frontiers | Frontiers in Education

TYPE Original Research
PUBLISHED 11 April 2025
DOI 10.3389/feduc.2025.1537174

OPEN ACCESS

EDITED BY
Patricia Caratozzolo,
Institute for the Future of Education, Mexico

REVIEWED BY
Carmen Gloria Burgos,
Universidad de Atacama, Chile
Favourate Y. Mpofu,
National University of Science and Technology, Zimbabwe
Ebru Albayrak,
Sakarya University, Türkiye
George Kehdinga,
Durban University of Technology, South Africa

*CORRESPONDENCE
Héctor X. Ramírez-Pérez
heramire@up.edu.mx

RECEIVED 30 November 2024
ACCEPTED 24 March 2025
PUBLISHED 11 April 2025

CITATION
DelaTorre-Diaz L, Ramírez-Pérez HX and Escobar-Castillejos D (2025) The effectiveness of curriculum standardization in data analysis and tools proficiency for undergraduate education: a case study.
Front. Educ. 10:1537174.
doi: 10.3389/feduc.2025.1537174

The effectiveness of curriculum standardization in data analysis and tools proficiency for undergraduate education: a case study

Lorena DelaTorre-Diaz[1], Héctor X. Ramírez-Pérez[1]* and David Escobar-Castillejos[2]

[1]Universidad Panamericana, Facultad de Empresariales, Ciudad de México, Mexico, [2]Universidad Panamericana, Facultad de Ingeniería, Ciudad de México, Mexico

Introduction: The rapid evolution of technology necessitates the development of advanced computing and data analysis skills in undergraduate education. Standardizing curricula is a strategy to ensure consistent learning outcomes and align educational objectives with industry requirements. This study investigates the impact of a standardized curriculum on students' academic performance and professional certification outcomes.

Methods: A quasi-experimental design was used to analyze 1,597 students enrolled in a data analysis course before and after implementing a standardized curriculum at a private university in Mexico City. The study assessed course grades and certification exam scores to evaluate the effectiveness of standardization. Parametric and non-parametric tests were applied to ensure robust analysis.

Results: Implementing the standardized curriculum resulted in a slight decrease in average course grades but significantly improved certification exam scores, exceeding the threshold for certification. The findings highlight enhanced proficiency in data analysis tools and consistency in achieving educational objectives across groups.

Discussion: The results suggest that curriculum standardization effectively addresses teaching methodologies and assessment criteria discrepancies. While increased curriculum difficulty temporarily impacted grades, the improved certification outcomes demonstrate the value of standardization in preparing students for industry demands. These insights provide a foundation for future curriculum development to align academic instruction with the evolving requirements of a technology-driven workforce.

KEYWORDS

data analysis, digital tools, curriculum standardization, higher education, educational innovation

1 Introduction

Technological advancement demands the development of strong computing and data-analytic competencies in undergraduate education. Organizations and institutions now require professionals to have expertise in computing, quantitative analysis, data processing, and management. According to Simaremare et al. (2024), technological advancements require individuals to develop knowledge and skills in using different tools to remain competitive. Consequently, education is essential in enabling students to adapt to environmental changes. Although current generations of students are more adept at using technology, many students entering higher education lack sufficient computer proficiency to succeed in quantitative analysis courses. This gap underscores the growing need for integrating technology as a fundamental component of academic and professional environments, shifting its role from optional to essential (Rubin and Abrams, 2015; Gasigwa et al., 2024).

A primary objective of education is to prepare individuals for societal integration and real-world situations (Gasigwa et al., 2024). According to the World Economic Forum (2023), businesses anticipate that 44% of workers' core skills will be disrupted by 2027 due to the rapid pace of technological advancements. In this context, future skills such as analytical thinking and technological literacy have become critical for workforce readiness. To foster these competencies, educational institutions should emphasize developing these abilities to ensure graduates are well-prepared to thrive in rapidly evolving professional environments (Ehlers and Kellermann, 2019).

Higher education institutions are key allies in preparing students for an increasingly data-driven workforce. The need for graduates with strong technological competence has led universities to seek innovative instructional strategies to enhance students' analytical and computational skills (Rubin and Abrams, 2015; Carayannis and Morawska-Jancelewicz, 2022). Practical learning approaches extend beyond passive instruction, encouraging active engagement in tasks such as manipulating computational tools (McCloskey and Bussom, 2013). According to Barreto (2015), using software to observe the impact of altering variables or formulas facilitates deeper understanding by bridging abstract concepts with practical applications. Moreover, Barreto mentions that "the abstract thinking necessary to create a mental representation of the described subject poses a significant barrier to learning." Nevertheless, disparities in instructional depth and focus across different course sections can lead to varying levels of student proficiency and learning outcomes.

