), teachers emphasized issues related to *Classroom Management (e.g., unclear instructions, group control fail, etc.), Student Engagement, including both motor and affective domains (e.g., performance issues, task invariability, inappropriate intensity; and lack of motivation, boredom, respectively), and Behavioral Management (e.g., issues with students' discipline and behavior). Most of these issues from the first reflections turned into more positive events at the end of the program (figure 3). This may hint at the fact that, on the one side, the teachers were able to attend to these issues with more efficiency and to use instructional strategies to solve/improve them, and on the other side, they may be more responsive in implementing a variety of strategies to diversify and individualize their teaching approach.*

Another interesting change started occurring from the third session onward. Due to their enhanced reflection skills and ability to critically reflect on both their own and students' actions, teachers' noticing started being mirrored in their on-the-spot actions. As a result of this change, teachers were able to notice an issue (e.g., some students not engaged, negative attitude towards an activity, etc.), evaluate circumstances, and make an immediate alteration to the occurred condition. According to Schön (1983), reflection-in-action is a critical feature of a professional, as it allows practitioners to interpret, analyze, and provide solutions to sudden and unique conflicting situations. Our findings are congruent with those of Jung (2012), who found PE teachers become more aware of issues related to their instructional practices and are able to make modifications during their teaching.

Another important aspect that seems vital to teachers' changes is involving experts in reflective discussions (Brown & Kennedy, 2011). Reuker (2017b) suggests that using multiple professional perspectives might increase teachers' effectiveness when addressing student behavior issues. In a study conducted by Brown and Kennedy (2011), teachers were able to improve their interactional styles with disruptive students as a result of a collaboration with educational psychologists. Similarly, Kleinknecht and Groschner (2016) demonstrated that peer and expert feedback enhanced pre-service teachers' self-reflections. Equivalent patterns could be observed in our study, where experts from the fields of physical education and pedagogy also

viewed PE teachers' videos and attended the discussion sessions. Furthermore, the experts were asked to deliver written feedback on every video, suggesting various strategies that teachers could apply to improve certain aspects of the teaching-learning environment. As a result of these interactions and collaborations, it seems that the teachers felt better prepared to manage their classrooms and students' behavior effectively, also suggesting the implementation of different strategies to avoid side activities that could interrupt contents or reduce learning possibilities (Little & Hudson, 1998).

CONCLUSIONS

Our findings seem to support the hypothesis that video-based intervention programs involving self-reflective tasks, peer reflections, and discussion clubs may largely benefit PE teachers' TPV. Indeed, the reflection cycle presented in this study, with three main steps that progressively involved peers and experts in the video-analysis process, seemed to have contributed to a number of positive changes in our participants, as well as to teachers' increased understanding of their students' individual needs. Especially in a PE setting, an efficient focus on constantly dynamic events may be of particular importance due to the fact that teachers, at times, need to react quickly and efficiently in tasks that prompt students to move around the classroom environment. Although this may be considered one of the first studies of this kind in the field of PE, our outcomes suggest that VBR programs could be added to the traditional pre-service and in-service teacher training so that teachers can learn a tool for autonomous self-evaluation during the course of the school year.

The major limitation of this study is that it is based on the case of two teachers only. However, recruitment is one of the common difficulties in research of this type, especially when using video recording, which requires permissions at more levels than usual. Therefore, our results must be taken as explorative, also considering the fact that the proposed intervention has no precedents in the field of PE. Future research in this line may aim at recruiting larger samples: this would allow for diversification of outcomes, for instance, based on gender, years of experience, or level of education. In addition, the analysis of the effects of VBR programs may also cover other aspects, such as changes in teachers' perceived self-efficacy in the classroom or their students' enjoyment and engagement during PE sessions. Finally, incorporating new technologies, such as eye-tracking devices, may provide additional information that can be contrasted with teachers' self-reflections to examine differences between in-class real-time focus and post-class teachers' SA and KBR parameters.

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MORE PAY AND BENEFITS OR BETTER WORK-LIFE BALANCE? POST PANDEMIC PERSPECTIVES ON EMPLOYEE CENTRICITY AMONG UNIVERSITY FRONTLINE STAFF

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ABSTRACT

The COVID-19 pandemic forced organizations across diverse industries to redraw their business models globally. Businesses crumbled, downsized, laid off workers, streamlined and digitalized their workflow, and maintained skeletal staff to support integral business functions. Remote working and flexible schedules were institutionalized to manage service employees globally. The study compared the effects of work-life balance and employee remuneration on employee job satisfaction and loyalty intentions. The study targeted frontline staff at three public universities in Zimbabwe, and 327 valid responses were obtained. Structural Equation Modeling (SEM) revealed that employee remuneration, remote working, and flexible scheduling positively and significantly influenced employee job satisfaction.

Further, the analysis indicated employee preference for remote working and flexible work scheduling over more pay and benefits. The positive impact of job satisfaction on employee loyalty intentions was also confirmed. This study flags the significant contribution of work-life balance by bringing new empirical evidence on the relative significance of remote working, flexible working arrangements, and employee remuneration on employee job satisfaction and loyalty intentions in the post-pandemic normal. The study recommends that universities should harness digital technologies to promote sustainable remote working and enhanced employee autonomy.

KEYWORDS

Employee job satisfaction, employee loyalty intentions, employee remuneration, flexible scheduling, remote working, work-life balance

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Highlights

- *Post-COVID effects of work-life balance and employee remuneration on employee job satisfaction and loyalty intentions of frontline university staff.*
- *Data was collected from 327 university staff through questionnaires and analyzed using structural equation modeling.*
- *Remote working, flexible scheduling, and remuneration positively influenced university staff job satisfaction.*
- *University frontline staff preference for better work-life balance outweighs pay and benefits.*

INTRODUCTION

The global economy embarks on the positive trajectory as it recovers from the jaws of the COVID-19 pandemic that changed the rules of the game for most industries. As efforts to contain the pandemic became the global imperative, preventive methods such as wearing facemasks, social distancing, advanced hygienic practices, decongesting public and office spaces, and vaccination were adopted (Shitu et al., 2022; Dangaiso, Makudza, Jaravaza, et al., 2023). To stay afloat in the new normal, most industries had to re-model their operational frameworks (Puri et al., 2020; Dangaiso, Makudza, Tshuma et al., 2023). The social distancing requirement also meant that organizations had to decongest their workplaces too. Most COVID-19 regulations permitted the skeletal physical staff complement tasked with overseeing the integral functions of the business (Toscano, Bigliardi and Polevaya,

2022). Remote working and flexible working arrangements were formalized as service employees were directed to execute their duties further away from each other (Galanti et al., 2021; Kurdy et al., 2023).

The current COVID-19 prevalence reports strongly suggest that the pandemic is phasing out (World Health Organisation, 2023), and as such, social distancing requirements are no longer necessary. Universities, and other organizations alike are now operating on a continuum between models that existed pre-COVID-19 and models that were implemented at the height of the pandemic (Dangaiso et al., 2023). Notwithstanding, employee response to remote working during and after the pandemic remains an under-researched subject, especially in developing countries. As employers seem to revert to pre-COVID business models, it has also been suggested in the literature that workers gain satisfaction and hence perform better when they can equitably balance between the demands of their private, social, and family commitments and those of their professions (Pereira, 2020; Silaban and Margaretha, 2021; Boakye et al., 2023). COVID-19 provided more work-life balance by serendipity as employees could attend to the demands of their private lives whilst virtually executing their jobs (Galanti et al., 2021; Mohammed et al., 2022). It remains an empirical void whether or not workers would prefer to continue with remote working and flexible scheduling arrangements post the COVID-19 pandemic.

Several studies have examined the nexus between employee remuneration and job satisfaction. A positive effect of better rewards has been reported in previous studies (Naji, 2014; Akhtar et al., 2016; Mabaso and Dlamini, 2017; Anggraini, Muchtar and Masdupi, 2019). However, these studies were conducted under stable conditions, and this research investigates the interplay of the variables mediated by COVID-19. Further, underwhelming business performance during the pandemic era significantly affected employee remuneration as most businesses crumbled, and some even laid off staff (Susanto et al., 2022; Toscano, Bigliardi, and Polevaya, 2022). Thus, this merits the subject a further empirical inquiry.

Moreover, research on COVID-19-induced flexible scheduling and remote working remains unexamined in most countries. Although the effects of COVID-19-induced remote work and flexible scheduling have not yet been fully examined, prior research on work-life balance suggests that they are expected to positively influence employee job satisfaction. Studies that have conducted a comparative analysis of the effects of COVID-19-induced employee remuneration, remote working, and flexible work scheduling on employee job satisfaction and loyalty intentions are missing in the literature. This research examines the differential effect of employee remuneration, remote working, and flexible scheduling on employee job satisfaction and loyalty intentions among university frontline staff in Zimbabwe.

The findings of this study inform university service administrators, university Human Resource Management practitioners, top management, and labor consultants as they attempt to re-design service management models that yield maximum productivity, employee satisfaction, and loyalty during the COVID-19 crisis. The study may also enable them to understand the antecedents of job satisfaction in a period where COVID-19 has distorted the business landscape. More so, the study enlightens practitioners on the relative strength of each predictor on employee job satisfaction so that strategies for managing university frontline staff can be developed from an informed viewpoint. The research also highlights how service providers can harness work-life balance and reward strategies to leverage employee satisfaction and loyalty. Further, research on employee satisfaction adds an important dimension to the management of service staff as organizational performance hinges on a satisfied workforce; hence, this research brings a key impetus for university growth. The COVID-19 context pre-mediating events on the entire global landscape also lends this study an important gap. The study also advances empirical literature on employee rewards, work-life balance, and job satisfaction from the perspective of a developing economy, where such studies are still scarce.

Succinctly, the objectives of the study were to:

1. Determine predictors of job satisfaction and subsequent loyalty intentions among university employees in the post-COVID-19 context.
2. Establish the relative importance of employee remuneration (pay and benefits), flexible scheduling, and remote working (work-life balance).

Subsequent sections of this paper cover the literature review, research methodology, results and discussion, conclusions, implications, and future research directions.

THEORETICAL BACKGROUND AND HYPOTHESIS DEVELOPMENT

The Job Demands-Resources (JD-R) Model

Several theoretical frameworks have been employed in literature to explain the balance between working conditions and employee satisfaction and behavioral intentions (e.g., the equity theory (Adams, 1963), the hierarchy of needs theory (Maslow, 1943), and the expectancy theory (Vroom, 1964). As a sequel to these foundational theoretical frameworks, the Job-Demands-Resources (JD-R) model (Schaufeli and Bakker, 2004; Bakker and Demerouti, 2017) has emerged as a relatively more recent and useful model. The JD-R model is a well-established theoretical model in the field of occupational health psychology, which suggests that work conditions, categorized into job demands and job resources, affect employees' well-being and performance. "Job demands refer to the physical, psychological, or socio-organizational aspects of the work whose energy-depleting process induces people to experience energy loss and fatigue, leading to stress, burnout, and health impairment. On the contrary, job resources refer to the physical, psychological, social, or organizational aspects of the job that reduce job demands while stimulating work motivation, personal growth, and development," Galanti et al. (2021, p. 1).

The current study borrows its theoretical underpinning from the JD-R model as the research seeks to evaluate the balance between remote deployment, employee remuneration, job satisfaction, and loyalty intentions. Work

itself is inherently a physical, emotional, and psychological strain that affects employee health, especially those who occupy boundary-spanning roles (Osborne and Ballantyne, 2012; Lee and Kim, 2022). Further, the deployment model (physical or remote workstation) adds another aspect which can either be a stressor or a resource that can reduce work strain. Proponents of work-life balance argue that it seeks to reduce job stress by permitting employees to equitably manage the demands of both work and private lives (Silaban and Margaretha, 2021; Susanto et al., 2022; Boakye et al., 2023), thus it emerges a valuable resource for employers. Competitive remuneration has been traditionally viewed as worthwhile compensation for effort or work done; hence, it is a resource that reduces the strain attributed to job commitments (Anggraini et al., 2019; Aliyu et al., 2023). As such, the JD-R model underpins this research, as it examines the interplay of employee remuneration, remote working, and flexible working arrangements on employee job satisfaction and loyalty intent in Zimbabwean universities.

Employee Loyalty Intentions

Employee loyalty has been defined as the willingness of an employee to commit to an organization for the future and a disposition to continue serving in a role defined by a mutual value exchange relationship (Trinh, Van and Nguyen, 2023). Extant literature has extensively discussed employee retention due to its perceived correlation with organizational performance and long-term success. Organizations high in employee loyalty have been earmarked to achieve long-term success due to the positive relationship between loyalty intent and financial performance, productivity, organizational harmony, internal brand advocacy, relationship commitment, and employee performance (Gebregziabher et al., 2020; Buli, 2021). Several antecedents of employee loyalty intent have been suggested in the literature, e.g., organizational growth, career development, accomplishment, promotion, remuneration benefits, job security, and job satisfaction (Putra et al., 2020; Toscano et. al., 2022; Trinh et al., 2023).

Job Satisfaction

Satisfaction is a subjective judgment of whether or not a product, service, offer, experience, or activity meets individual expectations (Pereira, 2020). Satisfaction has been extensively researched in the literature on services marketing and human resources management (HRM) due to its correlation with the future behavioral intentions of consumers and employees. Job satisfaction defines an employee's contentment with the job they serve. Satisfied employees show affection, commitment, effort, and self-sacrificial behavior toward accomplishing the requirements of their jobs (Anggraini et al., 2019; Boakye et al., 2023). Job satisfaction is a key aspect of people management because of its association with employee productivity, organizational harmony, unity of purpose, and overall business performance (Kurdy et al., 2023; Trinh et al., 2023). In contrast, job dissatisfaction is an unwanted phenomenon because it attracts resentment, poor morale, low productivity, disregard for company performance, turnover intentions, and labor attrition (Frempong et al., 2018; Gebregziabher et al., 2020).

COVID-19 Mediated Antecedents of Job Satisfaction

Many researchers have suggested a plethora of factors that drive employee job satisfaction in extant literature (Costen and Salazar, 2011; Buli, 2021). This research examines the relative contribution of employee remuneration and work-life balance as the dominant factors evident amid the COVID-19 pandemic. Two main dimensions of work-life balance are conceptualized as remote working (work from home) and flexible scheduling (individualized or customized work plan in an uncontrolled setting), as these were the main strategies adopted by service providers at the height of the pandemic (Galanti et al., 2021; Mohammed et al., 2022). Most organizations are operating on pre and post-COVID-19 models as the pandemic shows signs of fading away (Dangaiso, Makudza, Jaravaza, et al., 2023). As such, these were modeled to predict job satisfaction in a post-pandemic context.

Employee remuneration refers to the monetary and non-monetary rewards that are awarded to an employee for a job done over a regular time interval, e.g., one month (Wambeti et al., 2020; Trinh et al., 2023). The remuneration package includes wages and salaries obtained as well as fringe benefits such as housing, healthcare coverage, transport, and education (Wambeti et al., 2020; Aliyu et al., 2023). In Zimbabwe, grocery items, mostly food hampers, have been popularized during the COVID-19 pandemic as employers' token of appreciation towards boundary-spanning employees who had the highest risk exposure to contracting the virus.

Remote working refers to a special working model that permits service employees to conduct their routine tasks from their homes (Galanti et al., 2021; Mohammed et al., 2022). In a remote working setup, service staff periodically report to their physical offices whilst executing most of their core duties from home. Most service providers were forced to maintain a skeletal staff complement who oversees the integral business functions on site (e.g., IT technicians, healthcare staff, drivers, management, cleaning, and security operators). Most frontline employees were deployed to work from home as efforts to decongest the workplace were globally institutionalized (Mohammed et al., 2022). Most work-related services were Internet-mediated, and all communications were conveyed through digital platforms.

Flexible scheduling is defined as work arrangements that allow service employees to individually customize their work plans without direct interference from their line managers (supervisors) (Putra et al., 2020; Galanti et al., 2021; Mohammed et al., 2022). Under flexible scheduling, service employees have full discretion over which tasks they will complete as a priority, and which ones are categorized as peripheral and those not bound by deadlines and the preferred working times they consider best for optimum productivity (Mohammed et al., 2022). Flexible

scheduling gives employees autonomy to execute their work more freely and helps them to self-manage while still being solely responsible for the outcomes of their work plans (Putra et al., 2020; Galanti et al., 2021).

Employee Remuneration and Job Satisfaction

The relationship between employee earnings and job satisfaction is well grounded in literature. The main premise underlying the theory is that employees perform better when there is a satisfactory balance between the inputs (labor) and the outputs (wages and salaries) in their exchange relationship with their employers (Adams, 1963; Vroom, 1964). Employees are, therefore, expected to attain high job satisfaction when they receive remuneration commensurate with their efforts (Anggraini, Muchtar and Masdupi, 2019). A positive relationship between remuneration package and job satisfaction has been suggested in previous research (Naji, 2014; Mabaso and Dlamini, 2017; Anggraini et al., 2019; Wambeti et al., 2020; Trinh et al., 2023). However, the effects of remuneration strategies remain unexamined in the context of the COVID-19 pandemic, in which business performance dwindled, and remuneration packages were significantly affected. However, cognizant of the support from studies conducted pre-COVID-19, this study proposed that;

H1: Attractive employee remuneration positively influences employee job satisfaction among university frontline staff in the post-COVID-19 era.

