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The learning curve in Total Quality Management Education: Cognitive progression and pedagogical transformation using Bloom's taxonomy

Joel Mark P. Rodriguez[i]
Rizal Technological University, Mandaluyong City, Philippines

Ma. Del Carmen G. Labong[ii]
Rizal Technological University, Mandaluyong City, Philippines

Kathleen A. Bautista[iii]
Rizal Technological University, Mandaluyong City, Philippines

John Jarold M. Flores[iv]
Rizal Technological University, Mandaluyong City, Philippines

Jean T. Francisco[v]
Rizal Technological University, Mandaluyong City, Philippines

Abstract
This study examined the learning curve of college students in Total Quality Management using Bloom's Taxonomy to assess cognitive development from basic recall to higher-order problem-solving and creativity. Based on Bloom's taxonomy, Constructivist Learning Theory, and Outcomes-Based Education, this research aimed to identify factors influencing the learning of Total Quality Management, compare teaching strategies, and determine their effects on cognitive progression. A quantitative descriptive–correlational design was employed with 157 second-year Total Quality Management students using a validated Likert-scale questionnaire measuring teaching methods, prior knowledge, engagement, technology use, and assessment practices. Descriptive statistics and Spearman's rho correlation were applied to examine relationships between learning conditions and cognitive performance across Bloom's six levels. Findings revealed that case studies and project-based learning enhanced application skills, whereas lectures had minimal impact on cognitive development. AI-assisted tools and simulations were rated highly for improving analytical skills; however, no significant correlations were found between teaching strategies and higher-order cognition. These results suggest that instructional methods alone are insufficient without structured scaffolding and intentional learning design. The study highlights the need for problem-based learning, competency-driven assessments, and strategic digital integration in Total Quality Management education.

Keywords
Blooms taxonomy; competency development; learning curve; teaching methods; total quality management.

Curva de aprendizagem de estudantes universitários em Gestão da Qualidade Total (TQM) baseada na taxonomia de Bloom

Resumo
Este estudo examinou a curva de aprendizagem de estudantes universitários em Gestão da Qualidade Total utilizando a taxonomia de Bloom para avaliar o desenvolvimento cognitivo, desde a memorização básica até a resolução de problemas de ordem superior e criatividade. Baseada

na taxonomia de Bloom, na Teoria da Aprendizagem Construtivista e na Educação Baseada em Resultados, a pesquisa teve como objetivo identificar fatores que influenciam a aprendizagem da Gestão da Qualidade Total, comparar estratégias de ensino e determinar seus efeitos na progressão cognitiva. Um projeto quantitativo descritivo-correlacional foi empregado com 157 alunos do segundo ano de Gestão da Qualidade Total, utilizando um questionário validado na escala Likert que mediu métodos de ensino, conhecimento prévio, envolvimento, uso de tecnologia e práticas de avaliação. Estatísticas descritivas e a correlação rho de Spearman foram aplicadas para examinar as relações entre as condições de aprendizagem e o desempenho cognitivo nos seis níveis de Bloom. Os resultados revelaram que estudos de caso e aprendizagem baseada em projetos aprimoraram as habilidades de aplicação, enquanto as aulas teóricas tiveram impacto mínimo no desenvolvimento cognitivo. Ferramentas assistidas por inteligência artificial e simulações foram bem avaliadas por melhorar as habilidades analíticas; no entanto, não foram encontradas correlações significativas entre estratégias de ensino e cognição de ordem superior. Esses resultados sugerem que os métodos instrucionais por si sós são insuficientes sem um suporte estruturado e um projeto de aprendizagem intencional. O estudo destaca a necessidade de aprendizagem baseada em problemas, avaliações orientadas por competências e integração digital estratégica na educação Gestão da Qualidade Total.

Palavras-chave
taxonomia de Bloom; desenvolvimento de competências; curva de aprendizagem; métodos de ensino; gestão da qualidade total.

Curva de aprendizaje de estudiantes universitarios en Gestión de Calidad Total (TQM) basada en la taxonomía de Bloom

Resumen
Este estudio examinó la curva de aprendizaje de estudiantes universitarios de Gestión de la Calidad Total utilizando la taxonomía de Bloom para evaluar el desarrollo cognitivo, desde la memorización básica hasta la resolución de problemas complejos y la creatividad. Basándose en la taxonomía de Bloom, la Teoría del Aprendizaje Constructivista y la Educación Basada en Resultados, la investigación tuvo como objetivo identificar los factores que influyen en el aprendizaje en Gestión de la Calidad Total, comparar estrategias docentes y determinar sus efectos en el progreso cognitivo. Se empleó un diseño cuantitativo descriptivo-correlacional con 157 estudiantes de segundo año de Gestión de la Calidad Total, utilizando un cuestionario validado de escala Likert que midió los métodos de enseñanza, los conocimientos previos, la participación, el uso de la tecnología y las prácticas de evaluación. Se aplicaron estadísticas descriptivas y la correlación rho de Spearman para examinar las relaciones entre las condiciones de aprendizaje y el rendimiento cognitivo en los seis niveles de Bloom. Los resultados revelaron que los estudios de caso y el aprendizaje basado en proyectos mejoraron las habilidades de aplicación, mientras que las clases teóricas tuvieron un impacto mínimo en el desarrollo cognitivo. Las herramientas y simulaciones asistidas por inteligencia artificial obtuvieron una buena calificación en la mejora de las habilidades analíticas; sin embargo, no se encontraron correlaciones significativas entre las estrategias de enseñanza y la cognición de orden superior. Estos resultados sugieren que los métodos de instrucción por sí solos son insuficientes sin un apoyo estructurado y un diseño de aprendizaje intencional. El estudio destaca la necesidad del aprendizaje basado en problemas, las evaluaciones basadas en competencias y la integración digital estratégica en la formación en Gestión de la Calidad Total.