In recent decades, standardization has been increasingly employed to address these inconsistencies as an educational strategy to ensure uniform and structured learning experiences across different cohorts (de Vries and Egyedi, 2010). Standardization in curricula involves defining common learning objectives, instructional methodologies, and assessment criteria to provide all students with a comparable educational foundation, regardless of the instructor or study group. Research suggests that curriculum standardization can improve educational consistency, equitable assessment practices, and alignment with industry expectations (Timmermans and Epstein, 2010).

While the benefits of standardization are well documented, its implementation requires balancing flexibility with uniformity. Standardized curricula ensure that all students develop essential competencies, but they may also limit instructors' ability to adapt content to specific student needs. According to Skarpenes and Walmann Hidle (2024), rigid standardization can hinder innovation in teaching methodologies and reduce opportunities for personalized learning. Thus, successful standardization models should not be viewed as an absolute constraint but rather as a structured framework that ensures core competencies while maintaining adaptability for diverse learning contexts.

This study examines the implementation and effectiveness of curriculum standardization in undergraduate data analysis education. The research highlights how standardization influences and improves students' academic performance and professional certification outcomes. The findings suggest how structured curricula can strengthen students' technological proficiency while ensuring alignment with industry demands. The study aims to inform educators and institutions on best practices for adopting standardized models to enhance student preparedness for a technology-driven workforce.

2 Related work

University students face several difficulties when processing data. Nonetheless, some programs, such as Microsoft Excel, may prove beneficial. This reliable software allows professionals to address calculations and administrative issues (Simaremare et al., 2024). As stated by Barreto (2015), Microsoft Excel is the appropriate software for obtaining practical and valuable computer-based skills, as it enables pupils to become proficient in precious problem-solving software. Additionally, Microsoft Excel is a versatile and effective tool for deploying various statistical functions (Brooks and Taylor, 2016; Damjanovic and Katanic, 2023). It simplifies the comprehension of business mathematics, quantitative business analysis, and graphic presentation of data.

Spreadsheets transformed the business landscape in the 1980s. Microsoft Excel was introduced in the 1990s and has maintained a preeminent role in data processing and analysis (Barreto, 2015). SPSS is a commonly used statistical program; nonetheless, Microsoft Excel has advantages for educational integration (Damjanovic and Katanic, 2023). Compared to SAS or SPSS, Microsoft Excel is readily accessible in the market and is offered at economical pricing (Rubin and Abrams, 2015). Even after the introduction of Google Sheets in the mid-2020s, Excel has remained the spreadsheet software most demanded by employers (Rebman et al., 2023). Consequently, teaching Microsoft Excel is advantageous because of its widespread availability on most devices, user-friendliness, and utility as a standard tool in business and scientific contexts (Iji et al., 2022).

Students need to show a better understanding of spreadsheets, which is required by many employers (Rubin and Abrams, 2015). Microsoft Excel is an excellent tool for educating students on data analysis, and it is also beneficial for data analysis presentations and charts (Kumar, 2023). For Gasigwa et al. (2024), "Learners will perform poorly in statistics due to a lack of proper training provided to teachers to improve their use of Excel software as a pedagogical tool." Therefore, professors should train and prepare students in computer and Excel learning.

Educators aim to disseminate material through many methods to optimize sensory engagement. Teaching Excel through theory and practice is possible, and students often display an increased proficiency when mastering some Excel functions (Rubin and

Abrams, 2015; Damjanovic and Katanic, 2023). A study in Nigeria examined the impact of Microsoft Excel instruction on senior secondary students' academic achievement and retention (Iji et al., 2022). The results indicated enhancements in both attainment and retention, and the authors advocated for raising awareness among academics to adapt and execute teaching methods with this software.

The rise of digital data analytics has led to more objective educational assessments and the implementation of standards into tangible measurement technologies (Williamson and Piattoeva, 2019). Every class should be conducted according to a protocol tailored to the course, accompanied by a delineated set of materials or exercises (Barzegar et al., 2020). On the other hand, effective study requires meticulous and proficient data analysis and collection (Kumar, 2023). Consequently, educational institutions should intensify training for students to reach performance standards required by businesses and institutions (Skarpenes and Walmann Hidle, 2024).

Barzegar et al. (2020) mentions that classifying students based on their topic mastery, irrespective of their majors, resulted in enhanced competency due to material homogenization. However, a Belgian study found that dividing children into distinct groups may yield minimal overall advantages in academic achievement (Lavrijsen et al., 2022). The primary factor influencing achievement was the behavior of the teachers. Consequently, a potential approach to achieve better results following the criteria set by businesses and organizations could involve standardization of course contents and materials.