Remote Working and Employee Job Satisfaction

The VUCA (Volatile, Uncertain, Complex, and Ambiguous) concept has often been used to describe unpredictable environmental circumstances that befall corporate organizations (Putra et al., 2020). Concurrent with the Job Demands-Resources (JD-R) model (Schaufeli and Bakker, 2004; Bakker and Demerouti, 2017), the flexible firm theory (Atkinson and Hall, 2011) also espouses that firms are receptive to flexible employment models to navigate through the volatile business circumstances. As such, the flexible firm model also envisages organizations succeeding through disruptive innovation, radical transformation, and venturing into untested business propositions (Galanti et al., 2021). Research has shown that adventurous and risk-taking businesses have found success by serendipity (Morris et al., 2002; Hacioglu et al., 2012). Although the relationship between remote working and job satisfaction remains unexamined in the COVID-19 context, prior studies on work-life balance suggest that employees are likely to be satisfied when they can equitably navigate between social, private and family commitments and their job commitments (Putra et al., 2020; Silaban and Margaretha, 2021; Toscano et al., 2022; Boakye et al., 2023; Kurdy et al., 2023). Thus, university frontline employees are expected to embrace remote working models that award them more discretion to attend to both sides of their commitments. As a result, this study also predicted that;

H2: Remote working positively influences employee job satisfaction among university frontline staff in the post-COVID-19 era.

Flexible Work Scheduling and Employee Job Satisfaction

Flexible work scheduling, also conceptualized as flexi-time, encompasses that individual service employees are given the autonomy to tailor, plan, schedule, and organize their daily obligations such that they meet departmentally or functionally set objectives (Putra et al., 2020; Boakye et al., 2023). The conventional work schedule implies more direct interference of the line managers in the planning and execution of routine tasks (Mohammed et al., 2022). However, under flexible work arrangements, more discretion rests with the service employee as they operate from a remote workstation. Home offices have been popularized during the COVID-19 pandemic (Putra et al., 2020; Galanti et al., 2021; Mohammed et al., 2022). The influence of flexible work scheduling on job satisfaction remains under-researched in most economies. However, prior research on employee autonomy, self-managing, and decentralized workflow models suggests that employees are more adaptive, productive, and satisfied with a sense of trust and belief that they are able to perform without interference or direct supervision (Putra et al., 2020; Mohammed et al., 2022; Laß, et al., 2023; Trinh et al., 2023). Given this perspective, this research also proposed that;

H3: Flexible work scheduling positively influences employee job satisfaction among university frontline staff in the post-COVID-19 era.

Job Satisfaction and Employee Loyalty Intentions

Extant literature identifies satisfaction as a key proxy of future behavioral intentions (Frempong et al., 2018; Dhir et al., 2020; Trinh et al., 2023). In support of the JD-R model, the disconfirmation theory (Oliver, 1980) 17 (4 suggests that satisfaction is achieved whenever conditions or performance meets individual expectations, that satisfaction is a positive feeling towards a product, service, event, person, or object, and its conditions an individual's future disposition towards that entity. Job satisfaction epitomizes the condition where an employee has positive feelings towards their job, work environment, and employer (Dhir et al., 2020; Silaban and Margaretha, 2021).

Proponents of the internal marketing paradigm support that employee satisfaction is a key antecedent of corporate success. A satisfied employee is expected to have a positive attitude toward the employer whilst demonstrating favorable future behaviors towards the employer (Benjarongrat and Neal, 2017; Frempong et al., 2018). The positive effect of job satisfaction on loyalty intentions has been reported in a number of empirical studies (Frempong et al., 2018; Gebregziabher et al., 2020; Buli, 2021; Trin het al., 2023). In a work environment where significant changes have been made at the height of the COVID-19 pandemic, it is imperative that employers evaluate employee job satisfaction, as well as its influence on future employee behavioral intentions. Job satisfaction has been shown to trigger a positive effect on employee turnout, organization harmony, individual motivation,

peer support, employee performance, financial performance, and loyalty intentions in most studies (Frempong et al., 2018; Dhir et al., 2020; Buli, 2021; Trinh et al., 2023). In the light of the foregoing, this study also predicted that;

H4: Employee job satisfaction positively influences employee loyalty intentions among university frontline staff in the post-COVID-19 era. Figure 1 illustrates the hypothesized research model.

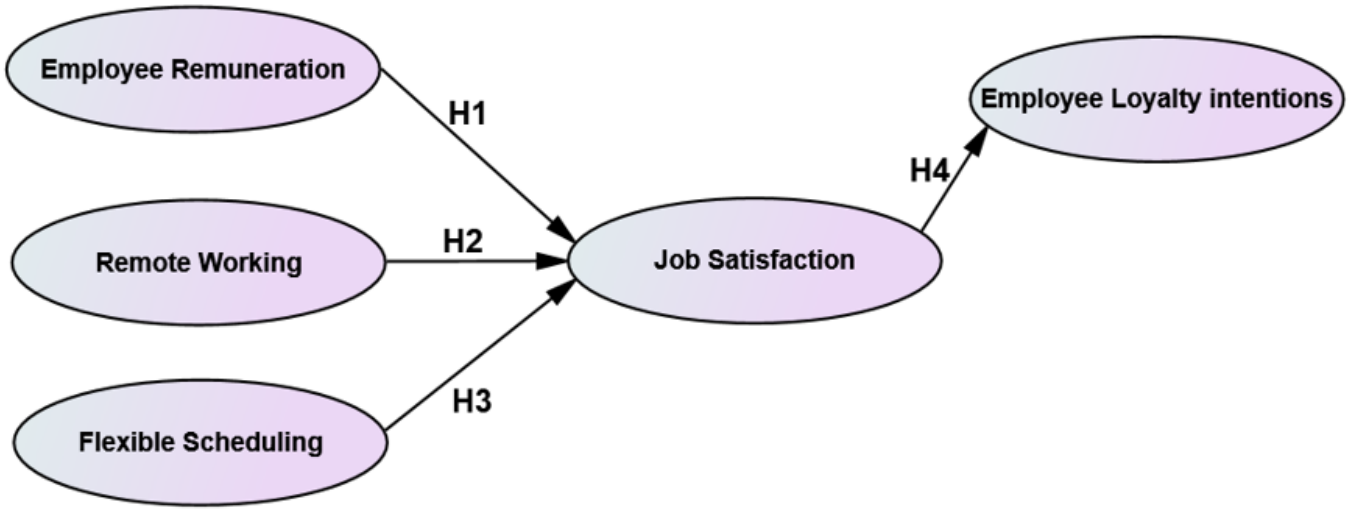

Figure 1: Hypothesized research model

METHODS AND MATERIALS

Research Design

The study's purpose was to examine the effects of employee remuneration, remote working, and flexible scheduling on employee job satisfaction and subsequent loyalty intentions. An explanatory research design through a quantitative research approach was employed. Model assessment enrolling Structural Equation Modeling in AMOS enabled estimation of parameters within prior hypothesized causal effects.

Population and Sampling

A cross-sectional survey employed convenience sampling to select 392 academic and non-academic frontline employees at three public universities in Zimbabwe. Due to challenges in obtaining a sampling frame, random sampling techniques could not be used. Sampling was conducted using a staged approach where the first batch of boundary spanners were physically sought to complete person-administered questionnaires whilst the second batch of respondents working in remote environments was contacted through an online monkey survey. The sample size was based on data analysis methods, sizes used in similar studies, resource constraints, and completion rates. The item to response should range from 1-4 to 1-10 for each set of observed variables (Chepchirchir and Leting, 2015). Thus, for this study, 100-250 samples were considered sufficient. From a sample of 392 respondents, 327 cases were deemed valid for conclusive analyses.

Measures

The measurement scales used in this study were adopted from previous research. These were measured on a 7-point Likert scale from strongly disagree to strongly agree. These were conceptualized as employee remuneration (Wambeti et al., 2020; Trinh et al., 2023), remote working (Toscano et al., 2022; Kurdy et al., 2023), flexible scheduling (Putra et al., 2020; Boakye et al., 2023), employee job satisfaction (Silaban and Margaretha, 2021; Trinh et al., 2023) and employee loyalty intentions (Gebregziabher et al., 2020; Trinh et al., 2023). A pilot study was used to refine the instrument based on 16 students from the sampled universities.

Data Collection Procedures

The study obtained ethical clearance from the Zimbabwe Ezekiel Guti University Ethics Committee. The permission to collect survey data from the employees of the three universities was also granted. Further, the purpose of the research was shared with participants, who were also educated that participation was voluntary. More so, the participants rights of confidentiality and privacy were observed before and after data collection. The participants were also instructed not to submit any personally identifiable information.

Data Analysis Methods

A two-step procedure was followed to estimate model parameters following the guidelines of Anderson and Gerbin (1988). This was Confirmatory Factor Analysis followed by Structural Equation Modelling. The assessment of the measurement model ensured that validity and reliability requirements were met. The model fit indices used in this research belong to absolute, relative, and parsimony-adjusted model fit indices. Convergent validity was based on the Average Variance Extracted (AVE), whilst the comparison between the square of the AVE and construct correlations was the criteria for examining discriminant validity. Based on the maximum likelihood estimation, hypotheses tests were done using path estimates (β), t-values (C.R) (>1.96), and p-values (<0.05) at the 95% confidence interval.

Variable	Category	Frequency	Percentage
Gender	Female	163	49.8
	Male	164	50.2
	Total	327	100.0
Age	18-25 years	64	19.6
	26-34 years	61	18.7
	35-43 years	108	33.0
	44-52 years	56	17.1
	53-65 years	38	11.6
	Total	327	100.0
Education	Ordinary level	21	6.4
	Diploma	58	17.7
	Bachelor's degree	119	36.4
	Master's degree	99	30.3
	Doctorate degree	30	9.2
	Total	327	100.0
Experience with the university	0-5 years	83	25.4
	6-10 years	91	27.8
	11-15 years	110	33.6
	16-20 years	37	11.3
	21 years plus	6	1.8
	Total	327	100.0
Staff Category	Academic staff	131	40.1
	Nonacademic staff	196	59.9
	Total	327	100.0
Income	$1-500	170	52.0
	$501-1000	135	41.3
	$1001-1500	22	6.7
	Total	327	100.0

Table 1: Demographic profile (Source: Survey data)

RESULTS

Demographic Profile of Respondents

The major highlights were that gender was evenly distributed among males (50.2%), slightly surpassing their female counterparts (49.8%) by one respondent. The 35-43 age group had the highest frequency (108; 33.0%) whilst the 53-65 group had the least participants (38; 11.6%). Further, bachelor's degree holders dominated the sample (119; 36.4%) and the doctorate degree holders had the lowest frequency (30; 9.2%). University employees between 11-15 years of service had the highest frequency (110; 33.6%), followed by those in the 6-10 years category (91; 27.8%). In terms of income, 170 (52%) employees confirmed that their monthly earnings were between $1 to $500, and 135 (41.3%) showed that they were in the $501 to $1000 category. 131 (40.1%) academic and 196 (59.9%) non-academic staff participated in the study. Table 1 illustrates the demographic characteristics of the respondents.

Assessment of the Measurement Model

The results of the Confirmatory Factor Analysis procedure confirmed that uni-dimensionality was satisfied with all standardized factor loadings greater than 0.7 (Kline, 2023), except RW5 (0.588), JS4 (0.610), and ELI3 (0.699). These were removed from further analysis save for ELI3 because it did not affect the Average Variance Extracted (AVE) (Hair et al., 2019). Inspecting the modification indices and the standardized residual covariance matrix did not suggest any further model re-specifications. Given that, the fit of the measurement model was examined. The normed Chi-square (x^2/df) = 2.98, Root Mean Square Error of Approximation (RMSEA) = .07, Root Mean Residual (RMR) = .06, and Goodness of Fit Index (GFI) = .912. The Comparative Fit Index (CFI) = .943, Incremental Fit Index (IFI) = .943, and Tucker-Lewis Index (TLI) = .932. These absolute and relative fit indices, respectively, provide evidence of the good fitting model (Byrne, 2013; Hair et al., 2019; Kline, 2023).

The Average Variance Extracted (AVE) was above the recommended threshold of 0.5 (Hair et al., 2019; Kline, 2023). They ranged from 0.527 (Employee loyalty intentions) to 0.805 (Employee remuneration). Thus, convergent validity was present. The comparison between the square root of the Average Variance Extracted (AVE) and the construct correlations provided the basis for examining discriminant validity. According to Fornell and Larcker (1981), the square roots of the AVE (squared extracted variances) should be higher than the construct correlations (shared variances) between the corresponding variables. The results in Table 3 confirm that this condition

was met on all constructs; hence, there were no discriminant validity problems. Construct reliability was examined using composite reliability. These ranged from 0.770 (Employee loyalty intentions) and 0.954 (Remote working). A threshold of 0.7 was recommended by Nunnally and Bernstein (1994), thus construct reliability was present. In line with recommendations given by Hayes and Coutts (2020), McDonald's omega was used to test internal consistency since it is more robust than the widely used Cronbach's alpha. The internal consistency threshold is 0.7 or higher. Hence, all constructs had internal consistency as they were greater than the stipulated threshold. Table 2 shows the psychometric properties of the measurement model, and Figure 2 illustrates the measurement model.

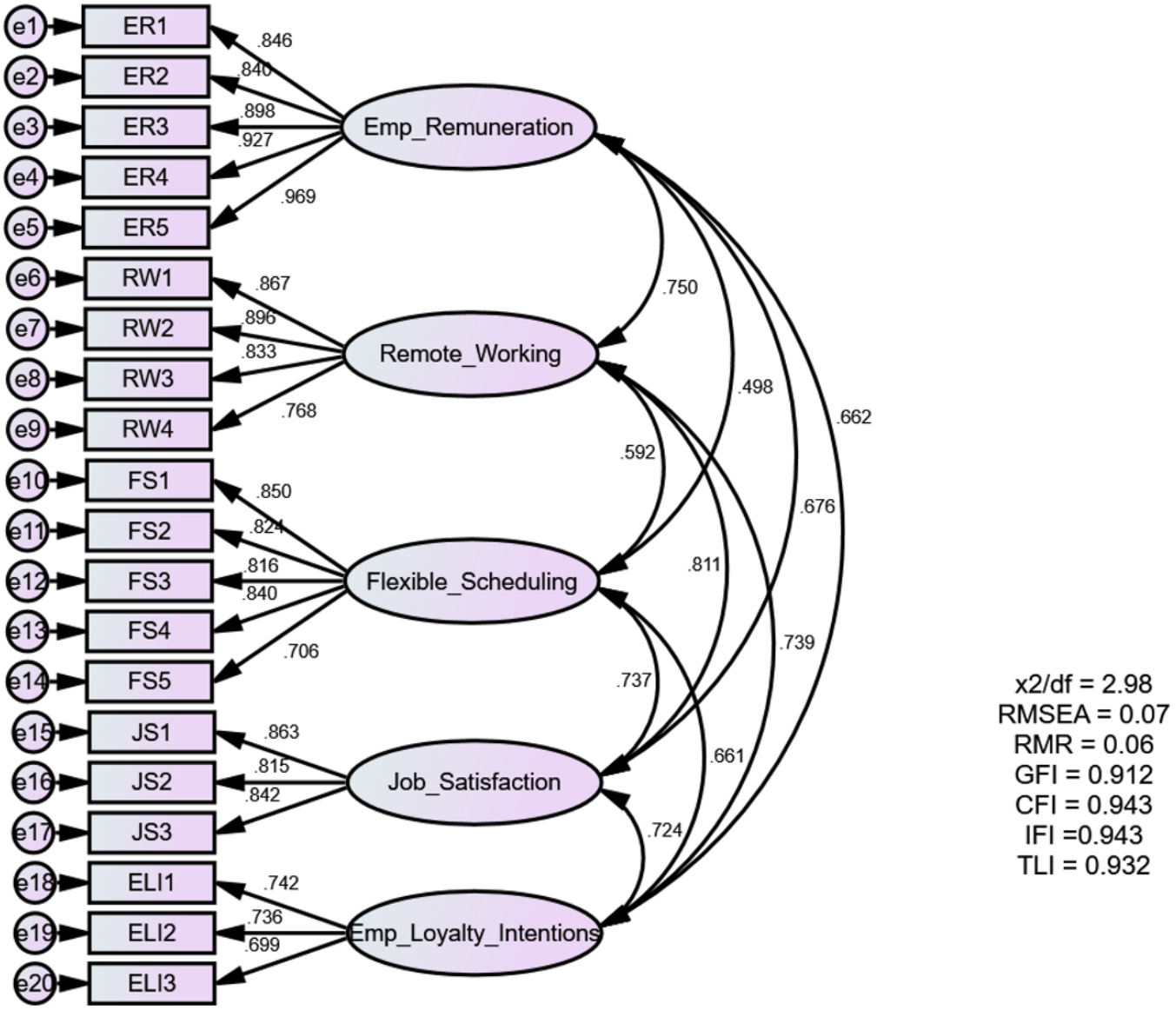

Figure 2: Measurement model (Source: own analysis)

Construct/Observed	Loading	AVE	CR	Omega
Employee remuneration		.805	.954	.938
ER1: My current salary is commensurate with my abilities	.846			
ER2: the university's allowances and commissions are reasonable	.840			
ER3: I am perfectly fine living with my current salary	.898			
ER4: the payment of wages to the employees is fair and transparent	.927			
ER5: Pay and benefits packages are pleasant	.969			
Remote Working		.710	.907	.881
RW1: I am pleased to work from home	.867			
RW2: Working from home allows me to look after my personal needs, too	.896			
RW3: Working from home allows me to execute my duties with comfort	.833			
RW4: Working from home is the best decision my employer ever made for our welfare	.768			
Flexible Scheduling		.654	.904	.902
FS1: I am given the discretion to decide all the work in my area of responsibility	.850			
FS2: I am trusted by my superiors and empowered to make decisions	.824			
FS3: I make my own work plan for my routine duties	.816			
FS4: I get assigned work by my superiors and can improve it in my own way.	.840			
FS5: I set my own priorities and timelines without the help of my supervisor	.706			
Job Satisfaction		.706	.878	.839
JS1: I am happy with my job selection	.863			
JS2: Taking this job was the best career decision I ever made	.815			
JS3: I will choose this position again, given another chance	.842			
Employee Loyalty Intentions		.527	.770	.792
ELI1: I recommend this university to job seekers	.742			
ELI2: I intend to stay in my job for the future	.736			
ELI3: I will not switch to another employer in the future even if I am offered a higher salary	.699			

Notes: Loading = standardized loading, AVE = Average Variance Extracted, CR = Composite reliability, Omega = McDonald's omega

Table 2: Psychometric properties of the measurement model (Source: own calculations)

Construct	1	2	3	4	5
Employee Remuneration (1)	.897				
Remote Working (2)	.750	.842			
Flexible Scheduling (3)	.498	.592	.809		
Job Satisfaction (4)	.676	.811	.737	.840	
Employee Loyalty Intentions (5)	.662	.729	.661	.724	.736

Table 3: Assessment of Discriminant validity (Source: own calculations)

Structural Equation Modeling and Hypothesis Testing

The hypothesized model was evaluated on three criteria: the model fit, significance of path estimates, and its explanatory power. The model fit of the structural model was as follows; x^2/df = 3.1, GFI = .910, RMSEA = .08, and RMR = .07, CFI = .948, TLI = .938 and IFI = .948. The thresholds for absolute and incremental fit indices were satisfied.