Palabras clave
taxonomía de Bloom; desarrollo de habilidades; curva de aprendizaje; métodos de enseñanza; gestión de calidad total.

1 Introduction

In the rapid transformation of educational systems, Total Quality Management (TQM) is now part and parcel of higher education institutions striving to improve teaching and learning, research, and institutions-industry communication (Nasim; Sikander; Tian, 2019). Although TQM is widely accepted as one of the engines of institutional performance and academic quality (Kistiani; Permana, 2020), it has attracted significantly less attention to how students learn and advance within TQM subjects, especially in business and management studies. It matters because quality learning is dependent on institutional policies but also on how the management principles of quality are internalized for use and transfer to academic and professional settings.

A key under-explored dimension of TQM education lies in student learning progression, from the foundational knowledge toward higher-order cognitive skills. Most existing studies focus on faculty performance and quality assurance mechanisms (Mohaimen *et al.*, 2022), such that limited understanding remains about how students develop cognitively in the different stages of learning. Without this understanding, institutions may fail to ensure that the instructional strategies are designed to build deep understanding and practical competence.

Higher education must, however, synchronize teaching approaches with these new needs through well-organized and multidimensional learning systems (Wei; Yin, 2024). The study investigates this by knowledge progression of students on TQM as in Bloom's Taxonomy that includes classification of learning from simple recall to higher reasoning and innovation. By mapping the learning curves, the study promises to improve the pedagogies, curriculum, and learner participation in TQM.

Ultimately, the resulting evidence will assist the institutions in refining their teaching methods to ensure that the students do not only memorize TQM concepts but can apply, analyze, and innovate in real-world contexts related to quality management. This would contribute to developing competent, industry-ready graduates. The study seeks to:

1. Determine how students perceived difficulty and advancement in learning about TQM concepts.
2. Establish different factors key to their learning curve (for example, teaching methods, prior knowledge, and engagement)
3. Analyze how different teaching strategies affect learning outcomes.
4.

1.1 Literature review

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1.1.1 Learning theories and framework in Higher Education

Established learning theories and frameworks underlie effective learning within higher education and guide the development of curricula and instructional strategies. Bloom's Taxonomy, created by Benjamin Bloom, classifies learning into cognitive, affective, and psychomotor domains, providing a very basic framework through which curriculum development and personalized learning results can be enhanced (Engin *et al.*, 2024). In business education, in which TQM requires analytical and practical skills, Bloom's taxonomy is a critical structuring of learning progression from basic recall to advanced application and innovation. Moreover, approaches that are based on Bloom's taxonomy have become effective in building vocabulary competency amongst students, specifically in business communication, which manifests how structured cognitive learning can impact student proficiency in any discipline (Jaiswal; Al-Hattami, 2020). More than the traditional instructional models, constructivist learning theory encourages active engagement using problem-based learning, group discussions, and collaborative projects, which improve critical thinking and facilitate better realization and knowledge of intricate issues such as TQM (Hidayatullah, 2024). In addition, the mode of learning through simulations promotes real-world experience, wherein students can develop practical problem-solving skills using scaffolding techniques and technology to facilitate different stages of learning (Chernikova *et al.*, 2020). This integration of the theories underlines the importance of a multi-faceted approach to learning in higher education: ensuring that the students not only understand the concepts of TQM but also apply them within professional practice.

1.1.2 TQM Education in Higher Education

TQM has been an important approach to improving teaching quality and institutional effectiveness in higher education. By focusing on particular management philosophies, TQM offers a systematic approach to continuous improvement in academic institutions (Lin; Zhang, 2019). One of the most popular uses of TQM is curriculum management because it integrates assessment methods and quality improvement, making the educational programs flexible and uniform (Rahmanto; Ramadhan, 2024). Furthermore, with the advent of e-learning, TQM ensures standards in e-learning by enriching the quality assurance mechanisms, optimizing control systems, and supervisory measures that facilitate effective delivery of online teaching (Di; Ju, 2023). Outside of academia, TQM has received much attention in molding the success of an organization in the service industry; its adoption would influence performance and global competitiveness (Magd; Negi; Ansari, 2021). However, despite the many advantages TQM has in education, its implementation comes with challenges, which must be planned and executed strategically to have sustained improvements in teaching quality and student satisfaction (Khurniawan *et al.*, 2020). TQM principles may be a strong foundation for the integration of teaching, learning, and institutional management excellence.

1.1.3 Cognitive learning progression in business education

Structured frameworks shape the cognitive learning progression of business education toward knowledge acquisition, problem-solving, and adaptability in complex business environments. OBE has proven that the performance of learners in business courses improves drastically, providing students with better knowledge, analytical skills, and career development opportunities (Saha *et al.*, 2023). Similarly, TQM principles help in cognitive development by incorporating quality leadership, teamwork, strategic planning, and empowerment, which creates a customer-centric attitude that is necessary for business success (Azhar, 2023). In addition to the conventional learning models, organizational learning promotes sustainable business practices through knowledge creation, retention, and transfer, allowing students to learn and develop sustainable business models (Ademi; Sætre; Klungseth, 2024). Moreover, through the integration of RL, student knowledge about business process mining becomes reinforced, offering predictive insights for business operations given uncertainty (Bousdekis *et al.*, 2023). In the same way, the role that TQM serves in character development explains how rigorous quality management approaches can promote good values, personal discipline, and strategic thinking-a factor that buttresses cognitive as well as affective development within business learners (Suandia, 2023). The observations above underscore the advisability of having systematic learning techniques incorporated into the business education curricula. In this respect, students have to learn theoretical concepts and build the cognitive abilities to enhance leadership and innovation in the business world.