Educational standardization has been widely explored in various disciplines to promote consistency in student learning outcomes (Helda and Syahrani, 2022; Nahar, 2023). Timmermans and Epstein (2010) define standardization as "a process of constructing uniformities across time and space through the generation of agreed-upon rules." A well-structured curriculum ensures alignment between learning objectives, instruction, and assessments. Consequently, it has been implemented to reduce disparities in instructional quality. Atuhurra and Kaffenberger (2022) revealed that misalignment between curriculum standards, teacher instruction, and national assessments can create incoherence in learning outcomes. The authors found that standardization can be linked to better student performance and retention of key concepts when adequately implemented.

Allensworth et al. (2021) provides further evidence on how structured professional learning (PL) around standardized curricula influences student performance. Their study in Chicago Public School examined how professional development for teachers contributed to better instructional practices and student achievement in math following the implementation of the Common Core State Standards in Mathematics (CCSS-M). Results revealed that schools with more extensive professional learning initiatives around the standards saw more significant improvements in student outcomes, particularly in grades, test scores, and pass rates. Lastly, a key insight from their study is that standards alone do not automatically improve student learning. Thus, their success depends on how teachers and institutions implement them. Schools with more extensive participation in professional learning around the CCSS-M reported higher student engagement with standards-aligned instructional practices.

Crompton and Sykora (2021) performed a study highlighting the importance of developing instructional technology standards for educators to ensure consistency in implementing technology across different educational settings. Their research demonstrated that clear technology guidelines can enhance curriculum standardization by providing structured yet adaptable frameworks for digital learning. The study emphasized that technology integration must be aligned with instructional goals rather than being treated as an add-on, ensuring that digital tools support student learning rather than distract from it. Lastly, the study found that educator involvement in the standardization process is crucial for ensuring the practical applicability of instructional technology standards.

3 Methods

This study employed a quasi-experimental design to evaluate the impact of curriculum standardization on students' academic performance and certification outcomes in an undergraduate data analysis course. The analysis compared two cohorts:

- **Pre-standardization cohort:** students who completed the course before implementing standardized content.
- **Post-standardization cohort:** students who completed the course after introducing the standardized curriculum.

The study aimed to determine whether standardization initiatives led to statistically significant improvements in student learning outcomes by analyzing final course grades and certification exam scores. To ensure rigorous statistical evaluation, parametric (Student's t-test) and non-parametric (Mann-Whitney U test) methods were applied to assess differences in performance across the two cohorts.

To uphold research integrity and participant privacy, all student data were anonymized before analysis, ensuring no personally identifiable information was accessible. Data handling procedures followed institutional research guidelines, maintaining compliance with ethical research standards.

3.1 Case study

Students in the Faculty of Business must complete the Technological Tools for Information Management course during their first semester. This course aims to establish a foundational understanding of Microsoft Excel, enabling students to attain an above-average proficiency in the application, which will benefit their future academic pursuits and early professional endeavors.

Furthermore, students must pass the Microsoft Excel 2019 Specialist certification as a prerequisite for obtaining the academic degree (Certiport, a Pearson VUE Business, 2025). This examination not only facilitates assessment against a uniform criterion that all students recognize but also allows them to incorporate this accomplishment into their resumes when they commence their job search. The certification provides external validation of their proficiency in spreadsheet management, data analysis, and automation technologies, confirming adherence to industry standards. The required minimum score for certification is 700 points out of 1,000.

The professors teaching this subject are familiar with the certification exam and have structured the syllabus based on the topics covered in the certification. To address inconsistencies in instruction, a curriculum standardization process has been applied since 2021 to all groups involved. This initiative ensures that all students receive the same level of instruction and preparation, independent of their instructor. The standardization strategy includes the following key elements:

1. Syllabus Revision and Expansion—The curriculum was restructured and expanded to cover all topics tested in the certification exam, along with advanced Excel tools commonly used in corporate environments that extend beyond the scope of the Microsoft Specialist certification. This ensures that students meet certification requirements and acquire real-world competencies relevant to business analytics and data-driven decision-making.
2. Faculty Collaboration for Instructional Design—A team-based approach to curriculum development was implemented, fostering collaboration among instructors. Professors shared their experiences and best practices to create comprehensive and engaging learning materials, including case studies, interactive assignments, and real-world business applications.
3. Development of a Unified Work Plan—A structured course sequence was established, outlining a clear progression through Excel topics. This sequence ensures a logical instruction flow, beginning with fundamental spreadsheet operations and advancing toward complex data analysis techniques. Standardized lesson plans and teaching methodologies were introduced to maintain consistency across all course sections.
4. Standardized Midterm and Final Examinations—To ensure fairness and consistency in assessment, midterms and final exams were standardized across all course sections. Exam difficulty levels were calibrated to align with the learning objectives and certification requirements, guaranteeing that students were evaluated under uniform conditions.
5. Designation of a Course Coordinator—A dedicated course coordinator was appointed to oversee the implementation of the standardization process. This role includes monitoring instructional quality, resolving discrepancies in teaching approaches, and ensuring that all course sections adhere to the established guidelines.