Secondly, the path estimates were examined. The study predicted the positive effect of employee remuneration on employee job satisfaction. The study's results confirmed this positive causal relationship (β = .126, t = 2.274 and p = .023). Given these results, the hypothesis (H1) was supported, and the study confirms that attractive remuneration packages positively impact the job satisfaction of university frontline staff in Zimbabwe. However, the study also sought to investigate the relative strength of each predictor of employee job satisfaction. On this dimension, remuneration had the least impact compared to remote working (β = .509, t = 7.721 and p < 0.001) and flexible scheduling (β =.394, t = 7.128 and p < 0.001). The SEM path diagram is shown in Figure 3.

Furthermore, the study also hypothesized that remote working positively impacts the job satisfaction of university frontline staff in H2. The results of the analysis also confirmed this positive causal relationship (β = .509, t = 7.721, and p < 0.001). Hence, the hypothesis gained empirical support. This confirms the positive impact of work-life balance on job satisfaction in a post-pandemic context in Zimbabwe. Interestingly, the comparative analysis through SEM estimates revealed that remote working was the strongest predictor of employee job satisfaction among frontline employees in Zimbabwean universities compared to employee remuneration (β = .126, t = 2.274 and p = .023) and flexible scheduling (β = .394, t = 7.128 and p < 0.001).

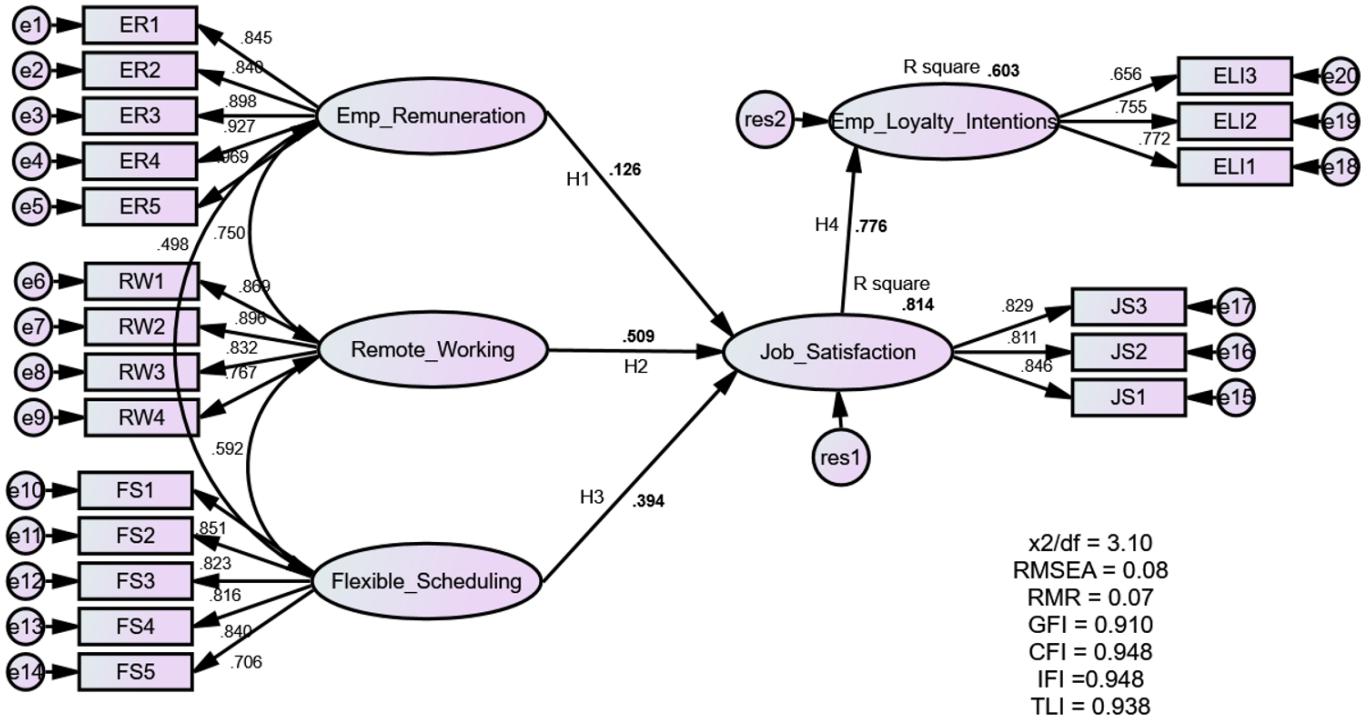

Figure 3: The structural model (Source: own calculations)

The study also predicted that flexible scheduling positively influenced employee job satisfaction in H3. The findings of SEM also confirmed this positive causal effect ($\beta = .394$, $t = 7.128$ and $p < 0.001$), hence the H3 was confirmed. The results support the idea that the autonomy to plan and self-organize work schedules and set individual priorities, goals, and performance targets has positively impacts employee satisfaction. Relatively, flexible scheduling was second in strength, just between remote working ($\beta = .509$, $t = 7.721$ and $p < 0.001$) and employee remuneration ($\beta = .126$, $t = 2.274$ and $p = .023$).

The ultimate hypothesis predicted that employee job satisfaction positively influences employee loyalty intentions in H4. The findings from SEM also confirmed this positive causal influence ($\beta = .776$, $t = 10.238$ and $p < 0.001$); hence the hypothesis (H4) was supported. The findings support that delighted employees have the greatest propensity to stay with their current employers. Satisfied employees have been shown to surpass performance goals and are more likely to stay longer than those who are not satisfied.

The last criterion that was used to evaluate the structural model was the explanatory power of the model. The model explained 81.4% and 60.3% of the variance in employee job satisfaction and loyalty intentions. The predictors (employee remuneration, remote working, and flexible scheduling) explained 81.4% of the variability in employee job satisfaction. More so, employee job satisfaction also explained the 60.3% variability in employee loyalty intentions (Figure 3). Models that explain at least 50% of the variance have been suggested to have significant power of prediction (Hair et al., 2019). Table 4 shows the outcomes of hypothesis testing.

Hypothesized relationship	Estimate (β)	C.R	p-value	Result
H1: ER→JS	.126	2.274	.023	Supported
H2: RW→JS	.509	7.721	***	Supported
H3: FS→JS	.394	7.128	***	Supported
H4: JS→ELI	.776	10.238	***	Supported

*Notes: ER = Employee Remuneration, RW = Remote Working, FS = Flexible Scheduling, JS = Job satisfaction, ELI = Employee Loyalty Intentions, C.R = Critical Ratio/t-statistic, a 95% confidence interval was used, and *** denotes p<0.001.*

Table 4: Outcomes of hypothesis testing (Source: own calculations)

DISCUSSION OF FINDINGS

The study aimed to examine the differential effects of employee remuneration, remote working, and flexible scheduling on employee job satisfaction and, subsequently, loyalty intentions. Structural relationships that were hypothesized in the proposed model were confirmed. In H1, the study predicted that employee remuneration would positively affect employee job satisfaction. The results ($\beta = .126$, $t = 2.274$, $p = .023$) confirm this relationship and H1 gained empirical support. Although most organizations were unable to operate at their full productive capacity, there is still evidence that attractive remuneration leads to job satisfaction. University frontline employees indicated that they value pay and benefits awarded to them by their employers. These results have been supported in related studies (Naji, 2014; Mabaso and Dlamini, 2017; Anggraini et al., 2019; Wambeti, Waweru and Mwaura, 2020; Trinh et al., 2023). However, in our comparative analysis based on the strength of path coefficients and *t*-statistics,

employee remuneration had relatively the weakest impact on job satisfaction. The findings pinpoint that university boundary-spanning staff preferred remote working (β = .509, t = 7.721, $p < 0.001$) and flexible scheduling of work (β = .394, t = 7.128, $p < 0.001$) to employee remuneration.

In H2, the positive effect of remote working on employee job satisfaction was hypothesized. Findings confirmed this relationship, leading to the confirmation of H2. Mediated by the COVID-19 circumstances, remote working was evidently important for university frontline staff (β = .509, t = 7.721, $p < 0.001$). Prior research on work-life balance also supports the positive effect of remote work on job satisfaction. Concurrent with the Job Demands-Resource model (Schaufeli and Bakker, 2004; Bakker and Demerouti, 2017), the remote working arrangement reduces job stressors because it promotes more balance between work and life, thus reducing job stress. These results have been reported in related studies (Putra et al., 2020; Silaban and Margaretha, 2021; Toscano et al., 2022; Boakye et al., 2023; Kurdy et al., 2023). Further, the statistical results in the structural model elaborated on the importance of remote working (working from home). Amongst the COVID-19-mediated antecedents of job satisfaction, remote working had the strongest impact as compared to employee remuneration (β = .126, t = 2.274, p = .023) and flexible scheduling (β = .394, t = 7.128, $p < 0.001$).

More so, H3 proposed the positive effect of flexible scheduling of university work on employee job satisfaction. The results (β = .394, t = 7.128, $p < 0.001$) confirm the positive and significant impact, and hence H3 gained empirical support. Job autonomy emerged as a significant predictor of employee satisfaction in a COVID-19-induced deployment model. In support of the underlying theory, the more employees are free to plan, execute, and coordinate their work without direct interference from their line managers, the higher the propensity to achieve job satisfaction (Bakker and Demerouti, 2017). Flexibility and job autonomy reduce job stress by allowing the incumbent employee to freely use their initiative to perform their duties. Thus, the findings are aligned with the Job Demands-Resources (JD-R) framework (Schaufeli and Bakker, 2004; Bakker and Demerouti, 2017). The more work (stressor) an employee has, the more autonomy (cognitive resources) they need to accomplish. These findings have been confirmed in earlier studies (Putra et al., 2020; Mohammed et al., 2022; Laß, Vera-Toscano and Wooden, 2023; Trinh, Van and Nguyen, 2023). In terms of relative strength, flexible scheduling had the second strongest impact on job satisfaction in the model. Altogether, remuneration benefits, remote working, and flexible scheduling explained 81.4% of the variability in employee job satisfaction of university frontline staff in Zimbabwe. In terms of priority ranking of the three predictors of university frontline staff job satisfaction, remote work had the strongest impact, followed by flexible work scheduling, and the least was employee remuneration. These results were in tandem with Barrero, Bloom, and Davis (2021), where employees literally favored working from home and would start to actively consider other job offers at the same remuneration but with an option to work from home if remote working and flexible work scheduling are removed.

The ultimate hypothesis, H4, predicted that employee job satisfaction would positively influence employee loyalty intentions. The results from SEM indicate that a positive and significant relationship was evident, which influenced the support for H4. The findings extend the existing literature supporting the key role of employee satisfaction on loyalty intent. Similar findings have been reported by previous researchers (Frempong, Agbenyo and Darko, 2018; Gebregziabher et al., 2020; Buli, 2021; Trinh, Van and Nguyen, 2023). Boundary-spanning roles are naturally stressful and relatively low-paying jobs across service industries; hence, employee satisfaction is a priority in a service context. Given the high staff attrition that has been reported in the Higher Education sector in Zimbabwe in recent years (Zimbabwe National Statistics Agency, 2022), employee job satisfaction occupies critical space in the survival and future growth of universities. This research confirms that 60.3% of the variability in employee loyalty intent of university frontline staff was explained by job satisfaction. The current research, therefore, suggests that continuous evaluation of employee job satisfaction is an imperator in the university service setting.

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Conclusions

The purpose of the study was to determine and compare the antecedents of job satisfaction and employee loyalty intentions in a COVID-19-mediated employee deployment model. The findings inform the conclusion that although employee remuneration positively influences employee job satisfaction, remote working, and flexible scheduling have a stronger positive impact. Further, the study concludes that employee job satisfaction positively impacts employee loyalty intentions in the context of university frontline staff.

Theoretical Implications

The study makes key contributions to literature in the domain of services marketing and human resources management by adding to studies that evaluated the impact of employee remuneration, remote working, and flexible scheduling on employee job satisfaction and, subsequently, loyalty intentions. The research was grounded in the Job Demands-Resources model and the equity and flexible firm theories. This research advances theory by confirming the key positive role of work-life balance on employee job satisfaction, and further, the study confirms that in the mediation of the COVID-19 context, work-life balance has a much-outsized positive effect on job satisfaction compared to employee remuneration. This presents a key contribution to the literature, given the over-emphasis on wages and salaries that dominate conventional job satisfaction literature. Moreover, the research adds that, comparatively, remote working, flexible scheduling, and employee remuneration positively contribute to employee job satisfaction. In the age of digitalization, service employees are best productive utilizing digital platforms to execute their duties whilst also having oversight on their private family engagements and social communities. The study challenges the theory that

confines work to physical corporate workstations, thereby disenfranchising frontline service staff from overseeing their social and private affairs that affect their physical, mental, and emotional well-being.

Practical Implications

Management of frontline staff is critical to organizational success, especially in the domain of service providers. The negative effect of job dissatisfaction, emotional burnout, employee job stress, and workplace fatigue on employee productivity is well established in the literature. The nature of emotional stress and labor endured by frontline employees implies that managing job satisfaction and loyalty intentions is critical, especially for service providers. This research provides important nuggets for universities and other service providers alike as they rework post-COVID-19 business models for deploying and managing their service staff. Most non-specialist service managers, especially in developing economies, have been fixated on the view that employee remuneration is the sole source of job satisfaction; however, this perspective has been challenged in literature. Current findings imply that service providers have key considerations to make in the digital era for work-life balance. Given that employees indicated that remote working arrangements have the strongest impact on job satisfaction, service providers should review their policy towards supportive and inclusive employee management policies. This could present a huge opportunity to harness employee loyalty through employee job satisfaction.

Recommendations

To enhance employee job satisfaction and loyalty, the study recommends that service providers design flexible work schedules and foster remote work and electronic job design. Although most managers view employee remuneration as the important antecedent to job satisfaction, this study recommends that service providers should consider augmenting remuneration with work-life balance to enhance job satisfaction. Research evidence suggests that employees perform better when they can multitask between all essential facets of their lives. Organizations should allow service employees to work at home whilst overseeing the needs of their families and also being able to plan and set out their assignments without much interference from their line managers. To enable this, service providers should fully digitalize their workflow to expedite routine tasks, meetings, group engagements, service inquiries, and other official correspondence using digital enterprise management systems and enhanced e-communication platforms. To enhance productivity and job satisfaction, service providers should work against employee micro-management by promoting more autonomy, trust, responsibility, and authority.

Limitations and Future Study

Human satisfaction is a subjective construct and varies due to a range of contextual or peculiar environmental circumstances; therefore, the findings of this research may not be reproduced in other unique organizational settings, given that a limitation on the generalizability of the findings, future studies may explore determinants of job satisfaction in the contexts of their environments. Factors such as organizational culture, leadership style, and organizational success may be important determinants of job satisfaction in other contexts.

Further, the study employed a mono-quantitative design suited to examine causal relationships in structural models. However, a limitation is that this design does not allow participants to give in-depth accounts of their lived experiences. Future studies may explore qualitative designs to discuss findings from different perspectives. Moreover, the sample size was small, involving 327 students and three universities due to budget constraints.

Lastly, contextual factors such as COVID-19 fears and health factors could have probably explained employee opinions on remote working arrangements. As such, future researchers may re-evaluate this model under entirely stable conditions to examine the replicability of findings.

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BIDIRECTIONAL BRAILLE-SPEECH COMMUNICATION SYSTEM FOR DEAFBLIND STUDENTS

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ABSTRACT

Deaf-blindness is a type of dual disability wherein visual and auditory capabilities are significantly impaired. Special communication methods have been developed for the deaf-blind community. Yet, these methods require that both people involved have prior knowledge and training to successfully communicate, limiting deaf-blind people's social interactions, particularly in academic settings. This paper describes the development of a device that enables two-way communication between a everely deaf-blind user and a hearing person with no prior knowledge of Braille and no additional intermediaries. A Convolutional Neural Network (CNN) scheme for speech recognition was designed and implemented along with the development of an algorithm capable of developing both text-to-speech and Finger-Braille-to-text conversion. Lastly, a system integration via 3D modeling and additive manufacturing was carried out to deliver a functional prototype. The resulting device aims to allow deaf-blind students to send and receive information entirely in finger Braille, using buttons and vibrotactile feedback. In contrast, the hearing tutor receives auditory messages and speaks to reply, making the educational experience as familiar as possible for both parties. Users testing the device achieved an average typing accuracy of over 95% and demonstrated an understanding of commands transmitted through the device's components.