1.1.4 Factors affecting the learning curve in TQM

There are several factors that affect the learning curve of students in TQM, such as teaching methods, prior knowledge, and student engagement. Simulation-based learning is the most effective teaching method for developing interpersonal skills and self-awareness, followed by case studies and traditional lectures, which also improve comprehension and practical application (Farashahi; Tajeddin, 2018). Among them, the case method pedagogy is especially productive in business learning, which ultimately leads to high satisfaction, superior quality of learning, increased competencies in using digital tools, and higher interest in the course

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(Gómez-López *et al.*, 2022). Moreover, this method could be easily utilized in large-size undergraduate business courses, which turns out to be a flexible as well as scaleable teaching tool (Moorhouse, 2021). Another critical element of the learning curve is prior knowledge activation, wherein strategies such as open-ended prompts and procedural supports enable students to tap into existing knowledge, hence making them have a better understanding and retention according to the precision and depth of the prior knowledge of the students (Hattan; Alexander; Lupo, 2024). Student involvement in teacher education enhances student engagement, motivation, and intrinsic learning; challenges the conventional dynamics of teachers and students; and promotes active learning and democratic values (Bergmark; Westman, 2018). All these aspects together describe how students develop in their understanding of TQM. Active learning strategies, structured knowledge-building techniques, and engaging pedagogical approaches are critical for creating a more effective and adaptive learning environment.

1.1.5 The role of technology in learning TQM

With technological development, TQM education will not be lacking in digital tools and learning resources, which means students get to learn more effectively. This way, the performance of students in acquiring knowledge improves with digital educational resources availability. The acquisition of knowledge becomes more flexible and accessible (Rakic *et al.*, 2020). Students in accounting and business courses have realized the efficiency of online teaching and learning tools, especially in distance learning environments, where technology allows for constant engagement and interaction (Abdel-Rahim, 2021). Simulation-based learning is also very effective in developing complex skills since it includes various scaffolding techniques and technology-assisted learning phases that improve problem-solving and analytical thinking (Chernikova *et al.*, 2020). More recently, such developing technologies as Artificial Intelligence (AI) have been transforming digital learning environments. It increases learners' engagement, satisfaction, and overall educational outcomes by personalizing the learning experience. The technology of blockchains is also becoming popular in higher education in safe record-keeping and is being used for the verification of academic credentials, ensuring the integrity of the learning records (Rodriguez, 2024). These technological advances redefine, as a whole, how TQM is taught and learned, and it makes education more efficient, accessible, and adaptable to evolving industry demands.

1.1.6 Assessment methods for learning TQM

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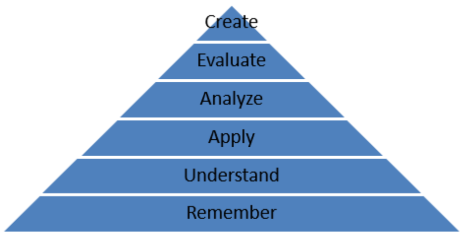
Effective assessment methods are critical for monitoring student learning progression in TQM to ensure that instructional strategies are aligned with desired educational outcomes. Bloom's Taxonomy is a basic framework for translating learning goals into measurable outcomes, which categorizes student development across cognitive, affective, and psychomotor domains (Gavrilović-Obradović; Zdravković, 2022). To develop metacognitive skills and learning outcomes, problem-based learning models based on a revised taxonomy of Bloom have been found to motivate critical thinking and problem-solving (Agung *et al.*, 2023). Further, in self-regulated learning strategies in digital learning environments, goal setting, self-evaluation, and time management are significant to the development of independent and reflective learning behaviors (Ceron *et al.*, 2021). Another critical aspect of learning assessment is evaluative feedback, which helps considerably in skill acquisition and the structured transfer of knowledge, especially in sequential decision-making tasks (Gupta; Biswas; Srivastava, 2023). While feedback in general has a moderate effect on student learning, it has a more significant impact on cognitive and motor skill outcomes rather than motivational or behavioral aspects, and the use of the right type of feedback is very important in educational settings (Wisniewski *et al.*, 2020). Collectively, these assessment methodologies ensure that students in TQM courses not only understand theoretical concepts but also develop the critical skills necessary for practical application in business environments.

1.1.7 Best practices in teaching and learning TQM

Implementation of TQM education with best practices entails strategic planning, collaboration, innovation, and the integration of technology in improving learning quality and increasing employability of students. Character education can be improved by proper systematic planning, active educator involvement, and adequate infrastructure in an educational setting with a focus on the structured management of quality, which contributes to student development as cited by Suandi, 2023. Teacher collaboration also helps significantly improve student academic performance, although such factors as reluctance by teachers, engagement, and lack of training impede its full realization in TQM-focused learning environments (García-Martínez *et al.*, 2021). Another emerging best practice is the integration of machine learning and artificial intelligence in higher education, which helps identify at-risk students and provide personalized interventions, thus improving student retention and promoting educational sustainability (Villegas-Ch; Govea; Revelo-Tapia, 2023). More so, several drivers such as governance leadership, student support, research, curriculum design, innovative practices, infrastructure, and collaboration act as the basis of having effectiveness TQM and employer-foes of students at HEIs, which demand optimization to make it a high-impact learning environment (Fernandes; Singh, 2024). Finally, developing innovation performance in higher education is the strengthening of TQM practices and the development of an organization's learning capabilities to ensure competitiveness that continues to improve the teaching methodology being used in higher education (Jabri; Nadarajah, 2021). These best practices strengthen the holistic and adaptive approach about teaching and learning of TQM to ensure students have the skills, knowledge, and competence needed at the academic and professional levels.