Standardization aimed to eliminate discrepancies in the depth and difficulty of the topics taught in class. The goal was to ensure that all students, regardless of their teacher, could use and comprehend a specific set of Microsoft Excel functions and that all exercises and tests maintained the same difficulty level.

The standardized course covers a comprehensive range of Excel functionalities, ensuring students gain proficiency in essential spreadsheet operations, data management techniques, and business analytics tools. The following topics are included:

- Basic spreadsheet management: creating, deleting, renaming, and formatting worksheets; adding and managing rows, columns, and cell ranges.
- Data formatting and visualization: conditional formatting, sparklines, cell styles, and themes to enhance data presentation.
- Data organization and validation: sorting and filtering data, removing duplicates, applying data validation rules, and using named ranges.
- Fundamental functions: SUM, AVERAGE, MAX, MIN, COUNTBLANK, COUNTA, and mathematical operators.
- Logical and conditional functions: IF statements (single and nested), IFS, AND, OR, COUNTIF, SUMIF, AVERAGEIF.
- Text manipulation functions: CONCATENATE, LEFT, RIGHT, MID, TRIM, and PROPER for string operations.
- Lookup and reference functions: VLOOKUP, HLOOKUP, XLOOKUP for dynamic data retrieval.
- Data summarization and analysis: subtotals, pivot tables, and advanced filters.
- What-if analysis tools: Goal Seek, Data Tables, and Scenario Manager for decision support.

While the Microsoft Excel 2019 Specialist Certification assesses foundational skills, the course also integrates more advanced tools commonly used in corporate settings. The certification exam does not cover functions such as COUNTIF, SUMIF, AVERAGEIF, VLOOKUP, HLOOKUP, XLOOKUP, pivot tables, advanced filters, or What-If analysis tools. However, the curriculum emphasizes these topics to equip students with industry-relevant knowledge. This expansion has made the course more rigorous and intellectually challenging, requiring students to develop enhanced analytical and problem-solving skills. The proposed standardized curriculum aims to ensure that students meet certification standards and align with employer expectations for data-driven decision-making roles.

4 Methodology

This study is based on a quasi-experimental model, which analyzes 1,597 students enrolled in the "Technological Tools for Information Management" course at a private university in Mexico City. This cohort includes 649 students from the pre-standardization group and 948 from the post-standardization group. The standardization process began in 2022, and student records for five semesters, from 2022 to the first semester of 2024, were considered the periods during which standardization was applied. Four six-month periods between 2020 and 2021 were analyzed as pre-standardization periods.

Two variables were analyzed for both groups: the final grade obtained in the course and the score achieved in the certification exam. Students have two opportunities to take the certification exam if they do not reach the minimum passing score on the first attempt. In this study, the values of the second chance were used for those students who required this second chance. The time between the first and second attempts must not exceed 30 natural days, and no additional class sessions are destined to prepare students for their second try. The second attempt was used for both groups (pre- and post-standardization), which allowed for comparing the results of the changes in the course curriculum.