KEYWORDS

Accessibility, assistive technology, Braille, Convolutional Neural Networks, deaf-blindness, education

HOW TO CITE

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Highlights

- *Creating a Convolutional Neural Network to recognize the Spanish alphabet and its translation to Braille language.*
- *A working prototype capable of sustaining two-way communication through Finger Braille and Voice Recognition for its usage in educational environments.*
- *A Braille translation algorithm adapted to the Spanish alphabet to cater to the deaf-blind population of Mexico.*
- *A communication method for the deaf-blind requires no prior Braille or Sign Language knowledge from the hearing party.*

INTRODUCTION

In Mexico, 4.9% of the population has a disability, be it physical, sensory, psychosocial, intellectual, or multiple (INEGI, 2020). Out of all disabled people in the country, 6.5% (466,178 people) have deaf-blindness (CONADIS, 2018), a type of multiple disability wherein both visual and auditory capabilities are significantly impaired (Ask Larsen and Damen, 2014), which creates a barrier for interaction, education and integration to society. Deaf-blindness can occur for several reasons, the most common one being Usher Syndrome (Ayton et al., 2023). The most prevalent types of this syndrome are defined by partial or profound deafness at birth and a progressive loss of vision due to retinitis pigmentosa, which generally starts in childhood or adolescence (Ayton et al., 2023).

Patients with Usher Syndrome often get cochlear implants (CIs) to restore hearing, with reported good outcomes when done early in life (Ayton et al., 2023). However, this raises ethical concerns about parents deciding for their children without their consent. Schulz et al. (2023) address concerns about autonomy, freedom, identity, participation, and justice regarding CIs, with parents of deaf children reporting a lack of information and a bias towards implantation when discussing options with their children's doctors. Some CI users express feeling limited by the implant in that certain activities were off-bounds due to risks of electrical shock or damage to the implant (Schulz et al., 2023). Besides these physical factors, Smolen and Paul (2023) describe the impact of CIs on identity. They state that "deaf" and "Deaf" (capitalized) are distinct terms

that refer to the physical inability to hear and the 'culturally distinct group, who typically use a visual language and are said to have a "Deaf Identity"' (Smolen and Paul, 2023), respectively (the authors will henceforth use "deaf" and "deaf-blindness" to refer exclusively to the sensory impairments, but "Deaf," "Deaf-blindness" and "d/Deaf" or "d/Deaf-blindness" to acknowledge the cultural aspect of the conditions). With Deaf Culture being so prevalent, by giving patients CIs, doctors often inadvertently give deaf children a conflicting identity, being audio-logically deaf but able to hear thanks to technology. The authors of this paper present these issues not as an argument for why CIs should not be offered to d/Deaf-blind patients but as an explanation for why they are not always chosen. This work will focus primarily on severe to profoundly deaf-blind people who, for any reason, do not have CIs.

Castiglione and Möller (2022) state that human communication generally relies on "far senses": sight and hearing. Only when these senses are impaired do the "near senses" (i.e., taste, touch, and smell) gain importance in this aspect. Methods of communication with and between people with deaf-blindness can vary depending on the extent and type of their visual and/or hearing impairment and their personal preferences, having different options to communicate such as spoken languages, sign languages, tactile sign language, deaf-blind manual alphabet, tadoma, deaf-blind block alphabet, and finger Braille (Hersh, 2013).

The first two communication methods are only viable if the d/Deaf-blind person has enough residual visual and/or hearing capabilities, which is not always true. In individuals with Usher syndrome, once adequate methods may not always be so. In the words of a deaf-blind man who acquired visual impairment later in life: "I have become more isolated because of the vision impairment now during the last 15 years. […] when you have difficulties, you can no longer use lip reading" (Turunen-Taheri et al., 2023). Therefore, when visual or hearing stimuli are not viable, people with deaf-blindness and those who interact with them must learn another communication scheme.

Braille is a tactile writing system and alternative communication method that uses six dots to represent individual letters, punctuation marks, numbers, and more. These dots are numbered from top to bottom and from left to right, each having two states: raised or flat, allowing for 64 possible combinations (Blenkhorn, 1995). Some of these are reserved for "modifiers," changing how the following character is interpreted. For example, a character with raised 3rd, 4th, 5th, and 6th dots (⠼) is, in several languages, considered a number indicator, meaning that the following character will be interpreted as a digit. Similarly, a character with dots 4 and 6 raised (⠠) is used to capitalize the following letter in Spanish Braille. Modifiers can maximize the efficiency of a six-dotted Braille cell by re-signifying Braille patterns systematically instead of assigning a new combination to each character. However, there are contexts where these 64 combinations (plus modifiers) are not enough, in this case, a fourth row can be added to the Braille cell to allow for up to 256 unique characters.

The Braille typewriter or Brailler is an Assistive Technology device that works like a conventional typewriter, except that it has only nine keys. Six of these represent each of the six dots in a Braille cell; another key functions as a spacebar, and the remaining two help navigate the text (Moore and Murray, 2001). Pressing the keys causes a mechanism to hit the paper, raising the corresponding dots. Figure 1 shows a Perkins Brailler, one of the most common Braille typewriters.

In Figure 1, keys 1-6 represent the six dots that make up the Braille cell. Keys 1 and 4 are pressed by the index fingers of the left and right hand, respectively. Keys 2 and 5 correspond to the middle fingers, and keys 3 and 6 to the ring fingers. Key 7 is the spacebar, and key 8 is used to jump to the next line. Key 9 is the Backspace key used to go back to the previous character and correct any possible mistakes. The number 10 is the carriage lever and is not considered a key. It marks the position of the current character and is responsible for announcing the end of the line by making a sound when it approaches the end of the page (Morgan et al., 2011).

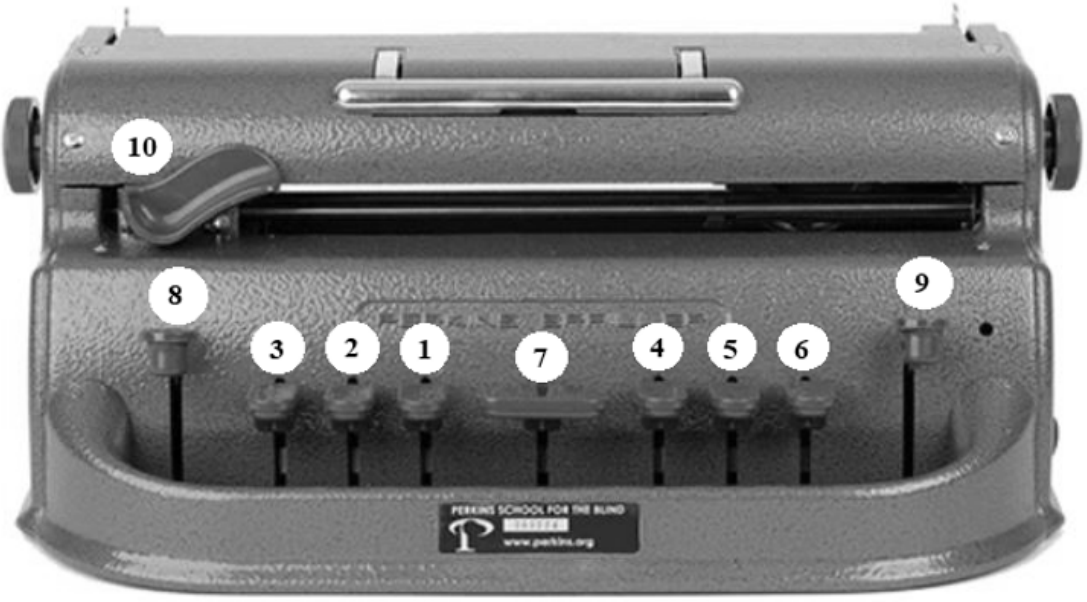

Figure 1: Perkins Brailler with its keys numbered.

As its name suggests, the Finger Braille system is based on traditional Braille. It consists of placing someone's index, middle, and ring fingers of both hands-on top of the same fingers of the person who is to receive the message. It follows the same logic as the Brailler, with each finger representing a dot in the cell, making up the Braille alphabet so that characters can be formed by tapping the fingers of the receiver (Ding, 2012). However, this system requires that both people know the Braille alphabet and its adaptation as Finger Braille, forcing them to interact with laymen via interpreters. Each of the methods listed above has advantages and disadvantages, like the deaf-blind block alphabet being simpler and easier to learn (Hersh, 2013) but much slower than the other methods. For example, tactile sign language is more difficult to master but is faster than finger Braille. Finger Braille can be learned faster than the deaf-blind manual alphabet, as it imitates the layout of a Braille typewriter (Hersh, 2013).

With the advent of novel technological paradigms, communication aids have been developed to further include people with sensory disabilities. Zdravkova et al. (2022) explored several applications of Artificial Intelligence (AI) in assistive technologies for communication and learning for different disabilities. For the d/Deaf-blind, they mention text-to-Braille translators with tactile displays, in which the Braille displays utilize AI for Optical Character Recognition, a Braille-to-text algorithm where a CNN converts a Braille line to text after image segmentation and optical Braille recognition; and Deep Neural Networks for text-to-Speech. Although the rest of their work focuses on other disabilities (i.e., dyslexia, Functional Speech Disorder, or blindness and deafness alone), the applications mentioned are cutting-edge for the use of AI to support people with sensory disabilities.

While developments have been made in other countries to facilitate the inclusion of the d/Deaf-blind, this is hardly the case in Mexico. For example, in the United States, several relay services are available for long-distance communication with a d/Deaf-blind user (NFB, 2014), and the National Center on Deaf-Blindness recognizes 52 State Deaf-Blind Projects (NCDB, 2013). In contrast, in 2008, Mexico's National Commission for Preventing Discrimination (CONAPRED) stated there was only one association, ASOMAS, in the whole country offering education, stimulation, and rehabilitation to children with d/Deaf-blindness or other "multiple challenges" (CONAPRED, 2008). Put into perspective, the USA has at least 52 times as many specialized projects for the d/Deaf-blind as Mexico (NCDB, 2013), but not nearly as many times its population. Bowen and Probst (2023) sustain the claim that teachers must have a specific skill set to effectively work with d/Deaf students with additional disabilities (which includes d/Deaf-blind children). Still, not enough teachers are qualified to do so given the growing number of d/Deaf and otherwise disabled students, and the contrasting decline in available preparation programs, even in the United States.

Adding to the requirements Bowen and Probst (2023) established for educating d/Deaf students with multiple disabilities, Olayi et al. (2023) suggest that for proper inclusion in the classroom, deaf-blind students should be provided with a special educator with Braille and (tactile) sign language skills, a teacher committed to serving those with special needs, a braillist, a sign language interpreter, and a caretaker. McKinney (2022) described a success story where the academic needs of a deaf-blind student, Ivey, were met through different communication methods, namely English-based signs, tactile symbols, Braille, and some spoken English. The student also had a one-on-one intervener (someone who specializes in aiding the deaf-blind with several tasks and is well-versed in alternative communication methods) to aid her in the classroom. The author highlights her own lack of experience and qualification for teaching the d/Deaf-blind before getting to teach Ivey, despite having years of experience with Individualized Education Programs and multiple degrees in special education. She also emphasizes the fact that having multiple disabilities generates unique conditions not experienced by those with only one of them, which calls for specialized services rather than ones that address the vision or hearing needs of the child (McKinney, 2022) solely.

A deaf-blind college student who participated in a study conducted in Ghana by Dogbe and Anku (2024) mentioned feeling like she had to carry her Braille machine everywhere for people who could not sign to her because although tactile sign language is quicker and more convenient for her, not enough people knew how to sign. An assistant lecturer in the same study stated that "including the deaf-blind learner in higher education warrants some essential resources, and it is time-consuming. The student needs assistive devices such as a braille machine and refreshable braille display, tape recorders, and note takers" (Dogbe and Anku 2014:128), further highlighting the special requirements that including a deaf-blind student in the classroom implies. All these examples indicate that teaching a d/Deaf-blind student requires plenty of resources and personalized services and that learners might benefit from having as many tools and communication methods available as possible.

Riccobono and Morrow (2022) conducted a survey of State Deaf-blind projects in the USA, which pointed out how the mere existence of these institutions did not guarantee that students would get access to a qualified intervener since there are not enough intervenors to meet the demand for their services. The authors mention that barriers keeping potential interveners from earning their qualifications include a severe lack of financial incentives, the long and tedious process of completing a portfolio, the general lack of interest in special education, and the retention of interveners due to the same reasons (Riccobono and Morrow, 2022). It is important to remember that this is the case in a country where several resources exist for the d/Deaf-blind. In Mexico, beyond a simple lack of specialized institutions or qualified professionals, a bulletin by the Mexico City Human Rights Commission (CDHCM, 2020) stated that there is not even specific data about deaf-blindness in Mexico other than what can be inferred from the intersection between data on blindness and deafness. This represents another obstacle for those seeking to assess and solve this issue.

In a study conducted in South Africa, which has similar struggles as Mexico regarding the lack of resources for the d/Deaf-blind, Manga and Masuku (2020) found that educators of d/Deaf-blind children struggled with teaching them due to under-preparedness and lack of support. In the words of one of the teachers interviewed, "It is a barrier because even though they can't see, they can't talk, they can't hear, you still have to

teach them sign language… But they won't understand" (Manga and Masuku, 2020). Similarly, d/Deaf-blind participants of a study done in Spain by Rodríguez-Jiménez et al. (2022) said that educational centers lacked the appropriate resources to cater to their needs, using oral language when teaching, which hindered their access to curricular content.

The lack of specialized tools enabling d/Deaf-blind children to access education remains a global problem due to their high costs and specific training requirements. This issue extends beyond the demographic of d/Deaf-blind students, affecting those with various other disabilities. A 2018 study conducted in the Czech Republic highlighted this problem, revealing that students with disabilities face a 1.5 times higher chance of experiencing unsuccessful completion of university studies (Mazouch et al., 2018). Ideally, d/Deaf-blind children should have access to specialized materials and teachers with adequate preparation as Teachers of the Deaf With Disabilities. Still, particularly in the context of Mexico, the existence of infrastructure for d/Deaf-blind children is alarmingly poor. According to 2018 data on the Mexican education system, Deaf-blind children between 5 and 17 years old have a 33% reduced probability of school enrollment than children with no disabilities (WFDB, 2024). Mexico also had one of the highest gaps (15%) between the percentage of deaf-blind children enrolled in school and that of children with other disabilities (WFDB, 2024), indicating a need for solutions specific to deaf-blind children in the country. The lack of said solutions is a potential factor for school dropout of children with the condition, alongside the inexistence of communication tools such as Braille typewriters for Spanish-speaking students and professors.

An international survey carried out by the World Federation of the Deaf-blind, or WFDB (2023), found that the primary school net attendance of children with deaf-blindness was 20%, but 75% for non-disabled children overall. Moreover, even for 20% of deaf-blind children who do attend primary school, it is a challenge to measure the quality of the education received. The same survey found that deaf-blind children were about three times less likely to be classified as "developmentally on-track" as per the World Childhood Index; that is, only 20% of deaf-blind children fit the literacy-numeracy, physical functioning, social-emotional development, and learning criteria expected of their age group. These numbers were also found to correlate to the country's income, ranging from 40% deaf-blind children who are developmentally on-track in upper-middle-income countries to only 13% in lower-income ones (WFDB, 2023).

Thus, the development of a low-cost, intuitive tool based on AI techniques and additive manufacturing that does not require previous knowledge from non-disabled people (and is adapted to the way the 64 combinations in 6-dot Braille are used in Spanish, including characteristic letters such as ñ, á, é, í, ó, ú and ü) will be particularly useful to further the inclusion of the d/Deaf-blind in a country lacking resources and visibility for the condition. This paper offers an alternative to bridge the gulf between what is needed and what is available to d/Deaf-blind students and facilitate their integration in Mexico into non-specialized schools through the development of a bidirectional Braille-speech communication system based on the design of a CNN for speech recognition. The development of an algorithm capable of performing both text-to-speech and Finger-Braille-to-text conversion is presented as well, allowing for real-time communication with no intermediaries to serve as a bidirectional tool for deaf-blind students.

MATERIALS AND METHODS

Several stages were followed in the development of the proposed device, which will be described in the following subsections. First, a Signal Acquisition process was required to train an AI algorithm to enable the device to recognize speech. The acquired signals needed to be processed to extract the pronunciation variations existing in Spanish-speaking persons. Then, a Braille-Speech Conversion Model encompassing both the speech recognition algorithm and the Braille-text conversion code was generated. Afterward, the complete system was integrated into a physical prototype fabricated with additive manufacturing techniques.

Signal Acquisition

To train the CNN designed for speech recognition, it was necessary to build a database containing audio samples. Due to time constraints, the scope of this database was limited to audios of single letters. Therefore, each of the 24 volunteers was asked to slowly recite the Spanish alphabet, and a sample of the noise in the room at the moment was recorded as well. All recordings were done in a single, empty room using a condenser microphone and a commercial digital audio workstation. Prior to the acquisition of each volunteer's speech data, they were asked to sign a consent form for the use of their voice and perform a couple of tests (namely saying the letters "f," "j," and "p") to adjust the gain and noise gate settings to ensure that no clipping would occur, and no unnecessary noise would be recorded. The sample rate was set to 44.1kHz throughout the entire process. Personally identifiable information such as name, age, or gender was not saved along with the samples, making all audio anonymous. Such information, however, was collected separately for analytic purposes to determine whether any demographics were underrepresented in the data set. Race was not assessed as a factor.