1.2 Theoretical framework

Figure 1 – Bloom's Taxonomy Pyramid



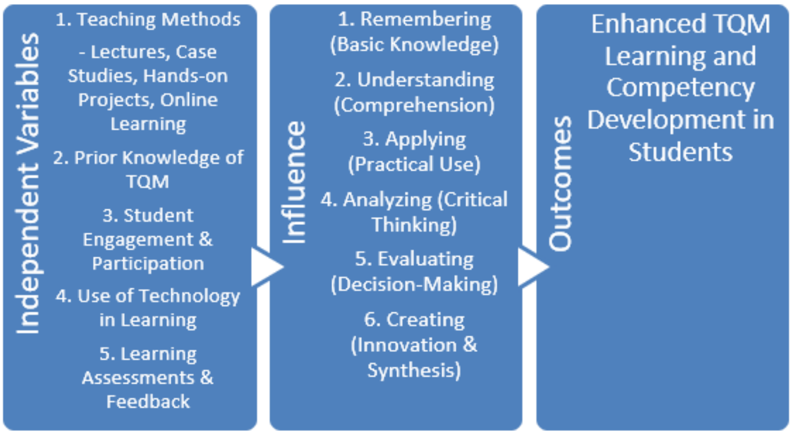
Source: Own elaboration (2025).

Bloom's Taxonomy, offers a structured method for gauging students' learning curve in TQM. The model breaks down cognitive learning into six stages, ranging from basic recall (Remember) to higher-order ability (Create). When learning TQM, students need to understand fundamental concepts, apply them to practice, examine quality processes, assess their impact, and design innovative solutions. The current study, therefore, applies Bloom's Taxonomy to gauge students' learning curve in TQM, noting how instruction approaches, prior knowledge, and interaction affect their development. By organizing instruction into these cognitive stages, instructors can maximize learning mechanisms and increase competency development in TQM learning.

1.3 Conceptual framework

This study analyzes a college student's learning curve in TQM to Bloom's Taxonomy of learning domains. The framework categorizes teaching methods, prior knowledge, student interest, technology use, and evaluation methods as basic elements of cognition progression in TQM.

Figure 2 – Conceptual framework (Rodriguez *et al.*, 2025)



Source: Own elaboration (2025).

At the lowest level (Remembering) students get exposed to fundamental concepts of TQM, and move on to Understanding, Applying, and finally Analyzing to gain problem-solving competency. In higher-order thinking skills, Evaluating and Creating, learns can assess quality management approaches and put forth original ideas and solutions. This study seeks to understand which factors along the way influence the development of TQM competencies and in turn assist educators on how to better their students learning outcomes.

1.4 Research question

Based on the conceptual framework, the study aims to analyze the learning curve of university students in TQM using Bloom's Taxonomy of Learning Domains. The subsequent research questions are developed to align with the independent variables (learning factors), the cognitive learning process (Bloom's Taxonomy), and the overall learning outcomes:

1. What are the Factors Influencing of College students in learning TQM in terms of:
   1.1. teaching methods
   1.2. prior knowledge of TQM
   1.3. Student Engagement & Participation
   1.4. Use of Technology in Learning
   1.5. Learning Assessments & Feedback
2. What is the Learning Progression Based on Bloom's Taxonomy of the students in terms of:
   2.1. Remembering (Basic Knowledge)
   2.2. Understanding (Comprehension)
   2.3. Applying (Practical Use)
   2.4. Analyzing (Critical Thinking)

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2.5. Evaluating (Decision-Making)
2.6. Creating (Innovation & Synthesis)

3. Is there a significant relationship between teaching methods (lectures, case studies, hands-on projects, online learning) and students' cognitive learning progression in TQM?
4. Which factors influencing learning in TQM have the strongest correlation with higher-order cognitive learning (Applying, Analyzing, Evaluating, Creating) in TQM?
5. What strategies can be implemented to enhance TQM education and improve student learning outcomes?

2 Methodology

Evaluating the learning curve of students in TQM has been carried out using Bloom’s Taxonomy, through a quantitative descriptive-correlational research design. In the correlational part, the relationship between some selected teaching strategies and the students learning cognition progression in TQM is investigated. The descriptive part Studies important factors of learning, including teaching techniques, levels of technology interest, learner engagement, and evaluation methods. A survey questionnaire in the Likert scale format was designed, aiming to obtain information about the students’ learning results and to measure their learning outcomes. Many selected instructional practices were subject to correlation and regression analyses to establish basic relationships between the students’ learning outcomes and the learning development. This works by providing this evidence because there is increased value in discovering particular growths in the student's learning and finding the most effective ways that aid the students in achieving higher-order thinking skills in University.

2.1 Participants and sampling technique

This study’s participants include 157 second-year students from four sections of TQM subjects offered in the first semester. Respondents were chosen through stratified random sampling to provide equal representation across the sections. This method is more efficient because it helps assess students’ learning progress without bias. The chosen students shed light on elements affecting their learning curve in TQM, which is in line with the study objective of measuring cognitive progression on Bloom’s taxonomy.

2.2 Data gathering procedure

A validated and reliable survey questionnaire was distributed to 157 second-year students participating in four TQM sections throughout the study's first semester at Rizal

Technological University. The questionnaire was divided into several sections, including cognitive development, learning components, instructional efficacy, and demographic data. The questionnaire was reviewed by experts to ensure its validity before being validated using the Lawshe Validity Method. Reliability was assessed using a pilot test, and the findings demonstrated high internal consistency with a Cronbach's Alpha of 0.905. The stratified random selection method ensured that every possibility was fairly represented. Surveys were distributed during class hours, and the students were given an adequate amount of time to answer them anonymously. Then, the statistical methods were applied to the data collected through these surveys to if they showed learning progression and whether the teaching methods were responsible for changing cognitive skills and TQM.

