

Technological acceptance of the use of AI tools by Mechatronic Engineering students at the UTD

Aceptación Tecnológica del uso de herramientas de IA en los alumnos de Ingeniería Mecatrónica de la UTD

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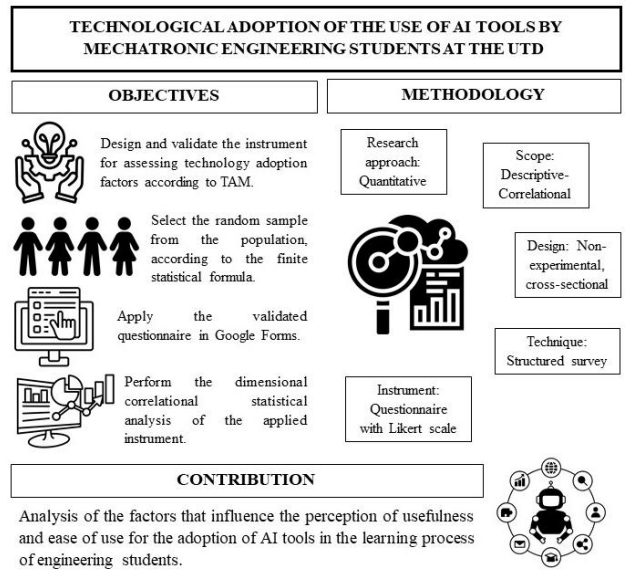


Abstract

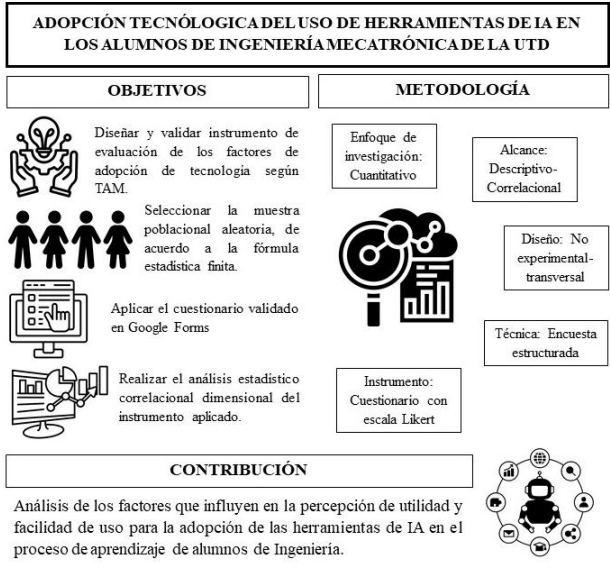
This research aimed to evaluate the factors that influence the adoption of AI tools by students at the Technological University of Durango, considering the dimensions of perceived usefulness, perceived ease of use, attitude toward technology, and intention to use, based on the Technology Acceptance Model [TAM]. A twenty-item questionnaire was designed and administered, validated with an Aiken's V coefficient of 0.97 and Cronbach's Alpha of 0.94. This instrument was administered to 149 students, and its statistical analysis showed that perceived usefulness is an important predictor of intention to use, with a correlation r of 0.647, given that students perceive the use of AI in their academic process as useful because it facilitates access to information and makes academic tasks more efficient.

Resumen

Esta investigación se orientó a evaluar los factores que influyen en la adopción de herramientas de IA por parte de los alumnos de la Universidad Tecnológica de Durango, considerando las dimensiones de percepción de utilidad, percepción de facilidad de uso, actitud hacia la tecnología e intención de uso, basadas en el Modelo de Aceptación de la Tecnología [TAM]. Se diseñó y aplicó un cuestionario de veinte ítems validado mediante coeficiente V de Aiken de 0.97 y Alfa de Cronbach de 0.94. Este instrumento se aplicó a 149 alumnos y su análisis estadístico mostró que la percepción de utilidad es un predictor importante en la intención de uso, mostrando una correlación r de 0.647, dado que los alumnos perciben útil el uso de la IA en su proceso académico ya que facilita el acceso a la información y eficientiza la realización de tareas académicas.



Artificial Intelligence, Perception, Technology Acceptance Model [TAM]



Inteligencia Artificial, Percepción, Modelo de Aceptación Tecnológica [TAM]

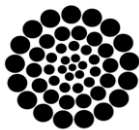
Area: Development of strategic leading-edge technologies and open innovation for social transformation

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Introduction

The incorporation of digital technologies into educational processes has brought about radical changes in the way students learn [UNESCO, 2019b]. Artificial Intelligence [AI] is based on the analysis of the human ability to reason according to their perceptions of facts and relationships between them, in order to obtain answers and develop knowledge. Currently, this technology has developed multiple applications to facilitate human tasks, among which the main functions include decision-making, pattern recognition, prediction, and autonomous learning [Russell & Norvig, 2016].

In 2005, Siemens emphasized that learning in the digital age requires a new theoretical understanding that includes connectivity and automation, given that AI represents an active component in students' cognitive processes. Zhang and Aslan [2021] mentioned that AI in education involves the study of areas such as computer science, learning sciences, psychology, neuroscience, linguistics, and other disciplines necessary to develop personal, adaptive, and effective learning environments to optimize traditional education. In this sense, AI has established itself as a strategic tool that promotes revolutionizing education through the personalization of learning, the analysis of educational data, and the automation of administrative tasks [Kamalov *et al.*, 2023].

The role of AI in learning lies in the use of intelligent simulators to facilitate tasks or processes of design and research in the field of education, by solving machine learning algorithms based on neural network models, using a representation and calculation method based on deep learning whose applications allow computers to learn to perform a myriad of tasks that promote learning, decision-making, problem-solving, language comprehension, and visual perception [Fernández De Silva, 2023].