Signal Processing

The raw data collected was edited to last exactly two seconds per letter, with the useful data roughly in the middle of each clip. Each letter was then exported as a separate audio file, with the name of the letter contained and the number of the volunteer to facilitate postprocessing. Since the data collected was insufficient to properly train a neural network (it amounted to 22.4 minutes of significant data once the pauses were cut out), the original 672 audio clips were modified in three different ways as a data augmentation method.

The first way involved pitch change by raising or lowering the frequency of the audio by two semitones; the second consisted of changing the speed to 120% and 70%, and finally, the third was achieved by performing a convolution of each audio with the room impulse response (RIR) of six different spaces. Added to the original files, this yielded a total of 7,392 samples or approximately four hours of audio data. Pitch and

speed change required the use of the library "librosa" (McFee et al., 2015), while the last type of data augmentation utilized the room impulse response database generated by MIT's *Computational Analysis Lab (Traer* and McDermott, 2016). However, only six RIRs were extracted from this library: the inside of a car, an office, a hallway, a cafeteria, an atrium, and a theater. Performing the convolution of the audios with these RIRs yielded new files that simulated the effect of recording in these different spaces. The new files were labeled accordingly, and their spectrogram was obtained through a Fast Fourier Transform. Given how CNNs excel at classifying images, the team opted for using images of the spectrograms instead of using the audio directly.

Database Description

After the data augmentation process, the final database consisted of 7,392 images. Figure 2 shows an example of the letters represented in Fourier space, plotting frequency against time. These images were then divided into folders according to their class. These included the 27 letters of the Spanish alphabet as well as a sample of the recording room with no speech produced, intended to help the algorithm discern between useful data and background noise. A holdout validation process was carried out, so the samples were split into three additional folders: train, validation, and test, according to the volunteer number on the sample. 70% of the data was reserved for training, 25% for validation, and the remaining 5% for testing the CNN.

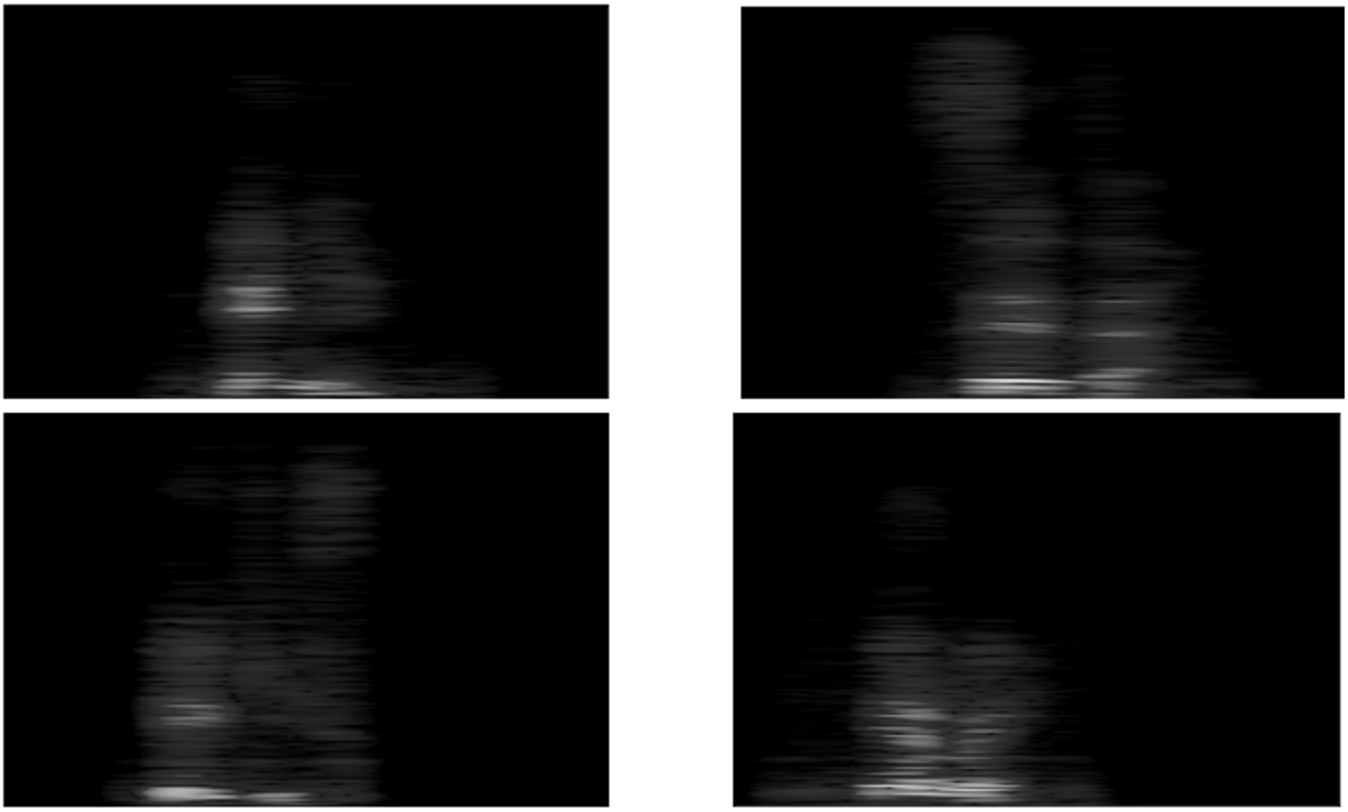

Figure 2: Spectrogram of letters Ñ (top left), Z (top right), X (bottom left) and R (bottom right)

Physical Prototype

As for the device itself, the 3D model was created using Computer Aided Design software and was then printed in polylactic acid (PLA) filament. The design is essentially a Braille keyboard with added coin vibration motors and hand rests. This design (depicted in Figure 3) was chosen since the layout of the keys closely resembles that of a Braille typewriter, aiming to aid the d/Deaf-blind user through familiarity. The hand rests added to allow the hand to adopt a comfortable position when touching the Braille keys while simultaneously keeping the intermediate phalanges of the index, middle, and ring fingers in contact with the coin motors, which vibrate in response to voltage changes to transmit Braille the way the user would receive it when communicating in Finger Braille. Key design elements were considered for its development, utilizing computer-aided design and additive manufacturing to generate the prototype shown.

In Figure 3, keys 1-6 are for writing Braille, as the Perkins machine shown in Figure 1. The key labeled "M" activates the microphone for Speech-to-Braille translation; the key labeled "T" is used to indicate the end of a Braille character, and the "S" key is used to initiate typing and mark the Braille message as complete before performing Braille-Speech conversion. Finally, elements "a" through "b" are the coin motors that transmit the message in Braille to the deaf-blind person.

Other relevant materials used besides PLA were push buttons, coin vibration motors, and polyester foam to help isolate the vibrations of each motor.

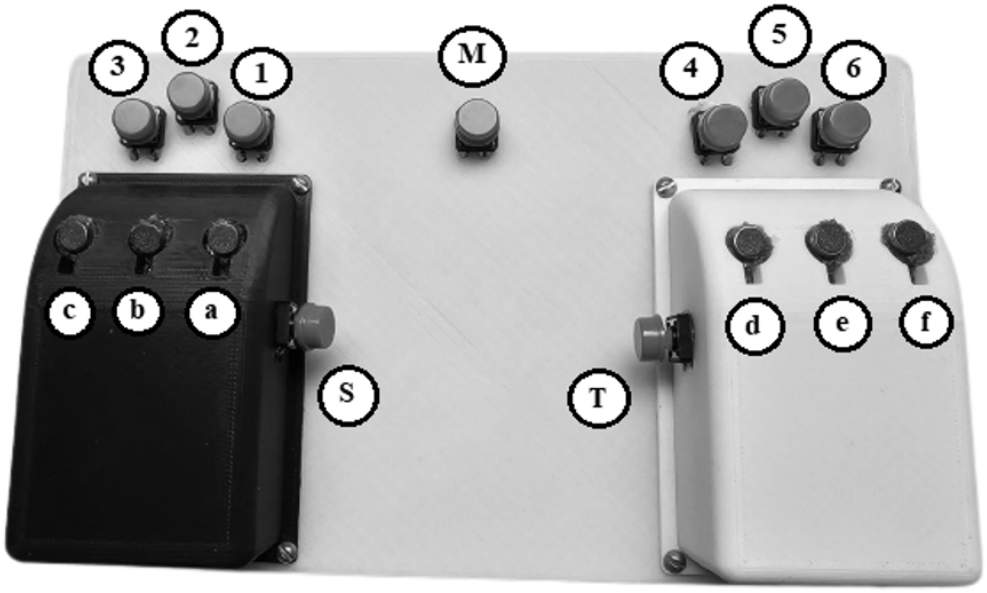

Figure 3: Fully assembled prototype

Braille-speech Conversion Model

To allow for bidirectional communication, both translation pathways were developed separately. Prior to the making of the physical prototype, the Braille-to-text pathway was developed using a computer keyboard as Braille input, likening certain keys to each of the six dots in a Braille cell. Then, since several keys were pressed simultaneously, they were rearranged alphabetically. At that point, a Python dictionary allowed the program to decode the Braille message and join it into a single string. Text-to-Speech was then implemented to convey the message to the hearing party. Once the physical device was ready, the input was simply changed to receive a Serial message sent by Arduino, which controlled the physical buttons and actuators. Three "control buttons" were implemented in the device to facilitate processing: one for activating the microphone, one for marking the end of a character, and one for activating typing mode and sending finger Braille messages. This enabled the code to run smoothly and without interruptions.

As for the speech to Braille pathway, a CNN was developed and trained using the dataset described above. Training is performed to obtain adequate *weights* between a neuron (the smallest processing unit within the CNN) and its inputs. Weights denote the strength of the link between an input and a certain neuron (Dongare, Kharde, and Kachare, 2012), where inhibitory connections are represented by negative weights and excitatory connections by positive ones. Weights are randomly initialized, after which an iterative process of analyzing the loss and updating the weights begins.

The loss value was obtained using categorical cross-entropy, which can be defined as shown in Equation 1 (Rusiecki, 2019):

$$E_{CC} = -\frac{1}{N}\sum_{i=1}^{N}\sum_{c=1}^{C}\left(p_{ic}\,loglog\left(y_{ic}\right)\right) \quad (1)$$

In equation 1, E_{CC} is the Categorical Cross Entropy loss, N is the number of label/value pairs in the training dataset, y_{ic} is the output, and C is the number of categories (Rusiecki, 2019). To improve the performance of CNNs, a backpropagation algorithm can help reduce errors by sending feedback to the previous layer. Mathematically, this process can be described by Equation 2 (Li et al., 2012).

$$x_{k+1} = x_k - \eta_k g_k \quad (2)$$

where *xk* is a matrix containing current weights and thresholds, η_k is the model's learning rate, and g_k is the current function's gradient (Li et al., 2012). Kingma and Ba's (2015) optimizer, Adam, was selected to optimize the learning process. Adam stands for Adaptive Moment Estimation; it estimates the previous momentum and gradient to update the learning parameters in every iteration. It also adapts the learning rate (essentially the magnitude of the changes made to the model with each iteration) for every parameter, depending on the momentum and gradient. To estimate the momentum, Adam uses Equations 3 and 4.

$$m_t = \beta_1 m_{t-1} + \left(1-\beta_1\right) g_t \quad (3)$$

$$y_t = \beta_2 v_{t-1} + \left(1-\beta_2\right) g_t^2 \quad (4)$$

where m_t and v_t are moving averages, g_t is the gradient of the current mini-batch, and β_1 and β_2 are hyperparameters with values of 0.9 and 0.999, respectively. The network architecture consists of four convolution layers of different dimensions with a 10x10 filter; these layers have a Rectified Linear Unit (ReLU) activation function, which eliminates all the negative values, preserving only the positive ones. The equation of ReLU is shown in Equation 5 (He, 2018).

$$f\left(x\right) = \left(0, x\right) \quad (5)$$

Each convolution layer is followed by a *max pooling* layer that obtains the main characteristics of the image by calculating the maximum value of every image matrix. After this filtering stage, a *flattened* layer reshapes the image into a string. Afterward, a dense layer of 512 neurons with a ReLU is the last stage before the output layer, which, a dense layer of 28 neurons with a softmax activation function to obtain 28

categories corresponding to every letter in the Spanish alphabet plus a "silence" category. The *softmax* equation is shown in Equation 6 (Banerjee et al., 2021).

$$softmax(z)_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}} \quad (6)$$

where z_i represents the input vector, and zj contains the values from the neuron output layer. The softmax activation function calculates the relative probabilities of each class, so the input will be categorized as the class with the highest probability. The proposed CNN structure is depicted in Figure 4.

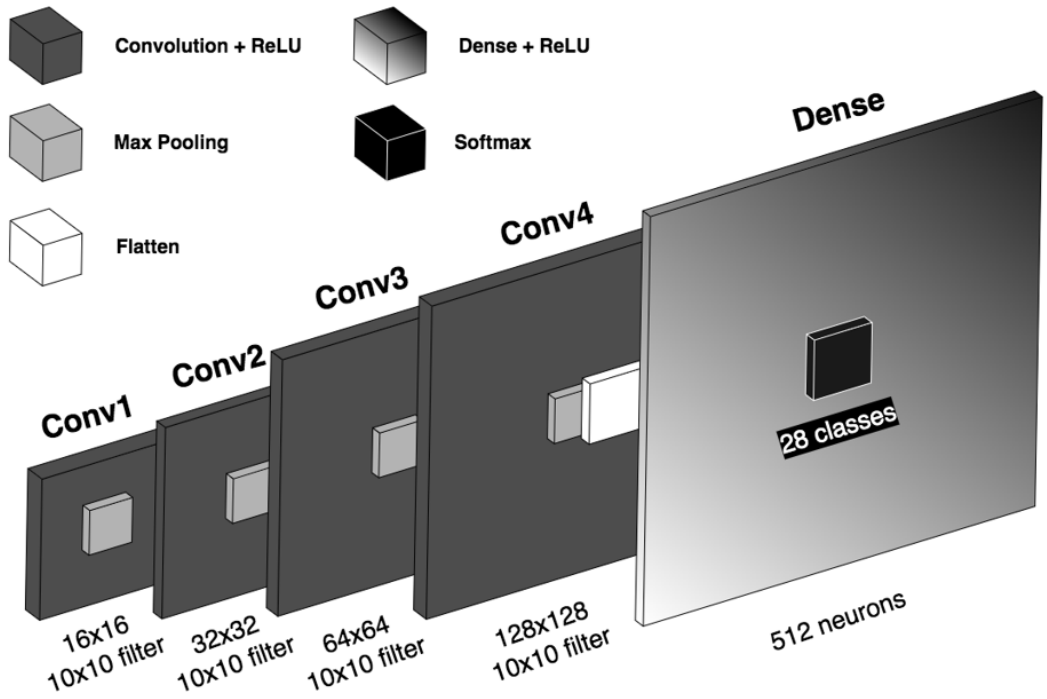

Figure 4: Architecture of the CNN

This algorithm delivered the spoken input as a String, which was then processed in Python. It used a dictionary like the one used for Braille to text but converted characters to the numbers of their corresponding Braille dot patterns. The Braille message was then sent to an Arduino board through a Serial port to deliver the instruction to activate or deactivate each vibration motor.

Mini-batch gradient descent was chosen over other methods for training the algorithm since it performed better over numerous training sessions. The final weights for the model were obtained with 150 epochs, which was empirically determined as the optimal number given that it allowed the model to converge without overfitting the weights to the training data. 5 steps were used per epoch, with a batch size of 17 samples for training and 6 samples for validation.

For this process, the training sample (images that the algorithm has never worked with) is run through the network and multiplied by the weights to obtain the highest output node (the category or class). It is then compared to the validation sample (images whose class the network already knows), and the weights are adjusted to improve the prediction. This process is repeated in every epoch until the prediction has the required accuracy.

The functioning of the device is shown in Figure 5. An interaction begins with the deaf-blind user typing in Braille (number 1 in Figure 5). Afterwards, the Braille message is translated and played on built-in speakers (number 2). Then, the hearing person replies by pressing the microphone activation button and speaking (3). Lastly, the message is translated by the CNN and text to Braille algorithms before being transmitted to the user via integrated vibration motors (4). This cycle is simply an example of how an interaction could occur, but Braille typing and spoken input can occur in any order if needed.