2.3 Data analysis

All the descriptive statistical parameters like the demographic profile, frequency, mean, and standard deviation of students' answers were collected in this study, providing a comprehensive view of the TQM learning experience in general. The reliability of the questionnaire was checked by calculating Cronbach's Alpha, and the outcome of the analysis was 0.905, explaining that the survey items exhibited a high level of correlation. The degree and direction of the relationships between different teaching strategies applied and the students' cognitive learning development was examined by utilizing the Pearson Correlation Coefficient. To discover the most robust approach to exercise that will produce positive effects on the teaching of higher-level cognitions (Applying, Analyzing, Evaluating, and Creating), regression analysis was performed. The use of these statistical procedures led to a comprehensive and data-based review of the improvement of TQM skills in students and it was possible to extract some deep findings from the data.

3 Results

Table 1 – Demographic Profile of the Respondents

Gender	***f***	***%***
Female	75	47.80 %
Male	82	52.20 %
Total	**157**	**100%**
Age	***f***	***%***
18 to 20	62	39.40 %
21 to 23	71	45.30 %
24 and up	24	15.30 %
Total	**157**	**100%**
Section	***f***	***%***
Section A	41	26.10 %

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Section B	37	23.60 %
Section C	38	24.20 %
Section D	41	26.10 %
Total	**157**	**100%**

Source: Own elaboration (2025).

The age, section and gender distribution of the respondents as in Table 1 indicates their population profile. The gender-wise respondents are fairly evenly distributed with 52.20% (82 individuals) as male and 47.80% (75 individuals) as female. It indicates nearly equal representation of both sexes with a slight predominance of male respondents. Compared with age distribution 21 to 23-year-old respondents (45.30%), followed by those between 18 and 20 years (18.40%). The least category is respondents that are 23 and above (15.30%). This can imply that the population surveyed contains mostly young adults with a big percentage of them in their late twenties. In categorizing sections respondents are spread over four sections with Section A and Section D being most represented (26.10% each). Section C represents 24.20% of the total with Section B being the smallest at 23.60%. The fairly even split between sections means that respondents were quite well chosen without much bias towards a particular group. Overall, the demographics reflect a broadly distributed sample in relation to section and gender and are concentrated amongst the younger members particularly those around early 20s.

Table 2 – Factors Influencing Learning in TQM

Teaching Methods	***Mean***	***SD***	***Verbal Interpretation***
1. Lectures provide clear explanations of TQM	3.08	1.33	Neutral
2. Case studies help understand real-world applications	3.48	1.19	Neutral
3. Hands-on projects improve the TQM application	3.55	1.18	Agree
4. Online learning resources enhance understanding	3.70	1.28	Agree
Overall Mean	**3.45**	**1.25**	**Neutral**
Prior Knowledge of TQM			
1. Had prior knowledge of TQM before this course	2.85	1.25	Neutral
2. Prior knowledge helped me understand advanced TQM concepts	3.09	1.33	Neutral
3. Lack of prior exposure made learning challenging	3.20	1.41	Neutral
Overall Mean	**3.05**	**1.33**	**Neutral**
Student Engagement and Participation			
1. Actively participate in class discussions	3.17	1.22	Neutral
2. Collaborate with classmates on TQM activities	3.43	1.31	Neutral
3. Group discussions help understand TQM concepts	3.62	1.36	Agree
Overall Mean	**3.41**	**1.30**	**Neutral**
Use of Technology in Learning			
1. Online learning platforms support TQM learning	3.25	0.89	Neutral
2. AI-based tools help understand complex TQM concepts	3.80	1.01	Agree
3. Simulation-based learning improves application of TQM	4.01	1.14	Agree
Overall Mean	**3.69**	**1.01**	**Agree**
Learning Assessments and Feedback			
1. Quizzes & exams effectively test understanding	3.17	1.29	Neutral
2. Instructor feedback helps improve TQM application	3.23	1.24	Neutral

3. Project-based assessments allow practical application	3.52	1.40	Neutral
Overall Mean	**3.31**	**1.31**	**Neutral**

Legend: “1.00-1.49 Strongly Disagree”, “1.50-2.49 Disagree”, “2.50-3.49 Neutral”, “3.50-4.49 Agree”, “4.50-5.00 Strongly Agree”.
Source: Own elaboration (2025).

The table 2 explores determinants of learning in TQM under teaching approaches, existing knowledge, student motivation, technology utilization, and testing. Teaching approaches got a neutral rating (mean = 3.45), although students preferred experiential projects (3.55) and internet-based learning materials (3.70) to conventional lectures. Pre-course knowledge of TQM had little effect (mean = 3.05, Neutral), suggesting that students acquired concepts in the course rather than drawing on pre-existing knowledge. Student participation was neutral (3.41), but group discussion (3.62, Agree) was helpful, implying that learning in groups improves understanding. Use of technology (3.69, Agree) was the most highly rated item, with AI-based software (3.80) and simulations (4.01) making a significant contribution to learning. Assessments and feedback (3.31, Neutral) indicated that students preferred project-based assessments (3.52) over quizzes or instructor feedback. Technology-based, hands-on, and discussion-type learning strategies were generally more effective overall, whereas traditional lectures, prior knowledge, and traditional forms of assessment were less effective. Increased interactive and technology-based approaches could further enhance TQM learning results.