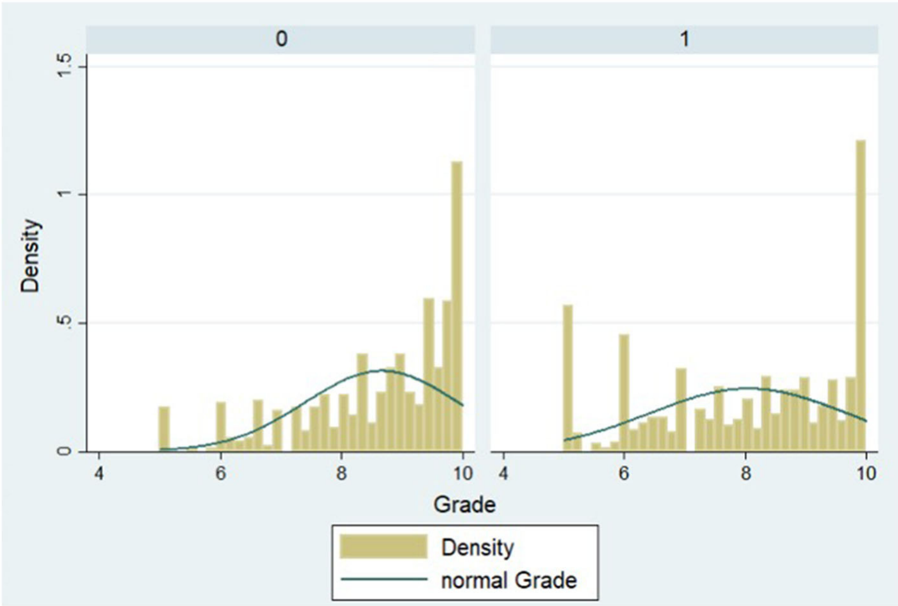

FIGURE 1
Distribution of students' grades before and after the standardization of the curriculum.

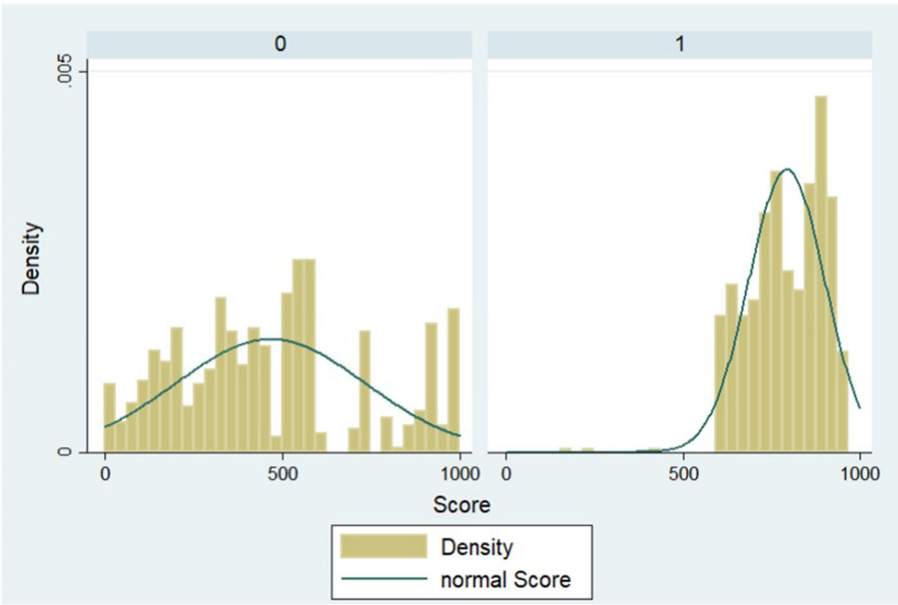

FIGURE 2
Distribution of certification test scores of students before and after the standardization of the curriculum.

The grades obtained in the course were gathered from the course records, and the determination of the grades is as follows:

$$\begin{aligned}\text{Final Grade} = {} & (0.21 \times \text{1st Midterm}) + (0.21 \times \text{2nd Midterm}) \\ & + (0.135 \times \text{Homework}) \\ & + (0.095 \times \text{Certification Preparation Exercises}) \\ & + (0.10 \times \text{Final Project}) + (0.25 \times \text{Final Exam})\end{aligned}$$

The certification test score is determined and informed by the company that provides the exam service on a 1,000-point basis.

The null hypotheses are:

$$H_0 : \mu_{\text{Grade G1}} - \mu_{\text{Grade G2}} = 0$$
$$H_0 : \mu_{\text{Score G1}} - \mu_{\text{Score G2}} = 0$$

The alternative hypotheses are defined as:

TABLE 1 Descriptive statistics of grades and test scores for students before and after standardization.

Variable	Standardization	*N*	Mean	SD	Min	Max	Median
Grade	No	649	8.65	1.27	5	10	9
Grade	Yes	948	8.04	1.63	5	10	8.4
Test score	No	649	465.35	269.61	0	1,000	442
Test score	Yes	948	792.60	107.59	166	957	785

$$H_1 : \mu_{\text{Grade G1}} - \mu_{\text{Grade G2}} \neq 0$$
$$H_1 : \mu_{\text{Score G1}} - \mu_{\text{Score G2}} \neq 0$$

The *t*-test and Mann-Whitney U tests were used to determine whether the differences between the means obtained in both the subject's grade and the certification exam score are statistically different after applying the standardization process.

5 Results

Figure 1 shows the course grade distribution before and after standardization. Group 0 represents the state before standardization, while Group 1 has already implemented the necessary adjustments.

The data representation shows a slight decrease in students' grades after standardization despite the absence of a normal distribution. This decrease can be attributed to a more extensive and demanding curriculum.