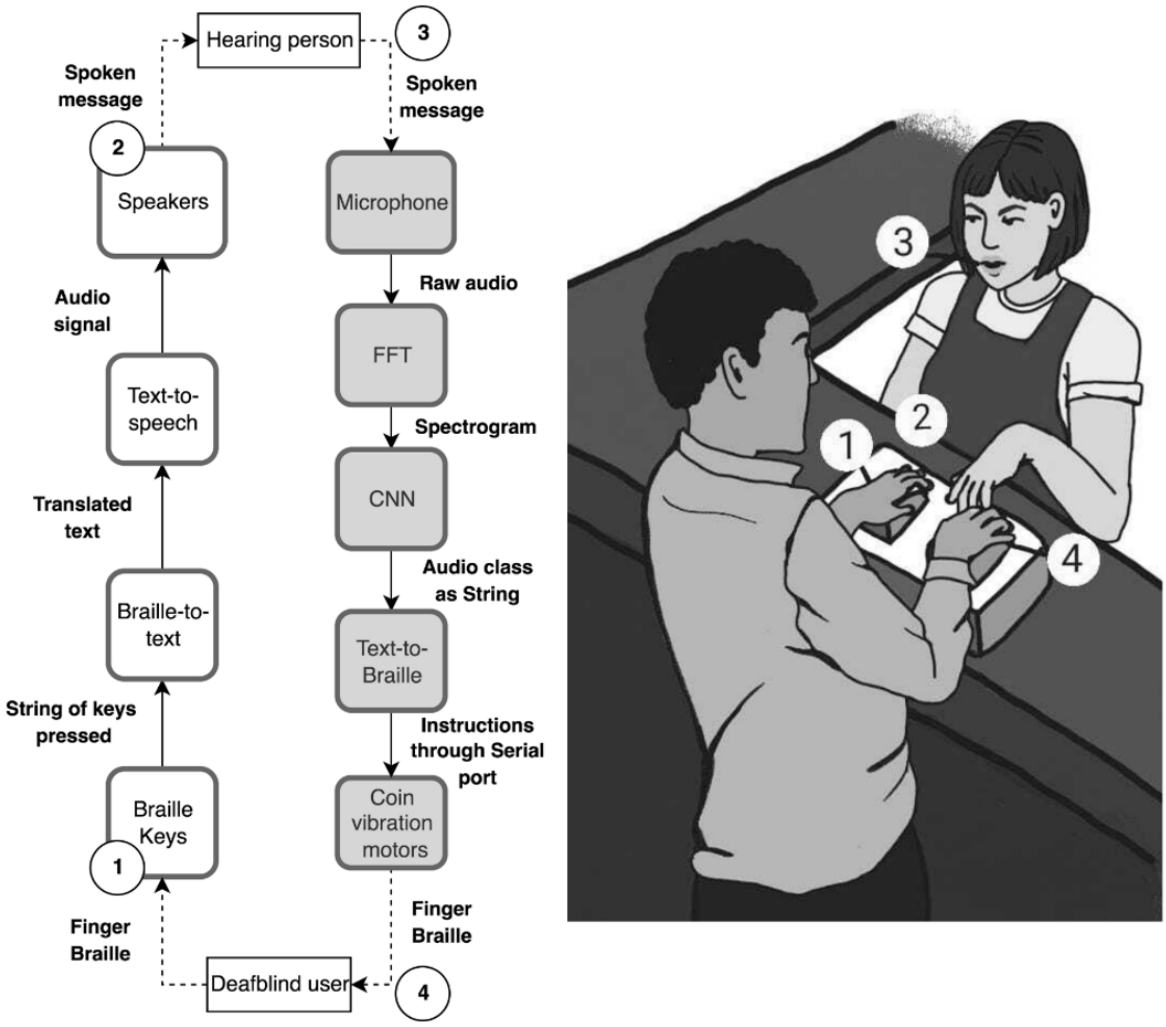

Figure 5: Diagram of device usage

RESULTS

Before assessing the performance of the device as a whole, the results of the CNN generated by the authors are presented. The accuracy graph of this model is shown in Figure 6, and its corresponding loss graph in Figure 7.

The model's accuracy with the training dataset approached 80%, while the classes of testing data (which the model had not learned from) were predicted with an accuracy of 60%. For reference, the team also tested Google Cloud Speech-to-Text. Since the authors' CNN was not designed to translate full sentences but only individual letters, Google's Speech-to-Text was tested only for its ability to recognize individual letters. The AI was used to predict the class of letters in the Spanish alphabet a total of 135 times, having a 60.74% accuracy, with 16.3% incorrect predictions and 22.96% instances of failure to classify speech at all. It must be noted that most of this

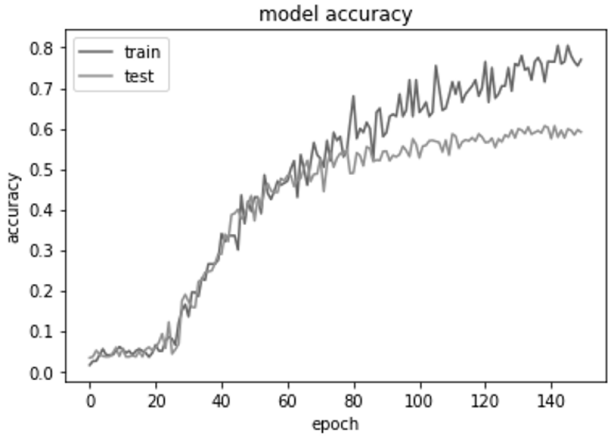

Figure 6: Accuracy graphed during training of the CNN

algorithm's mistakes stemmed from its being mainly designed to identify words instead of isolated letters. Therefore, when certain letters had the same sound as a word (for example, the Spanish pronunciation for the letter "c" and the word "se," "z" and "seta," or "d" and "de"), Google's algorithm often picked the word over the letter. Letters that did not have a homophone were identified correctly more often.

Three different trials were performed to test the device itself and the integration of its translation software. The first measured the performance of random subjects (first-time users) who were taught a few Braille letters and then asked to identify them using the device. This assessed the device's text-to-Braille algorithm and the adequacy of the Braille transmission system. The second trial tested the comprehension capacity of a deaf-blind user through the device, testing the Braille transmission portion of the algorithm. The third trial evaluated the written accuracy of a user, evaluating the ease of use of the physical prototype as well as the Braille-to-text communication pathway.

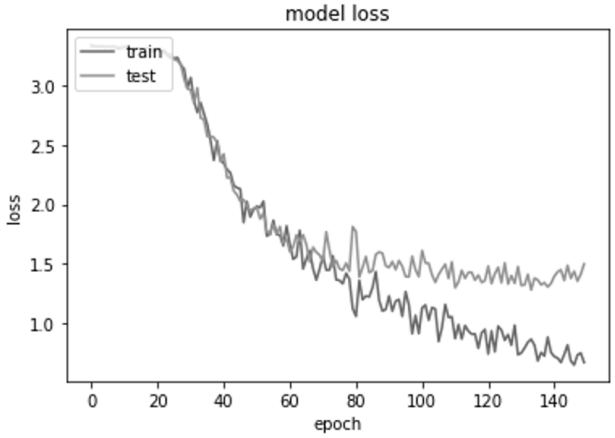

Figure 7: Loss graphed during training of the CNN

First Trial – Usability

20 subjects, including teachers, students, and parents at Tecnológico de Monterrey, were randomly chosen to learn 4 letters in Braille: a, b, c, and d. Age and gender varied among subjects but were not registered. All participants were sighted and hearing to facilitate this trial stage and guarantee that the subjects had no prior experience with Finger Braille. After approximately 2 minutes of learning the letters, they were told they would feel 4 letters in random order on the device and that they may or may not appear more than once. They were instructed to say the letters they perceived as they felt the vibrations. The point of this trial was to prove that a person without any previous experience with Finger Braille or Assistive Technology could easily adapt to the device and that the Braille transmission method used was adequate. From the trial, 3 out of 20 subjects made 1 mistake, which could be caused by the lack of concentration of the subject towards feeling the vibration on their phalanges. One of the subjects who made a mistake reported not being able to place his fingers in the required position due to his hands being too large for the device's design. He was asked to repeat the procedure, this time placing his fingertips on the coin vibration motors instead of his phalanges, and he got them all correct (the second attempt was not reported as part of the 20 samples). This suggests that the design and measurements of the hand rests are a possible area of opportunity instead of the algorithm itself or the idea of using vibration motors for this application. Apart from the mistakes, the other 17 subjects, with a perfect score, demonstrate that the ability to read Braille from the device can be easily learned. Deaf-blind people may have an advantage in learning how to use it since they are more used to employing their sense of touch to gather information, and many will already have at least a basic knowledge of Braille.

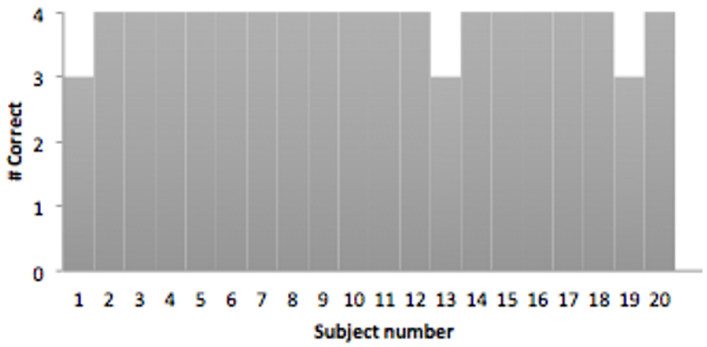

Figure 8: Number of letters identified correctly per subject

Using the Wald method (described by Equation 7) and counting each letter as a separate test (adding up to 80 binary instances in total), the confidence interval of this sample is 0.963±0.042 at a confidence level of 95% (Montgomery, 1991).

$$CI = \hat{p} \pm Z_{\frac{\alpha}{2}} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad (7)$$

where CI is the confidence interval, "$\hat{p}$" is the point estimator of the parameter "p" and equals the number of nonconforming observations over the total of the sample, "n" is the size of the sample, and $Z_{\alpha/2}$ is the Z value at half of the tolerance α (which was equal to 5 given the confidence level).

Second Trial – Communication

The second trial aimed to demonstrate effective communication between a user with full visual and hearing capabilities and a deaf-blind user. In this case, the non-disabled user says a command out loud to the device to convert speech to text and text to Braille. After the conversion of the sentence, the "deaf-blind" user (since the team was unable to find a d/Deaf-blind volunteer, this consisted of a hearing and sighted person wearing a blindfold and noise-canceling headphones to nullify possible auditory or visual stimuli) complies with the command given. This trial was performed 20 times with different kinds of simple, short commands; in all of them, the command was understood and followed exactly. This trial demonstrates that phrases can be communicated by the sender to the "deaf-blind" user, verifying the integration of all systems in the prototype and the viability of communication.

Commands were issued in Spanish, but their English translation is presented in Table 1, along with the result.

Command	Result
Touch your nose	Success
Raise your left hand	Success
Smile	Success
Turn to the right	Success
Raise a finger	Success
Touch your mouth	Success
Nod	Success
Stand up	Success
Point down	Success
Touch your ear	Success
Touch the headphones	Success
Clap	Success
Make a fist	Success
Touch your forehead	Success
Spin in place	Success
Touch the table	Success
Lift your pinky	Success
Touch your right shoulder	Success
Take off the headphones	Success

Table 1: Commands and responses obtained in the first trial

The subject was not asked whether they correctly identified every individual letter, but had they not, it appears the context was sufficient to allow them to understand and respond to the commands.

Third Trial – Accuracy

The final trial was to test the potential typing accuracy of a deaf-blind user. A pangram (a phrase that contains all the letters in a given alphabet) was dictated, and the times a mistake happened were counted. The pangram in Spanish was: "*Zumba la wifi yoyo jala con gofres él extraño virus huirá pero los kilos quedarán*". For this last trial, the objective was to detect if the device's hardware or software had any noticeable flaws during translation, as well as verify if it was easy to use for someone who already knew Braille. Two users familiar with Braille were asked to type the pangram word by word, including written accents and the uppercase Z, using no abbreviations. Accuracy was measured by calculating the number of Braille dots per word and comparing the total to the dots typed correctly by the user. Both present and absent dots were counted, making up a total of 6 points per character. For example, letters h (⠓) and r (⠗) differ by one point (dot 3), but letters s (⠎) and l (⠇) differ by two: dot 1 and dot 4. Each letter was counted as six dots, except for the initial Z, which requires an additional modifier (6 more dots) to become a capital letter.

User 1 was 95.833% accurate, and user 2 was 98.529%, out of a total of 408 dots in the phrase. Figure 9 compares the number of points gotten per word by each user, along with the total points for reference.

To further facilitate understanding of how mistakes occurred and how they were measured, Table 2 shows the specific Braille patterns expected per word and those written by each user. The number of points deducted (labeled "dots missed") is also presented next to each user's Braille output. Additionally, characters where the user made a mistake are underlined. In cases where a full character was omitted, 6 points were deducted, and the space was left blank in the table.

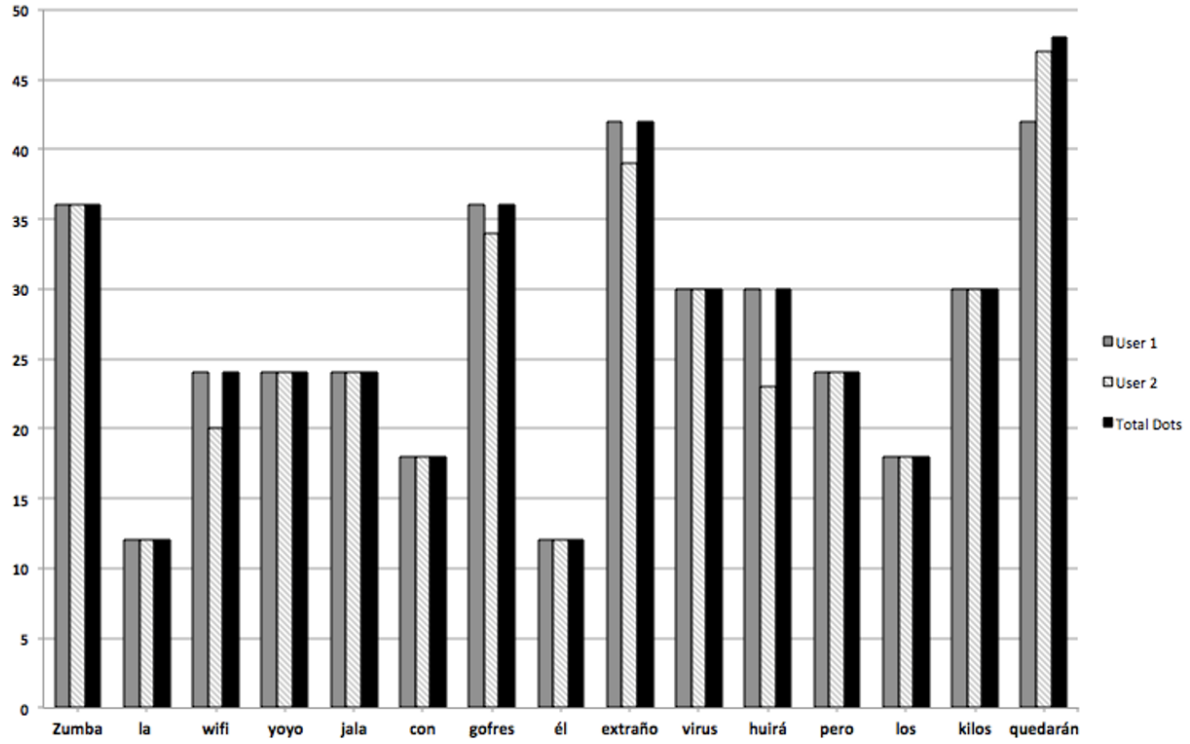

Figure 9: Correct dots per word by the user

Word	Expected Braille	User 1 Braille	Dots missed	User 2 Braille	Dots Missed
Zumba	⠵⠥⠍⠃⠁	⠵⠥⠍⠃⠁	0	⠵⠥⠍⠃⠁	0
la	⠇⠁	⠇⠁	0	⠇⠁	0
wifi	⠺⠊⠋⠊	⠺⠊⠋⠊	4	⠺⠊⠋⠊	0
yoyo	⠽⠕⠽⠕	⠽⠕⠽⠕	0	⠽⠕⠽⠕	0
jala	⠚⠁⠇⠁	⠚⠁⠇⠁	0	⠚⠁⠇⠁	0
con	⠉⠕⠝	⠉⠕⠝	0	⠉⠕⠝	0
gofres	⠛⠕⠋⠗⠑⠎	⠛⠕⠋⠤⠤⠤	2	⠛⠕⠋⠗⠑⠎	0
él	⠓⠊	⠓⠊	0	⠓⠊	0
extraño	⠢⠭⠞⠗⠁⠻⠕	⠢⠭⠞⠗⠁⠤⠕	3	⠢⠭⠞⠗⠁⠻⠕	0
virus	⠧⠊⠗⠥⠎	⠧⠊⠗⠥⠎	0	⠧⠊⠗⠥⠎	0
huirá	⠓⠥⠊⠗⠷	⠓⠥⠊⠗⠤	7	⠓⠥⠊⠗⠷	0
pero	⠏⠢⠗⠕	⠏⠢⠗⠕	0	⠏⠢⠗⠕	0
los	⠇⠕⠎	⠇⠕⠎	0	⠇⠕⠎	0
kilos	⠅⠊⠇⠕⠎	⠅⠊⠇⠕⠎	0	⠅⠊⠇⠕⠎	0
quedarán	⠟⠥⠢⠙⠜⠷⠝	⠤⠥⠢⠙⠜⠷⠝	1	⠟⠥⠢⠙⠜⠤⠝	6

Table 2: Detailed Braille output comparison for the third trial

DISCUSSION

As explained in the results section, the prototype successfully helped users without any Braille background to quickly learn and understand different letters. This trial proved that the device could be potentially used by people in the process of becoming deaf-blind to facilitate the learning of Finger Braille. The device could also be used by d/Deaf-blind students, as the second trial proved that users could understand simple commands without visual or auditory stimuli, using a neural network that translates full sentences. The final trial demonstrated that users with some Finger Braille background could write full sentences and all the Spanish alphabet letters with great accuracy, which means that deaf-blind people can use the device to establish communication with people without sensory disability.