Table 3 – Learning Progression Based on Bloom’s Taxonomy

Remembering (Basic Knowledge)	***Mean***	***SD***	***Verbal Interpretation***
1. Can recall fundamental TQM concepts	3.22	1.37	Neutral
2. Can define key TQM principles accurately	3.25	1.25	Neutral
3. Can list essential TQM tools and techniques	3.60	1.37	Agree
4. Can recognize the historical development of TQM	3.20	1.45	Neutral
Overall Mean	**3.32**	**1.36**	**Neutral**
Understanding (Comprehension)			
1. Can explain the role of TQM in business processes	3.41	1.28	Neutral
2. Understand how different TQM models (e.g., PDCA, Lean) work.	3.62	1.12	Agree
3. Can differentiate between Quality Control & Assurance	3.68	1.09	Agree
4. Can describe how TQM principles apply to different industries	3.93	1.14	Agree
Overall Mean	**3.66**	**1.16**	**Agree**
Applying (Practical Use)			
1.Can apply TQM tools in problem-solving	3.13	1.47	Neutral
2.Used TQM principles in case studies/projects	3.62	1.20	Agree
3.Can implement PDCA cycle to improve processes	3.59	1.22	Agree
4.Can conduct basic quality control checks	3.95	1.12	Agree
Overall Mean	**3.57**	**1.25**	**Agree**
Analyzing (Critical Thinking)			
1.Can identify quality management problems & suggest improvements	3.54	1.46	Agree
2.Can analyze a business case for quality enhancement	4.02	0.94	Agree

3.Can break down TQM strategy to find strengths/weaknesses	3.84	1.11	Agree
4.Can interpret data from quality reports and suggest improvements	4.34	0.65	Agree
Overall Mean	**3.94**	**1.04**	**Agree**
Evaluating (Decision-Making)			
1. Can assess effectiveness of different TQM strategies	3.53	1.12	Agree
2. Can compare effectiveness of different QM approaches	3.93	1.01	Agree
3. Can justify selection of TQM tools for a scenario	3.70	1.16	Agree
4. Can evaluate success of a quality improvement initiative	3.62	1.29	Agree
Overall Mean	**3.70**	**1.15**	**Agree**
Creating (Innovation & Synthesis)			
1.Have proposed quality management improvements/innovations	3.41	1.21	Neutral
2.Feel confident designing a TQM-based strategy	3.59	1.15	Agree
3.Can develop new quality improvement models	3.80	1.15	Agree
4.Can create a project proposal integrating TQM strategies	3.51	1.33	Agree
Overall Mean	**3.58**	**1.21**	**Agree**

Legend: "1.00-1.49 Strongly Disagree", "1.50-2.49 Disagree", "2.50-3.49 Neutral", "3.50-4.49 Agree", "4.50-5.00 Strongly Agree".

Source: Own elaboration (2025).

Table 3 of TQM learning progression according to Bloom's Taxonomy brings out different levels of cognitive growth among students. Remembering (3.32, Neutral) indicates that although students can remember basic concepts, they find it difficult to recall historical context. Understanding (3.66, Agree) shows that the students have a clear grasp of models of TQM, differentiation in quality, and applications in industries. Implementing (3.57, Agree) signifies TQM tool implementation expertise, especially in control checks and case studies. Business case analysis (4.02) and interpretation of quality reports (3.94) were very high with great capabilities. Evaluation (3.70, Agree) shows the ability to compare and assess TQM strategies effectively, e.g., the ability to select tools for circumstances. Developing (3.58, Agree) shows that students are able to design TQM strategy-driven projects and implement concepts therein. Overall, students perform best at evaluating and analyzing TQM principles, with practical application and innovation also well developed, but simple recall has to be enhanced.

Table 4 – Relationship Between Teaching Methods and Cognitive Learning Progression

		Remembering	***Understanding***	***Applying***	***Analyzing***	***Evaluating***	***Creating***
Lectures provide clear explanations of TQM	Spearman's rho	0.064	-0.126	-0.008	-0.038	0.039	-0.061
	p-value	0.424	0.117	0.918	0.634	0.63	0.451
Case studies help understand real-world applications	Spearman's rho	0.107	-0.186	0.201	-0.065	-0.102	-0.004
	p-value	0.183	0.02	0.012	0.42	0.204	0.961
Hands-on projects	Spearman's rho	-0.018	0.094	0.023	-0.056	0.127	-0.058

improve TQM application	p-value	0.824	0.24	0.774	0.489	0.114	0.468
Online learning resources enhance understanding	Spearman's rho	-0.009	-0.073	0.007	-0.087	0.013	-0.152
	p-value	0.907	0.362	0.927	0.277	0.873	0.057

Source: Own elaboration (2025).

The table 4 examines the correlation between teaching methods and cognitive learning development in TQM using Spearman's rho correlation. The results indicate that lectures are not correlated with any cognitive area, since all p-values are greater than 0.05, suggesting little effect on learning development. Case studies are found to have a very weak but appreciable positive association with application (ρ = 0.201, p = 0.012), proving that they support students in transferring TQM theories to real contexts, though not with understanding (ρ = -0.186, p = 0.02). Hands-on activities and web-based learning materials do not exhibit strong correlations with any cognitive areas, suggesting that although students might find them useful, their direct influence on quantifiable learning advancement is limited. Generally, case studies exert the strongest influence, specifically on application, while other approaches exhibit weak or non-significant correlations with cognitive learning phases.

Table 5 – Strongest Correlation Between Factors Learning Influence and Cognitive Learning of Students

		Teaching Methods	**Prior Knowledge**	**Student Engagement & Participation**	**Use of Technology in Learning**	**Learning Assessment & Feedback**
APPLYING	Pearson's r	0.110	0.077	0.081	0.034	-0.02
	p-value	0.168	0.34	0.313	0.670	0.804
ANALYZING	Pearson's r	-0.128	0.05	0.021	-0.097	0.026
	p-value	0.111	0.535	0.79	0.226	0.744
EVALUATING	Pearson's r	0.066	0.14	-0.143	-0.108	-0.001
	p-value	0.411	0.079	0.074	0.179	0.990
CREATING	Pearson's r	-0.118	0.047	-0.041	-0.113	-0.051
	p-value	0.141	0.562	0.609	0.160	0.525

Source: Own elaboration (2025).