The distribution of the certification test scores before and after the standardization process is shown in Figure 2. In this case, even though none of the groups show a normal distribution, an increase in the scores obtained is perceived.

The descriptive statistics of the two variables are presented in Table 1.

The minimum and maximum values for the course grades remain constant. However, the mean and median course grade decreased in the groups where the changes were applied. The certification test score is different because the score range was reduced; no student in the period analyzed after the standardization received the highest score, but the lowest value increased.

A one-way analysis of variance (ANOVA) was performed to determine whether statistically significant differences existed in course grades and certification exam results among students before and after curriculum standardization (Table 2). The final grade in the "Technological Tools for Information Management" course served as the dependent variable, revealing a statistically significant difference between pre-standardization and post-standardization groups, $F_{(1,1596)} = 65.01, p < 0.001$.

In the same way, when the certification exam score was analyzed as a dependent variable, the results indicated a statistically significant impact of curriculum standardization, $F(1, 1596) = 1,133.27$, $p < 0.001$ (Table 3). *Post-hoc* analysis utilizing Bonferroni's correction verified that standardized groups attained considerably superior certification scores compared to non-standardized groups ($p < 0.001$). Standardized groups achieved markedly inferior course grades relative to non-standardized cohorts ($p < 0.001$).

TABLE 2 One-factor ANOVA analysis results on course grades.

Source	SS	Df	MS	F	*p*-value
Between groups	146.287	1	146.28	65.01	< 0.001
Within groups	3,589.06	1,595	2.25	-	-

TABLE 3 One-factor ANOVA analysis results on certification exam score.

Source	SS	Df	MS	F	*p*-value
Between groups	41,257,837.6	1	41,257,837.6	1,133.27	< 0.001
Within groups	58,067,665.2	1,595	36,406.0597	-	-

TABLE 4 Results of the Shapiro-Wilk test for normality assessment.

Group	Variable	W statistic	*p*-value
No standardization	Grade	0.9206	< 0.001
	Score	0.95718	< 0.001
Standardization	Grade	0.96659	< 0.001
	Score	0.94132	< 0.001

TABLE 5 Results of the variance ratio test.

Group comparison	Variable	F statistic	*p*-value
Group 0 vs. Group 1	Grade	0.6059	< 0.001
Group 0 vs. Group 1	Score	6.2798	< 0.001

Shapiro-Wilk tests were applied to confirm normality in the data, and the variation ratio test was used to verify the homogeneity of variations. The results of both tests are shown in Tables 4, 5, confirming that the data in none of the groups meet the assumption of normality or homogeneity of variance.

Based on the above results, it was decided to use the non-parametric test of Mann-Whitney U for two samples to verify that the difference in the students' academic performance in the course and their results in the certification test is statistically significant. The results of this test are shown in Table 6.

These tests are based on the null hypothesis that the distribution of both groups is equal. These hypotheses are rejected for both the

TABLE 6 Results of the Mann-Whitney U test.

Group comparison	Variable	U statistic	*p*-value	Median group 0	Median group 1
Group 0 vs. 1	Grade	367,031	< 0.001	9	8.4
Group 0 vs. 1	Score	100,087	< 0.001	442	785

TABLE 7 Results of *t*-test and variance comparison.

Group comparison	Variable	*t* statistic	DF	*p*-value (*t*-test)	Mean difference
Group 0 vs. Group 1	Grade	8.0629	1,595	< 0.001	0.6162
Group 0 vs. Group 1	Score	−33.6641	1,595	< 0.001	−327.2496

course grade and the test score. Therefore, it can be stated that the means between the groups before and after standardization are statistically different. Even applying the *t*-test (assuming that the assumptions of normality were met), the result remains, rejecting the null hypotheses (Table 7).

6 Discussion and conclusion

Implementing a standardized curriculum in the "Technological Tools for Information Management" course had mixed impacts on student outcomes. While a slight decline was observed in students' academic performance, as reflected in their course grades, this variation is relatively modest. This can be attributed to including more advanced topics in the curriculum. These topics extend beyond the scope of the specialist-level certification exam, thereby increasing the overall difficulty of the course.

Conversely, a significant improvement was noted in the average scores achieved by students in the certification exam. Before standardization, the average score fell below the 700-point threshold required for certification. Following the standardization process, the average score exceeded 792 points, reflecting a substantial enhancement in student proficiency. This improvement highlights the effectiveness of the standardized curriculum in aligning instructional practices across groups, ensuring comprehensive content coverage, and fostering a deeper understanding of the subject matter. Similar to our results, a study presented by Bakir et al. (2019) showed that some elements that helped obtain better results on the Microsoft Excel Specialist certification for the students they evaluated were course-related: examples include custom-authored and more in-class instructions.