One of the limitations of this study was the team's inability to find d/Deaf-blind volunteers. As stated in previous sections, Mexico severely lacks infrastructure in this regard, which made it hard to know where to contact potential users in the first place, so the very problem hindered the project it attempts to mitigate. The next step for this project is to test the prototype with d/Deaf-blind people to consider the cultural and experiential aspects of Deaf-blindness as a Culturally Deaf-blind user would experience the use of the device differently due to their unique experiences with Deaf-blind culture.

Another possible limitation of adopting this prototype in schools is that the students must keep their hands on the device to avoid missing out on information during the lesson. This could hinder taking notes. One way to solve this situation is to adapt the prototype to wearable gloves using haptic technology to allow the d/Deaf-blind user to fully use their hands. Alternatively, the device could be adapted to allow for simultaneous rather than alternating speech-to-Braille reception and Braille-to-Text conversion, connecting the system to a laptop to store the notes without forcing the d/Deaf-blind student to stop "listening" through the vibration motors when switching to a note-taking method.

Compared to existing technologies, an area in which the device is lacking is coverage since this project focuses on severe to profoundly deaf and blind users. Estimates place the deaf-blind population at up to 15 million people worldwide (Kassem et al., 2022), but as previously stated, deaf-blindness exists in a spectrum of visual and auditory impairment, and some deaf-blind people have CIs, which somewhat re-establish hearing as a possible communication pathway. These users could benefit from technologies directed at solely blind individuals, but the potential impact of implementing CIs or disregarding the existing degree of hearing impairment should not be overlooked.

Liu et al. (2023) proposed a wearable Braille typing system utilizing triboelectric nanogenerators (TENG) to bypass the need for an additional power supply, which could be a downside to the current project, given the long consecutive periods during which a d/Deaf-blind student attending a regular school would have to use the device proposed in this work. Substituting the push buttons for TENGs or otherwise reducing the system's energy requirements could help extend battery life to minimize this problem.

Vincent et al. (2021) implemented a method of face-to-face communication between d/Deaf-blind users and a hearing and sighted layperson using a Focus 40 Blue 5th gen Braille display connected to a smartphone. The applications of their method and the present project are quite similar, differing mainly because the cost of the Focus 40 Blue alone exceeds USD 3,000 (Vincent et al., 2021), making it an inaccessible option for many schools and families in Mexico.

The trials also helped to identify areas for improvement. For example, in the first trial, one of the subjects could not feel the vibration motors because they were not in direct contact with their phalanges, so there is still room for improvement in the design of the hand rests or, as stated before, adapt the prototype to a wearable device to ensure continuous contact. The neural network also has room for improvement to increase the prediction rate of the alphabet letters. As mentioned in the results section, the prototype can integrate third-party AI algorithms such as Google Cloud speech recognition. This could be very helpful in classrooms for d/Deaf-blind students to follow the lesson in real-time, but the downside is that they would have to keep their hands on the device throughout the lesson.

There are additional areas in which improvements are being considered: design, communication process, and portability. The tests comparing both speech recognition algorithms suggest two possibilities: the device, paired with a commercial algorithm like Google's, can guarantee a high accuracy for communication. However, it might be advisable to develop a more sophisticated algorithm specializing in identifying individual letters for the application of individuals learning Braille on their own with the aid of the device. This could be achieved by generating a more comprehensive database to train the CNN presented in this work to recognize different types of voices and accents in multiple environments.

CONCLUSION

The inclusion of minorities is a complicated issue. This is especially true for particularly small communities, such as the Deaf-blind. The smaller a community is, the fewer financial and social incentives companies and governments will see to develop solutions tailored to their needs, which is why they often go unaddressed. The designed device represents an additional tool for this group as well as people without severe sensory impairments since anyone can use the device. It can therefore aid those who are gradually becoming deaf-blind to learn finger Braille during their transition into deaf-blindness; be a real-time communication tool to allow profoundly deaf-blind users to gain more independence; grant d/Deaf-blind students access to hearing and sighted institutions; or make it easier for people without sensory impairment (including intervenors, family members, friends, public servants, healthcare professionals and anyone with interest in accessibility) to learn Finger Braille. Despite the limitations described in prior sections, the device showed great translation accuracy and ease of use, which indicates its viability for the applications above.

In the future, the device could be tested against existing assistive technology for solely d/Deaf users, as a form of automatic subtitles to what is being said in a hearing classroom, or as a form of Alternative Communication for non-verbal autistic people and other sectors who have trouble speaking. The physical disposition of the device can also make it easier to type than a traditional keyboard for those with limited mobility since all keys are designed to be in contact with the corresponding fingertip in a resting hand position. In other words, small variations to the device's design and algorithm could address the problems of vastly different sectors in future projects. Still, it is imperative to get direct feedback from d/Deaf-blind users and educators of the d/Deaf-blind to validate any future changes to the device to optimize it for its original purpose.

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DOES ENTREPRENEURIAL ECOSYSTEM DRIVE ENTREPRENEURIAL INTENTION AND STUDENTS' BUSINESS PREPARATION? LESSON FROM INDONESIA

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ABSTRACT

Finding a way out for new business creation has been a global issue, and the Indonesian government has responded to this issue by promoting entrepreneurship programs for students. For this matter, understanding the role of the entrepreneurial ecosystem can be used to design and promote business for university students. This study employed structural equation modeling with partial least squares to raise understanding among variables. This study involved an entrepreneurial ecosystem to explain the intention of Indonesian university students to do business. The findings indicate that the entrepreneurial ecosystem robustly links with students' entrepreneurial intention and new business creation. This study confirms that access to finance, government programs, support, access to physical infrastructure factors, education, and training factors are crucial for determining Indonesian university students' business. The theoretical and practical implications were provided in this research.

KEYWORDS

Entrepreneurial ecosystem, entrepreneurial intention, prepare for business, university students

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Highlights

- *Enhancing the number of entrepreneurs from university graduates will help to overcome the unemployment issue and provide new job creation.*
- *An entrepreneurial ecosystem can promote entrepreneurial intention and students' business preparation.*
- *The entrepreneurial ecosystem consists of a ccess to finance, government programs, and support, access to physical infrastructure, and education and training.*
- *The government can consider an entrepreneurial ecosystem to boost entrepreneurial intention among university students.*

INTRODUCTION

The entrepreneurial intention has been attracted among Indonesian policymakers and scholars in recent years because of its role in driving entrepreneurial activities (Shahab et al., 2019; Doanh et al., 2021). Most scholars on this subject believe that entrepreneurial activities have been seen as a means of promoting economic development and economic welfare by creating new jobs (Hessels and Naude, 2019; Neumann, 2020). However, it is intriguing that Indonesia has struggled with the increase in the number of entrepreneurs. Among Singapore, Malaysia, and Thailand, Indonesia has the lowest desirability to be entrepreneurs compared to the total population (3.4%) (Wardana et al., 2021).

To deal with this, the Indonesian government promotes a program to enhance the number of entrepreneurs, for example, through students' entrepreneurship programs (Iskandar and Said, 2021). The program aims to increase the entrepreneurial capacity of Indonesian students in running and developing businesses. Furthermore, the Indonesian student entrepreneurship program emphasizes funding for student business development and the Indonesian student startup acceleration, which provides an acceleration scheme for students with digital startup businesses.

In addition to developing supporting programs for entrepreneurship, scholars and policy researchers should be aware of factors driving entrepreneurial intention and business preparation for students. The majority of scholars take a point the psychological factors,

such as self-efficacy (e.g., Badri and Hachicha, 2019; Doanh and Bernat, 2019), entrepreneurial mindset (Warraich et al., 2023; Wardana et al., 2021), and subjective norms (Azim and Islam, 2022; Nguyen et al., 2023) as the dominant in promoting entrepreneurial intention for students. Also, some researchers have investigated the relationship between entrepreneurship education and intention for business (Jena, 2020; Badri and Hachicha, 2019). Recent studies on this theme elaborated on the role of mindset mediating intention and business preparation (Wardana et al., 2021; Kwapisz et al., 2021).

There is little research investigating the entrepreneurial ecosystem on entrepreneurial intention and its impact on students' business preparation. In the existing studies, for instance, Wurth et al. (2021) criticize the role of the entrepreneurial ecosystem as a concept to synthesize a variety of research streams, and it needs government attention. Additionally, Ratten (2020) has attempted to link the Coronavirus and business issues from the perspectives of the entrepreneurial ecosystem. The recent study by Elnadi and Gheith (2021) has linked the relationship between the entrepreneurial ecosystem, self-efficacy, and intention in the context of Saudi Arabia, while Lu et al. (2021) focused on the entrepreneurial ecosystem in terms of education in the context of Chinese students. However, no studies have specifically elaborated on the entrepreneurial ecosystem in students' business preparation. Hence, this research fills the gap and aims to empirically examine the influence of the entrepreneurial ecosystem on entrepreneurial intention and its impact on business preparation.

This study makes several contributions to the theme of entrepreneurship studies. First, it adds insight into the role of the entrepreneurial ecosystem as the predicting factors for entrepreneurial intention and business preparation that is rare and missing in prior studies. This is important because a good entrepreneurial ecosystem promotes the productivity of students in terms of entrepreneurship and promotes efficiency regarding entrepreneurial activities. Second, this study provides other perspectives as the government considers taking policy for more efficiency in promoting new business creation from university graduates. Third, the focus study in Indonesia is a unique and under-researched setting for entrepreneurship ecosystem studies to raise productivity among students. Additionally, the study explores the relationship between the entrepreneurial ecosystem and students' business preparation, a relatively unexplored area in the literature.

This study is presented as follows: Section 1 concerns the entrepreneurial ecosystem. Section 2 provides the hypotheses' development and literature used in this research, followed by a detailed description of the method in Section 3. Section 4 presents the findings and discussion, then elaborates with the conclusion in Section 5.

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

The intention for entrepreneurship has been acknowledged among scholars and policy researchers as its role in promoting new business creation (Badri and Hachicha, 2019; Doanh and Bernat, 2019). Most studies believe that entrepreneurial intention and business preparation involve careful planning and a deliberate thought process (Mamun et al., 2017; Mei et al., 2020). Entrepreneurial intention is often linked with people's self-belief to promote new business creation or improve the value-added of the existing enterprise (Vuorio et al., 2018; Neneh, 2020; Jena, 2020). Linan dan Chen (2009) noted that entrepreneurial intention can be proxied by self-prediction, and pure intention while preparing for business is evidence of an act of planned behavior. The entrepreneurial intention reflects the intention construct from the theory of planned behavior (TPB) by Ajzen (1991), and the business preparation represents the behavior construct from the theory of reasoned action (TRA) developed by Ajzen and Fishbein (2000). The recent work by Miranda et al. (2017) remarked that entrepreneurship activities can be promoted through intention. Stimulating entrepreneurial intention is often linked with the entrepreneurial ecosystem. A prior study by Elnadi and Gheith (2021) revealed that entrepreneurship activities are the output of the entrepreneurial ecosystem, while another study by Breznitz and Zhanget (2019) remarked that an entrepreneurial ecosystem can drive students' intention for business. According to Duan et al. (2021), the entrepreneurial ecosystem comprises six primary domains: conducive culture, policy and leadership, financial availability, quality human capital, markets, and various institutional and infrastructure supports (Elnadi and Gheith, 2021). Meanwhile, Lu et al. (2021) documented that the entrepreneurial ecosystem can be formed with government support, financial support, entrepreneurship education, and a university environment.

In practice, the intention and willingness of students in entrepreneurship are closely related to the ecosystem related to financial support. Access to finance is essential and a major business problem, especially in Indonesia. Many entrepreneurs give first-rank access to finance as a constraint. An antecedent study by Lu et al. (2021) believes financial support is crucial to reducing students' aversion to entrepreneurial risk and enhancing their intention to initiate enterprises. Furthermore, government support is crucial in increasing entrepreneurial intentions and starting a business (Kebairi et al., 2018). The Indonesian government has provided a student entrepreneurship program that is expected to promote students' entrepreneurial intentions and prepare them for business. The program has two purposes. The first stimulus is to enhance the intention through workshops and enlarging the university's entrepreneurship education. Second, this program assists student businesses to be funded and assisted to develop and be competitive. In addition to government support, physical support also plays a crucial role in enhancing intention and preparing students for business (Ferri et al., 2018). In this case, students have a certain community with a certain place provided by the government in collaboration with the university. Some scholars agree that the facilities provided are very helpful for students to be involved in entrepreneurship activities (Mat et al., 2015).

Another main component of the entrepreneurial ecosystem is education and training factors. It determines and provides capital for students to engage in entrepreneurial activities. Universities also play a robust role in encouraging entrepreneurship as a career option through education (Jena,

2020; Li and Wu, 2019). University support can be realized by providing entrepreneurship education and creating a conducive environment for entrepreneurship (Mustafa et al., 2016; Boukamcha, 2015). Entrepreneurship education is an educational program where entrepreneurial behavior and intentions to become successful entrepreneurs in the future are sourced (Rauch and Hulsink, 2015). The university environment also motivates students to become entrepreneurs through key resources provided by the university, such as skilled educators, university infrastructure that supports business activities, and the existing network at the university. The growing body of literature has confirmed that education for entrepreneurship can drive entrepreneurial intention and prepare for their business (Wardana et al., 2021; Jena, 2020; Tung et al., 2020). Therefore, the hypotheses are presented as follows.

- **H1.** Access to finance influences students' entrepreneurial intention
- **H2.** Access to finance influences students to start new business
- **H3.** Government programs and support affect students' entrepreneurial intention
- **H4.** Government programs and support promote students to start new business
- **H5.** Access to physical infrastructure factors influences students' entrepreneurial intention
- **H6.** Access to physical infrastructure encourages students to start new business
- **H7.** Education and training factors affect students' entrepreneurial intention
- **H8.** Education and training factors affect students to starting new business
- **H9.** Students' entrepreneurial intention links to starting a new business

METHOD

Research Design and Sampling

This study used a survey design that distributed an online questionnaire to several university students in Malang of East Java in Indonesia. Determining this location area is understandable since Malang is well-known as an educational city with more than 50 private and state universities. The framework was gained from literature and previous work papers (see Figure 1). The participants in this study were students who completed entrepreneurship education and/or engaged in entrepreneurial activities. The sample was obtained using the convenience sampling technique, commonly used in social research and involves collecting data from an online pool of readily available individuals willing to participate.

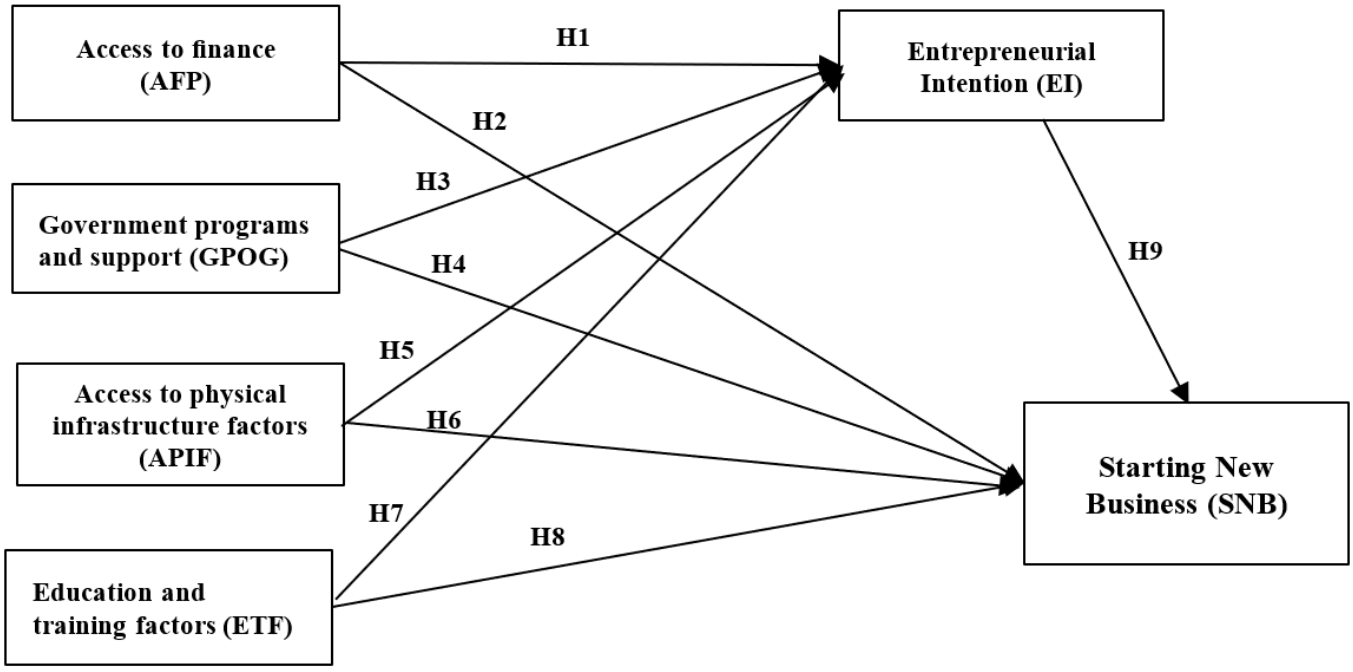

Figure 1: Conceptual framework

Data Collection

The questionnaires were first prepared in English and translated by a professional to Bahasa Indonesia. Hence, the research survey was open to all students from any discipline who enrolled at the university. The online questionnaires were distributed to approximately 430 students using WhatsApp and Telegram from April to May 2022, and 350 completed questionnaires. Some respondents did not complete the questionnaires; thus, we decided to remove them for analysis purposes. In this research, the respondents were asked for anonymity to meet the ethical issue. The details of the respondents are shown in Table 1. Of the male participants, 60 percent, while the female students engaged in this study were about 40 percent. Regarding age distribution, most respondents ranged between 19 and 20 years old and came from students in their third and fourth years of study. Table 1 also shows that the parents' occupation was that of an entrepreneur (37.14%), farmers (27.71%), and teachers/lecturers (25.71%).