Table 5 reports the relationship between learning influence factors and cognitive learning development through Pearson's r. The findings show that there are no significant or strong correlations between these factors and cognitive learning since all p-values are greater than 0.05. Methods of teaching have a weak positive relationship with applying (r = 0.110, p = 0.168) and evaluating (r = 0.066, p = 0.411), but these are not significant. Prior knowledge correlates weakly with evaluating (r = 0.14, p = 0.079), implying a possible effect, but still not significant. Student engagement correlates weakly with evaluating (r = -0.143, p = 0.074) and creating (r = -0.041, p = 0.609), with no strong predictive ability. Technology use and learning tests have little correlation with all levels of cognition. In general, the results indicate that none of these influences have a significant effect on cognitive learning development, calling for other teaching methods to promote student learning achievement.

Table 6 – Strategic Plan for Enhancing TQM Education for Higher Education

Strategic Goal	*Key Strategies*	*Expected Outcomes*	*Implementation Timeline*	*Responsible Entities*
Enhance Active and Experiential Learning	Implement case-based learning, hands-on projects, and simulation-based learning.	Improved critical thinking, problem-solving skills, and real-world application of TQM concepts.	Short-term (6-12 months)	Faculty, Curriculum Developers, Industry Partners
Integrate Advanced Technology in TQM Education	Utilize AI-based tools, blockchain for academic integrity, and gamified digital platforms.	Enhanced personalized learning, increased engagement, and streamlined academic record verification.	Mid-term (1-2 years)	IT Department, Faculty, Educational Technology Experts
Increase Student Engagement and Collaboration	Encourage group discussions, flipped classrooms, and industry mentorship programs.	Higher motivation, improved teamwork skills, and stronger connections between theory and practice.	Short-term (6-12 months)	Faculty, Student Organizations, Industry Experts
Optimize Assessment and Feedback Mechanisms	Introduce project-based assessments, self-regulated learning strategies, and AI-driven analytics.	More effective knowledge retention, targeted skill development, and better student learning tracking.	Mid-term (1-2 years)	Assessment Team, Faculty, AI & Data Analysts
Strengthen Institutional Support and Faculty Development	Provide faculty training, update curricula to align with industry standards, and promote research in TQM education.	Greater teaching effectiveness, curriculum relevance, and increased academic research output.	Long-term (2-3 years)	University Administration, Faculty, Research Departments

Source: Own elaboration (2025).

4 Discussion

The study results show that systematic, interactive, technology-enhanced approaches to TQM should be aligned with Bloom's Taxonomy and constructivist learning paradigms (Engin *et al.*, 2024; Hidayatullah, 2024). The empirical symptomatic results inferred suggest that the passing influence of the conventional lectures was exerted on the students at levels of Bloom's taxonomy,

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i.e. Remembering and Understanding, respectively, thereby implying that passive instruction did not contribute to the molding of initial cognitive skills. The case studies and project-type tasks much favored students in the field of Applying and Analyzing, thereby inline with research results concerning deeper cognitive processing and practical transfer of knowledge facilitated by experiential problem-based learning (Gómez-López *et al.*, 2022; Moorhouse, 2021). Therefore, the argument for cognitive progression has been strengthened in that past knowledge was poorly related with engagement; suggesting that higher thinking orders do not spring from mere exposure to a learner but are scaffolded in a systematic way and provided avenues for active construction of knowledge (Bergmark; Westman, 2018; Hattan; Alexander; Lupo, 2024).

In learning per se, technology-enhanced learning contributed most importantly to analytical reasoning and decision-making, located, all in all, at the upper tier of Bloom's taxonomy. This finds its corollary in literature stating that cognitives are enhanced by technology-embraced environments when merging into purposeful instructional designs (Chernikova *et al.*, 2020; Rodriguez, 2024). One the other hand, the application of technology vis-a-vis cognitive progression proved to be statistically insignificant, which means that digital tools do not in themselves create learning gains; this depends rather on their strategic alignment with desired learning outcomes along with support from monitored practice and feedback.

Assessment practices were consistent with these theoretical expectations. Students are extremely positive toward project-based assessments compared to traditional forms of quizzes in their ability to demonstrate learning, which correlate with performance tasks and reflective evaluation in an OBE and metacognitive development framework (Agung *et al.*, 2023; Wisniewski *et al.*, 2020). Such assessments, therefore, are reasoned to plug directly into the higher-order cognitive levels of Evaluating and Creating that require students to justify their decisions, synthesize concepts, and design an improvement initiative.

The results emphasize a deliberate intermix of project-based learning with experiential learning and technology. This project makes its way through the cognitive ladder from Understanding to Innovation in Bloom's. TQM teaching and competency of students with industry standards are changing insights; therefore, further inquiries should follow the path of personalized learning roads, AI-supported adaptive testing, and longitudinal impacts of hybrid methods of instruction.

4.1 Theoretical implications

The research findings support proven learning theories, such as Bloom's Taxonomy, Constructivist Learning Theory, and Outcome-Based Education (OBE), by showing that students perform well in analyzing and evaluating TQM concepts but perform poorly in simple recall and

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innovation. This implies that conventional lecture-based approaches are inadequate for promoting deep conceptual understanding and creativity, and active learning approaches are required. These are in line with Problem-Based Constructivist Learning Theory emphasizing problem-based learning, case studies, and project work over passive learning (Hidayatullah, 2024). The study also highlights the growing application of technology in teaching TQM, notably AI-based learning tools and simulation learning that strongly enhance problem-solving and decision-making skills (Chernikova *et al.*, 2020). But the weak correlation between technology use and cognitive learning development indicates that technology alone is not enough without instructional design. The research also validates the OBE model, competency-based learning, and project-based testing instead of conventional quizzes that had a limited effect on cognitive learning development (Saha *et al.*, 2023). Moreover, the results have implications for TQM education concepts, promoting improved teaching methods, curriculum relevance, and student-learning-centered methods (Lin; Zhang, 2019). Most importantly, the research highlights interactive, technology-enriched, and competency-oriented learning strategies that can enhance the quality of TQM education as well as its outcomes, guiding future research with adaptive learning model and innovative assessing methods.