These findings underscore the potential benefits of curriculum standardization in promoting consistency and achieving higher educational standards. While the increased difficulty of the course may temporarily impact grades, the enhanced certification outcomes suggest that students are better prepared to meet industry expectations and apply their knowledge effectively in professional contexts. As stated by Roth (2024), training students in spreadsheets like Excel increases logical reasoning and impacts learning outcomes. The results of this study can inform future efforts in curriculum design, particularly for courses that aim to integrate practical skill development with standardized assessment frameworks. By fostering collaboration among educators and aligning teaching methodologies with certification requirements, institutions can better equip students with the competencies needed to excel in a technology-driven workforce.

While this study provides compelling evidence for the effectiveness of curriculum standardization, several areas warrant further exploration. Standardized curricula must be continuously updated to balance rigor, adaptability, and alignment with industry demands. Future research should focus on refining standardization strategies that enhance academic performance while promoting flexibility, critical thinking, and real-world application.

One key area for further investigation is the long-term impact of curriculum standardization on student performance, knowledge retention, and professional readiness. A longitudinal study tracking multiple cohorts throughout their undergraduate programs could determine whether the competencies developed through standardization persist beyond the course and into professional practice. Such a study could also examine whether standardization positively or negatively impacts student adaptability in diverse workplace environments.

Another critical aspect for future research is instructor perspectives on curriculum standardization. Investigating educators' perceptions, instructional strategies, and challenges in implementing standardized curricula could offer institutions valuable insights for faculty training and curriculum refinement. Research should explore whether standardized instructional frameworks support or constrain pedagogical innovation, and how professional learning programs could be structured to optimize instructor effectiveness in delivering standardized content.

Furthermore, given the growing role of technology in standardized education, future research should assess how digital learning platforms, automation, and data-driven instructional design might enhance curriculum uniformity and student engagement. Evaluating the influence of instructional technology standards, as discussed by Crompton and Sykora (2021), could provide insights into how educational institutions can leverage technology-enhanced standardization models to improve learning outcomes. Additionally, research should explore the role of artificial intelligence and adaptive learning systems in ensuring personalized yet standardized instruction.

By addressing these areas, future studies can further enhance curriculum standardization strategies to optimize academic performance, foster professional skill development, and ensure real-world applicability. As higher education institutions continue to evolve in response to changing workforce demands, ongoing research will ensure that standardization remains a dynamic and effective tool for educational advancement.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the participants was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

LD-D: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing. HR-P: Investigation, Methodology, Project administration, Supervision, Validation, Writing – original draft, Writing – review & editing. DE-C: Conceptualization, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that no financial support was received for this article's research and/or publication.

Acknowledgments

We thank the Business and Engineering faculties of Universidad Panamericana, Mexico City Campus.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

The author(s) declare that no Gen AI was used in the creation of this manuscript.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

References

Allensworth, E., Cashdollar, S., and Gwynne, J. (2021). Improvements in math instruction and student achievement through professional learning around the common core state standards in Chicago. *AERA Open* 7:2332858420986872. doi: 10.1177/2332858420986872

Atuhurra, J., and Kaffenberger, M. (2022). Measuring education system coherence: alignment of curriculum standards, examinations, and teacher instruction in Tanzania and Uganda. *Int. J. Educ. Dev.* 92:102598. doi: 10.1016/j.ijedudev.2022.102598

Bakir, N., Dana, K., and Abdullat, A. (2019). Certifying business students in microsoft office specialist certification excel core exam: lessons learned. *Inf. Syst. Educ. J.* 17, 4–11.

Barreto, H. (2015). Why excel? *J. Econ. Educ.* 46, 300–309. doi: 10.1080/00220485.2015.1029177

Barzegar, K., Nemat Tabrizi, A. R., Jafari Gohar, M., and Vahdany, F. (2020). The effect of linguistic homogenization on english proficiency of students, case study: junior students of shahid sadoughi university of medical sciences, 2018. *J. Commun. Health Res.* 9, 46–53. doi: 10.18502/jchr.v9i1.2572

Brooks, S., and Taylor, J. (2016). Improving the teaching of microsoft excel: traditional book vs. online platform. *J. Educ. Bus.* 91, 251–257. doi: 10.1080/08832323.2016.1175411

Carayannis, E. G., and Morawska-Jancelewicz, J. (2022). The futures of europe: society 5.0 and industry 5.0 as driving forces of future universities. *J. Knowl. Econ.* 13, 3445–3471. doi: 10.1007/s13132-021-00854-2

Certiport, a Pearson VUE Business (2025). *Microsoft office specialist: Excel certification*. Available online at: https://certiport.pearsonvue.com/Certifications/Microsoft/MOS/Certify/Excel.aspx (accessed March 10, 2025).