S/No.	Characteristic	Frequency	Percentage
1.	Gender		
	Female	210	60.00
	Male	140	40.00
2.	Age		
	19 years old	90	25.72
	20 years old	135	38.57
	> 20 years old	125	35.71
3.	Parents' occupation		
	Entrepreneur	130	37.14
	Teacher/Lecturer	90	25.71
	Farmers	97	27.71
	Civil Servants	33	9.44
4.	Level of Study		
	Semester 3	12	0.01
	Semester 5	235	67.14
	Semester 7	115	32.85
5.	Prior educational background		
	SMA/MA (Senior High Schools)	130	37.15
	SMK (Vocational Schools)	220	62.85

Table 1: The demographics of respondents

Instrument Development

A conceptual model was provided based on the literature review and previous relevant papers. A questionnaire to measure entrepreneurial intention was borrowed and adopted from the prior study by Linan and Chen (2009). The entrepreneurial ecosystem was measured using 22 items from the Global Entrepreneurship Monitor (GEM, 2019). In this study, the entrepreneurial ecosystem includes access to finance, government programs, and support for new and growing firms, access to physical infrastructure, and education and training factors. Additionally, to measure the starting new business (SNB) variable, we adapted nine items from Lin et al. (2015). The questionnaire items were provided on a seven-point Likert scale ranging from 1 = strongly agree and 7 = strongly disagree.

Data Analysis

The data were analyzed using structural equation modeling (PLS-SEM) with statistical packages of Smart PLS (version 3.0) software. First, the outer model to assess the validity and reliability of the construct was implemented. Principal components for measurement included composite reliability, convergent validity, and discriminant validity. For discriminant validity, we adopted both the Fornell-Larcker criterion and HTMT ratio. Second, the inner calculation was implemented to estimate the hypothesis testing, including collinearity estimation, *R*-squared (R^2), and Q-squared (Q^2).

RESULTS AND DISCUSSION

Measurement Model

The estimation of the measurement model is primarily shown in this section. The construct validity was assessed based on convergent and discriminant validity. Convergent validity is deemed to be accomplished when the outer loading score is higher than 0.70 (Hair et al., 2020). As shown in Table 2, measurement items involved in this paper had a loading score ranging from 0.702 to 0.874 (> 0.70), indicating to meet the threshold. However, the remaining six items (AFP3, APIF3, APIF4, ETF2, ETF6, GPOG6) were dropped since they had a loading factor less than the cut-off value. In addition, the average variance extracted (AVE) of all construct variables was higher than 0.50, confirming convergent validity.

Later, composite reliability was estimated using Cronbach's alpha (α) and composite reliability (CR). The values obtained for both indicators were above the minimum threshold of 0.70, as recommended by Hair et al. (2020). As shown in Table 2, the CR value ranged from 0.775 to 0.894, while the (α) ranged from 0.702 to 0.887 to achieve composite reliability. For discriminant validity, the main principle used in the Fornell-Larcker criterion is that the AVE of each construct should be higher than the construct (Fornell and Larcker, 1981). From the estimation, it can be known that the model achieved the discriminant validity criteria (see Table 3). This suggests that the measurement of all constructs in the outer model is internally consistent and reliable.

Structural Model

This study first evaluated the collinearity among the constructs following the variance inflation factor value (VIF) and recommended meeting the criteria when the VIF is less than 5.00 (Hair et al., 2013). As informed in Table 4, the VIF value for the variable used in this study was less than 5.00, implicating the achievement of the collinearity estimation. Second, we used the *R*-squared (R^2) value to estimate the predictive accuracy of the model. The calculation results show that the R^2 value of the EI variable is 0.735, which means that 73.5 percent of the EI variant can be explained by robust levels of all entrepreneurial ecosystems (AFP, APIF, ETF, and GPOG) variables. Indeed, the R^2 value of the SNB variable is 0.824, which means 82.4 percent of the SNB variance can be explained by the AFP, APIF, ETF, GPOG, and EI variables at a strong level. Furthermore, the value of $Q^2 > 0$ (zero) indicates that the model has predictive relevance and vice versa. The calculation results show that the value of $Q^2 > 0$ (zero), indicating the model has predictive relevance.

Construct	Code Item	Loading (λ)	Cronbach's Alpha (α)	CR	AVE
Access to finance (AFP)	AFP1	0.823	0.878	0.916	0.733
	AFP2	0.873			
	AFP4	0.874			
	AFP5	0.853			
Access to physical infrastructure factors (APIF)	APIF1	0.864	0.775	0.868	0.688
	APIF2	0.766			
	APIF5	0.854			
Education and training factors (ETF)	ETF1	0.773	0.778	0.857	0.600
	ETF3	0.702			
	ETF4	0.785			
	ETF5	0.833			
Government programs and support (GPOG)	GPOG1	0.744	0.875	0.909	0.668
	GPOG2	0.845			
	GPOG3	0.795			
	GPOG4	0.831			
	GPOG5	0.866			
Entrepreneurial intention (EI)	EI1	0.857	0.894	0.922	0.705
	EI2	0.885			
	EI3	0.843			
	EI4	0.887			
	EI5	0.714			
Starting new business (SNB)	SNB2	0.861	0.857	0.903	0.700
	SNB3	0.885			
	SNB4	0.854			
	SNB8	0.739			

Table 2: Results of outer model assessment

	AFP	APIF	EI	ETF	GPOG	SNB
AFP	0.856					
APIF	0.681	0.829				
EI	0.709	0.826	0.840			
ETF	0.623	0.566	0.606	0.775		
GPOG	0.577	0.599	0.606	0.615	0.817	
SNB	0.459	0.427	0.396	0.884	0.555	0.837

Table 3: Discriminant validity

	AFP	APIF	EI	ETF	GPOG	SNB
AFP			2.257			2.413
APIF			2.151			3.442
EI						3.779
ETF			1.976			2.016
GPOG			1.933			1.955
SNB						

Table 4: VIF values

Hypothesis Testing

The path coefficients were analyzed to estimate the significance of the proposed structural relationships between the variables of interest. This analysis involved a standard bootstrapping technique with 5000 iterations and a significant level of $p < 0.05$. The resume of the hypothesis estimation of this study is shown in Table 5 and Figure 2. The first results indicate that access to finance has a significant effect on entrepreneurial intention ($\beta = 0.204$; t-value = 4.320; p-value = < 0.001) and starting a new business ($\beta = 0.077$; t-value = 2.071; p-value = 0.019), indicating that the appropriate access to finance will promote entrepreneurial intention and starting of business among university students.

The next results show that government programs and support have a significant effect on entrepreneurial intention ($\beta = 0.076$; t-value = 1.695; p-value = 0.045) and starting a new business ($\beta = 0.115$; t-value = 3.452; p-value < 0.001), confirming H3 and H4. In this regard, the role of government programs

and support raise the intention and business activities among university graduates. Furthermore, the results show that access to physical infrastructure factors has a significant effect on entrepreneurial intention (β = 0.585; t-value = 12.968; p-value = <0.001) and starting a new business (β = 0.099; t-value = 2.101; p-value = 0.019), indicating that access to physical infrastructure also plays a crucial role in driving intention and business practices among students.

Later, the outputs show that education and training factors have a significant effect on entrepreneurial intention (β = 0.102; t-value = 2.318; p-value = 0.010) and starting a new business (β = 0.986; t-value = 32.324; p-value = < 0.001), supporting H7 and H8. The finding implies the need for education and training to enhance productivity regarding entrepreneurial intention and starting a new business. The last finding for the direct effect shows that entrepreneurial intention significantly affects starting a new business (β = 0.299; t-value = 5.757; p-value = < 0.001), remarking a significant need to enhance entrepreneurial intention in promoting new business from university graduates.

Path	(β)	Std Error	t-value	p-value	Bias and correlated bootstrap		Decision
					LL95%CI	UL95%CI	
AFP → EI	0.204	0.047	4.320	< 0.001	0.130	0.278	H1. Supported
AFP → SNB	0.077	0.037	2.071	0.019	0.117	0.337	H2. Supported
GPOG → EI	0.076	0.045	1.695	0.045	0.000	0.150	H3. Supported
GPOG → SNB	0.115	0.033	3.452	< 0.001	0.061	0.172	H4. Supported
APIF → EI	0.585	0.045	12.968	< 0.001	0.505	0.655	H5. Supported
APIF → SNB	0.099	0.047	2.101	0.018	0.025	0.178	H6. Supported
ETF → EI	0.102	0.044	2.318	0.010	0.029	0.173	H7. Supported
ETF → SNB	0.986	0.031	32.324	< 0.001	0.033	0.127	H8. Supported
EI → SNB	0.299	0.052	5.757	< 0.001	0.213	0.382	H9. Supported

Note: AFP= Access to finance; APIF= Access to physical infrastructure factors; ETF = Education and training factors; GPOG= Government programs and support; SNB= Intention of starting new business; t-value > 1.645; p < 0.05; SE= standard error; β= path coefficient

Table 5: Path analysis and hypotheses testing

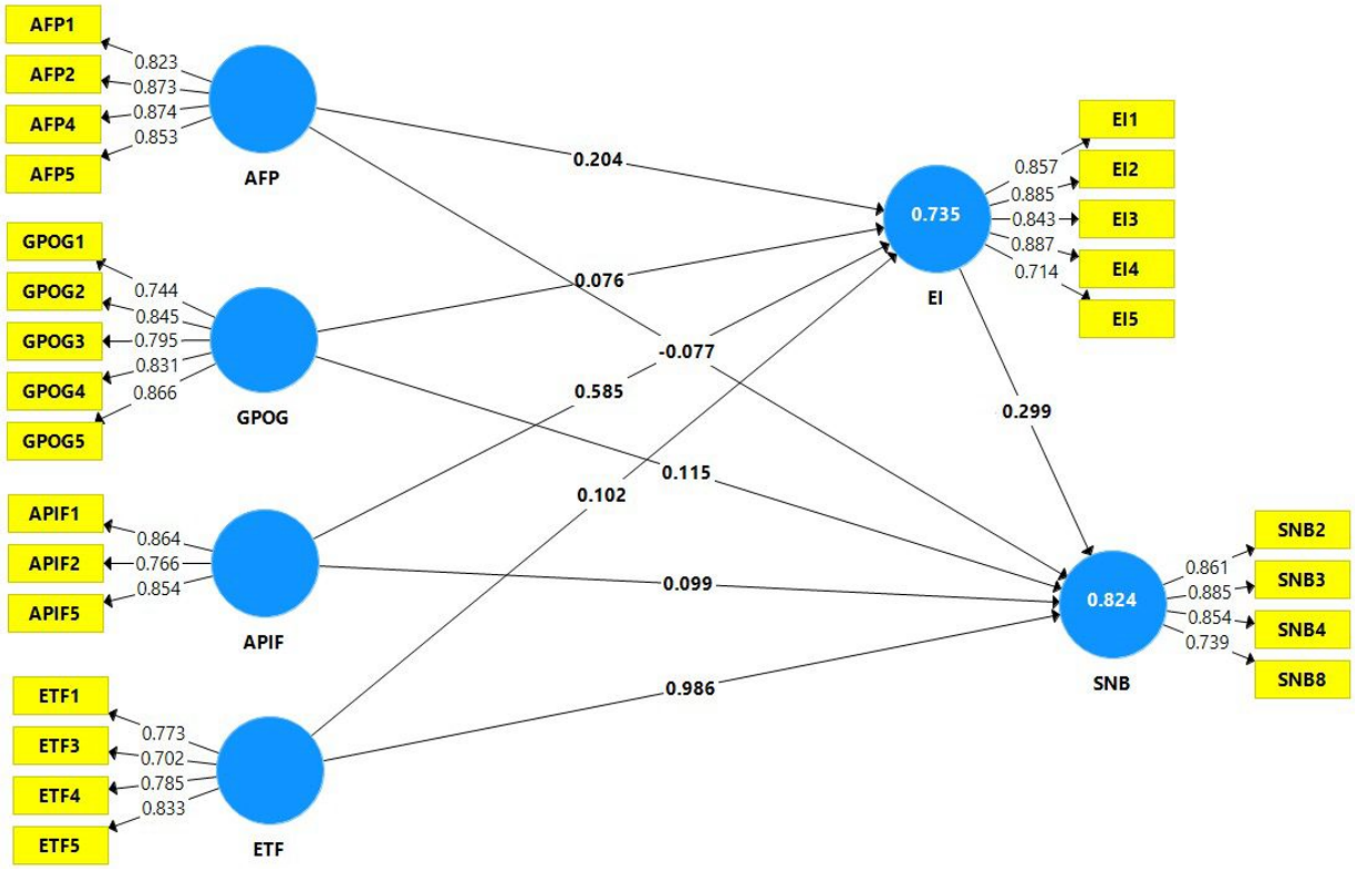

Figure 2: Final model

DISCUSSION

The study intends to examine nine hypotheses proposed. The first and second hypotheses sought to investigate the impact of access to finance, entrepreneurial intention, and starting a new business for Indonesian university students. As expected, this study indicates that access to finance is crucial for determining whether students are entrepreneurs or start a new business. These findings agree with a preliminary study by Lu et al. (2021), which remarked that financial support is crucial to reducing students' aversion to entrepreneurial risk and enhancing their intention to initiate enterprises. The theory of Planned Behavior by Ajzen (1991) noted that individual behavior is determined by their intention, while the intention is influenced by these main dimensions, both internal, such as ease of accessing financing. Some scholars in the Indonesian context ranked the financial issue as the main challenge for new business creation and shaping the business (Davis et al., 2017; Wardana et al., 2021).

Moreover, structural modeling analysis showed that government programs and support can drive students' entrepreneurial intention and preparation for their businesses. These results confirmed several prior studies (e.g., Kebairi et al., 2018; Najib et al., 2021), which mentioned that government support for business could address barriers to promoting intention and new business creation. In the context of university students, the Indonesian government has provided various entrepreneurship programs to promote entrepreneurial intention and support students' businesses. This implies that students positively perceived these programs, and most of them have been involved in the entrepreneurial program. These findings corroborate several prior works by Buffart et al. (2020), Kebairi et al. (2018), and Li et al. (2020), who mentioned that such government programs effectively support and provide a business incubator for students.

The next hypothesis in this research investigates access to physical infrastructure factors, entrepreneurial intention, and students' preparation for business. The fundamental explanation for these findings is that most universities in Indonesia have provided facilities such as a creative center, entrepreneurship corner, business camp, and other relevant models. The government provides these facilities in collaboration with the university (Wardana et al., 2021). Having these facilities, the student's activities on the campus can be accommodated and supported. This finding confirms a prior study by Hechavarria and Ingram (2019), who revealed that the entrepreneurial ecosystem, including access to physical and infrastructure, greatly supports intention and new business engagement for students.

This study also shows that education and training can explain students' entrepreneurial intention and business preparation. This finding confirms some recent works by Jena (2020) and Li and Wu (2019), who mentioned that education and training are significantly linked with students' entrepreneurial intention and business preparation. Entrepreneurship education on the campus provided students with the basic knowledge and theories of entrepreneurship. Some scholars believe that entrepreneurship education can motivate students to be entrepreneurs and their intention for entrepreneurship (Anwar et al., 2022; Hassan et al., 2022). However, the combination of education and training stimulates their intention and enhances the students' engagement in business. These two components matter for students in promoting entrepreneurial activities. The last findings indicate that there is a robust correlation between students' entrepreneurial intention and business preparation. This is supported by some preliminary studies by Mamun et al. (2017) and Tung et al. (2020), who expressed that entrepreneurial intentions drive the formation of students in starting and preparing their businesses.

CONCLUSION AND IMPLICATION

This study explores how the entrepreneurial ecosystem explains Indonesian students' entrepreneurial intention and business preparation. The findings indicate that the entrepreneurial ecosystem robustly links with students' entrepreneurial intention and new business creation. This study confirms that access to finance, government programs, support, access to physical infrastructure factors, education, and training factors are crucial for determining Indonesian university students' business. This study provides implications. First, the entrepreneurial ecosystem strongly influences the student's intention to start a new business, including access to finance, government programs, support for new and growing firms, access to physical infrastructure, and education and training factors.

Therefore, the government must continue increasing support and convenience for new entrepreneurs to access important factors in the entrepreneurial ecosystem. Second, universities must cooperate with the government besides providing entrepreneurial education and training. The goal is for the university to accommodate the government's support program for new entrepreneurs with changes to the program and curriculum that are coherent and relevant. This is important because most studies on entrepreneurship in Indonesia (Wardana et al., 2020; Kusumojanto et al., 2020; Suratno et al., 2021) have found no synergy between various government programs related to young entrepreneurs and universities. As a result, programs from the government are not effective because of the minimal involvement of universities, and vice versa. Thus, those variables can be considered to boost the intention and students' business preparation.

LIMITATION

Like other studies, this research has confronted some limitations. First, this study did not involve all the variables in the TPB model developed by Ajzen (1991), and other behavioral predictor variables such as self-efficacy, attitude, and mindset were not tested. Future research needs to take a complete picture by including all predictor variables in the TPB model developed by Ajzen. Second, this research does not involve all the variables from the model developed by the Global Entrepreneurship Monitor (GEM, 2019), namely social and cultural factors and government policies. The rational reason is that we do not include these variables because, in the Indonesian context, they already include the variables that we have tested. Future research should include all the variables GEM (2019) developed in the context of other countries.

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