4.2 Implications for teacher education

Some considerations for teacher education create a sense of urgency around preparing tomorrow's teachers in active-learning design, tech-enhanced teaching, and assessment strategies based on Bloom's Taxonomy. Teacher-education programs should impart pedagogical skills that enable imparting knowledge through problem-based, collaborative, and experiential approaches rather than through lecturing because these instructional methods have evidently progressed higher-order thinking more in students' learning. Other weak correlations between instructional methods and cognitive gains imply a need for some explicit training for teachers to scaffold themselves in an intentional sequence of instruction and to monitor student learning with the help of evidence-based assessments. If teacher education programs include these competencies in the curriculum, higher education will graduate professionals who can stimulate deep cognitive engagement, work with various learners, and enhance teaching practices across TQM and other professions.

4.3 Limitation of the study

This research is confined within a single institution TQM sample of second-year students and hence could not generalize its findings into other academic context. The study also used self-reported survey data which may result in a certain response bias failing to capture actual cognitive performance. Also, since the instructional delivery varied among the different instructors, this was not controlled for the short time frame within which the data were collected to capture long-term learning progression. Finally, because the correlational design cannot be interpreted causally, it suggests that further longitudinal or experimental research is needed to validate and continue developing these results.

5 Conclusions and recommendations

It strongly emphasizes systematic, interactive, and technology-enhanced pedagogies for strengthening the learning of TQM among students. The impact of active learning strategies such as case studies, collaborative projects, and experiential tasks has been seen to be significantly better in the ability of students to apply specific TQM tools and take many considerations in decision-making. However, conventional lectures add relatively little to cognitive development. These statements confirm Bloom's taxonomy in that higher-order thinking skills get triggered more easily with problem-based learning, co-operative discussion, and authentic performance task scenarios. The good reports by students regarding AI-based applications and simulation-based activities signify their prominence in developing analytical reasoning in business education as long as such should be meaningfully integrated into formalized instructional designs.

What further reinforced pedagogy was that competency-based, project-oriented assessments equivalent to OBE validated by this study turned out to be superior in terms of cognitive progression as compared to conventional "tests." These results further indicated the vital role of practical application, critical thinking, and creativity-all-important functions for readiness to join the industry-in the curriculum of business education. After all, it is inferentially understandable that no statistically significant correlation existed between teaching methods and cognitive learning progression since some confounding variables might have shaped the outcome, such as instructor-delivery style, students' prior academic preparation, motivation levels, and course duration. Thus, controlled designs, longitudinal data, and multi-institution samples should take care of these variables in future research.

The present study suggests strategies for further promoting TQM education, which include taking personalized learning routes, AI-powered adaptive assessment, and interdisciplinary teaching models to enhance cognitive growth. Studies into the long-term impact of experiential learning or the effectiveness of hybrid and blended instructional approaches will deepen the understanding of how business education is learning service-optimized while offering the needed quality management training in the ever-changing context of industry development.

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Joel Mark P. Rodriguez, Rizal Technological University, Philippines
[i] https://orcid.org/0009-0009-7195-8164
Regular Faculty at Rizal Technological University's College of Business, Entrepreneurship, and Accountancy (CBEA), specializing in Human Resource Management.
Authorship contribution: Study design, protocol development, data collection, data analysis and Authorship Contribution: The Overall Planning for this study, Conceptualization, Writing, Methodologies, Formal Analysis
E-mail: jmprodriguez@rtu.edu.ph

Ma. Del Carmen G. Labong, Rizal Technological University, Philippines
[ii] https://orcid.org/0009-0006-3661-1139
Master of Arts in Mathematics Education at the Rizal Technological University. At present, serves as the Head of the Student Records and Admission Unit (SRAU) and the University Registrar of the Rizal Technological University, where she leads efforts to strengthen academic records management and streamline student services.
Authorship Contribution: Formal Analysis, Methodology, Results Discussion, Data Curation
E-mail: mdcglabong@rtu.edu.ph

Kathleen A. Bautista, Rizal Technological University, Philippines
[iii] https://orcid.org/0009-0001-5521-0473

Doctor in education major in educational management both in Eulogio "Amang" Rodriguez Institute of Science and Technology (EARIST), with an extensive experiences educational teaching from the different university in metro manila. She is head of food services at Rizal Technological University.
Authorship Contribution: Revision and Editing, Language and Writing Style, Methodology
E-mail: kabautista@rtu.edu.ph

John Jarold M. Flores, Rizal Technological University, Philippines
[iv] https://orcid.org/0009-0004-0456-9293
Bachelor of Science in Business Administration major in Human Resource Management and Currently taking his thesis for Masters Degree in Pamantasan ng lungsod ng Marikina.
Authorship Contribution: Data Curation, Formal Analysis, Data Handling, Recommendations
E-mail: jjmflores@rtu.edu.ph

Jean Torres Francisco, Rizal Technological University, Philippines
[v] https://orcid.org/0009-0002-5070-1246
Certified Human Resource Associate and Learning and Development professional currently serving as Instructor I and Head of the PRIME-HRM Learning and Development Section at Rizal Technological University. And is presently pursuing Master in Business Administration (MBA).
Authorship Contribution: Administration of Questionnaire, Data Curation and Discussion
E-mail: jtfrancisco@rtu.edu.ph

DATA AVAILABILITY

The entire dataset supporting the results of this study has been published in the article itself.

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