Crompton, H., and Sykora, C. (2021). Developing instructional technology standards for educators: a design-based research study. *Comput. Educ Open* 2:100044. doi: 10.1016/j.caeo.2021.100044

Damjanovic, S., and Katanic, P. (2023). Employing microsoft excel for enhanced mathematical and statistical online pedagogy in economics amidst a pandemic. *Educ. Sci. Manag.* 1, 58–72. doi: 10.56578/esm010201

de Vries, H. J., and Egyedi, T. M. (2010). "Standardization education: developments and progress," in *New Applications in IT Standards: Developments and Progress*, ed. K. Jakobs (New York: IGI Global Scientific Publishing), 204–215. doi: 10.4018/978-1-60566-946-5.ch010

Ehlers, U.-D., and Kellermann, S. A. (2019). *Future skills: The future of learning and higher education*. Technical report, Karlsruhe.

Gasigwa, T., Bimenyimana, S., and Nteziryimana, J. (2024). Teachers' attitude towards the use of excel software, to teach and learn statistics on learner's performance in rwanda's kicukiro public upper secondary schools. *J. Res. Innov. Implic. Educ.* 8, 246–252.

Helda, H., and Syahrani, S. (2022). National standards of education in contents standards and education process standards in Indonesia. *Indonesian J. Educ.* 2, 257–269. doi: 10.54443/injoe.v3i2.32

Iji, C. O., Abakpa, B. O., Agbo-Egwu, A. O., and Takor, D. I. (2022). Utilizing microsoft excel spreadsheet technology to improve senior secondary school students' achievement and retention in quadratic function in Nigeria education. *Int. J. Teach. Learn. Mathem.* 5, 1–14. doi: 10.18860/ijtlm.v5i1.18292

Kumar, M. D. (2023). A study on importance of microsoft excel data analysis statistical tools in research works. *J. Manag. Educ. Res. Innov.* 1, 76–83. doi: 10.5281/zenodo.10449150

Lavrijsen, J., Dockx, J., Struyf, E., and Verschueren, K. (2022). Class composition, student achievement, and the role of the learning environment. *J. Educ. Psychol.* 114, 498–512. doi: 10.1037/edu0000709

McCloskey, D. W., and Bussom, L. (2013). Active learning and student engagement in the business curriculum: excel can be the answer. *J. Learn. Higher Educ*. 9, 1–12.

Nahar, L. (2023). The effects of standardized tests on incorporating 21st century skills in science classrooms. *Integr. Sci. Educ. J.* 4, 36–42. doi: 10.37251/isej.v4i2.324

Rebman Jr, C. M., Booker, Q. E., Wimmer, H., Levkoff, S., McMurtrey, M., and Powell, L. M. (2023). An industry survey of analytics spreadsheet tools adoption: microsoft excel vs google sheets. *Inf. Syst. Educ. J.* 21, 29–42.

Roth, W. S. (2024). Spreadsheet skills training: required and needs improvement. *J. Educ. Bus*. 99, 59–68. doi: 10.1080/08832323.2023.2253488

Rubin, S. J., and Abrams, B. (2015). Teaching fundamental skills in microsoft excel to first-year students in quantitative analysis. *J. Chem. Educ*. 92, 1840–1845. doi: 10.1021/acs.jchemed.5b00122

Simaremare, S. T., Atika, L., and Siregar, R. (2024). Effectivity of the microsoft excel application on student understanding in statistics courses. *Indonesian J. Educ. Soc. Human*. 1, 9–19. doi: 10.62945/ijesh.v1i2.60

Skarpenes, O., and Walmann Hidle, K.-M. (2024). The clash of cultures: individualization and standardization in education. *Policy Futures Educ*. 22, 1–17. doi: 10.1177/14782103241226526

Timmermans, S., and Epstein, S. (2010). A world of standards but not a standard world: toward a sociology of standards and standardization. *Annu. Rev. Sociol*. 36, 69–89. doi: 10.1146/annurev.soc.012809.102629

Williamson, B., and Piattoeva, N. (2019). Objectivity as standardization in data-scientific education policy, technology and governance. *Learn. Media Technol*. 44, 64–76. doi: 10.1080/17439884.2018.1556215

World Economic Forum (2023). *Future of jobs 2023: these are the most in-demand skills now - and beyond*. Available online at: https://www.weforum.org/stories/2023/05/future-of-jobs-2023-skills/ (accessed November 13, 2024).