The use of AI in education faces various challenges, including the lack of coherent public policies, limited technological infrastructure in educational centers, and a lack of teacher training. Combined with ethical and legal tensions surrounding the handling of personal data, this makes it necessary to establish regulatory frameworks to ensure its responsible and equitable use [UNESCO, 2019a].

Despite the incorporation of these technologies into the educational context, students' perceptions of their use are a determining factor in their acceptance, adoption, and effective use in their academic tasks. In this sense, perception is a cognitive process of consciousness [Allport, 1974], where students develop attitudes, beliefs, and feelings regarding the usefulness, ease of use, and ethical aspects of AI in their educational process. Understanding technology adoption processes allows us to assess the psychological, social, and technological aspects of the educational context, as well as the preferences and behavior of students in the digital age.

Several studies indicate that the main problem lies in understanding how students perceive AI, as this can directly influence their willingness to use these tools and take advantage of their benefits in their learning, given that a negative perception can limit their effective integration. Among the main studies, one conducted by Latifa Alzahrani in 2023 stands out, determining that facilitating conditions influence students' intention to use AI [Alzahrani, 2023].

Therefore, it is necessary to understand how students perceive the use of this technology in order to design pedagogical strategies that foster a positive attitude toward the responsible and ethical use of AI, as well as facilitate its acceptance and optimize its benefits in training processes.

This research was based on the Technology Acceptance Model [TAM] proposed by Fred Davis in 1986 to determine how factors of usefulness and ease of use influence students' perceptions of AI use and define its adoption in the educational context. This model is based on Reasoned Action Theory and uses measurement scales that predict user acceptance through psychometric properties, replacing attitudinal beliefs with constructs of perceived usefulness and perceived ease of use [Buabeng-Andoh, 2018].

This research took a quantitative approach, with a descriptive and correlational scope, whose objective was to evaluate students' perceptions of the use of AI in their learning process. The study population consisted of 236 students from the Mechatronics Engineering program at the Technological University of Durango in Durango, Mexico.

The research identified patterns of behavior and attitudes toward the use of AI by students. The results of the study provide scientific evidence that suggests the recurrent and indiscriminate use of this tool, influenced by sociocultural factors and technological trends, revealing the need to integrate AI content into the university curriculum through training and awareness programs that address technical and ethical aspects.

This analysis will contribute to strengthening the framework for the implementation of emerging technologies at the Technological University of Durango, promoting a more inclusive educational environment that is receptive to the challenges of the digital age.

Methodology

In this research, taking into account the study object, a quantitative approach was selected, with a descriptive and correlational scope, to find the relationship between the factors involved in the technological acceptance of AI and the learning process. The phenomenon is observed in its natural context without manipulation of variables, making this research non-experimental and cross-sectional research, given that the data was collected at a single point in time. The technique used is a survey, applying a structured questionnaire for data collection, facilitating quantitative analysis.

The stages of methodological development are shown in the figure 1 below.

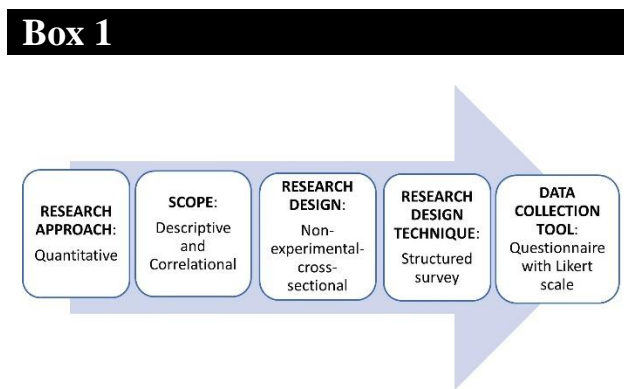


Figure 1
Research methodology approach
Source: Own elaboration

The first step in the process was to conceptualize and operationalize the variables, considering different criteria as presented in the following tables 1 to 4.

Box 2

Table 1
Variable: Perceived Utility [PU]

Dimension	Indicator	Item	Likert Scale
Efficiency	Improvement in academic performance	Using AI tools improves my academic performance	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly agree
Relevance	Relevance to learning and academic activities	I believe AI is important for achieving my learning goals.	
Productivity	Increase in academic productivity	AI tools help me complete my tasks more efficiently.	

Source: Own elaboration

Box 3

Table 2
Variable: Perception of Ease of Use [PEU]

Dimension	Indicator	Item	Likert Scale
Simplicity	Ease of learning and use.	It is easy to learn how to use AI tools.	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly agree
Accessibility	Availability and ease of access to AI tools	AI tools are readily available for use in academic activities.	
Intuition	Clarity of intuition in tool interfaces	The interface of AI tools is easy to understand and use.	

Source: Own elaboration

Box 4

Table 3
Variable: Attitude toward Technology Acceptance [ATA]

Dimension	Indicator	Item	Likert Scale
Simplicity	General willingness to use AI in education.	I feel positive about using AI in my learning.	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly agree
Accessibility	Level of curiosity and motivation to explore AI tools.	I am interested in learning more about AI tools and their applications.	
Intuition	Confidence in the usefulness of AI tools.	I trust that AI tools are useful and reliable for learning.	

Source: Own Elaboration

Box 5

Table 4
Variable: Intention to Use [IU]

Dimension	Indicator	Item	Likert Scale
Disposition	Willingness to adopt AI tools in academic activities.	I am willing to use AI tools for my academic tasks.	1=Strongly disagree 2=Disagree 3=Neutral 4=Agree 5=Strongly agree
Persistence	Intention to continue using AI in the future.	I plan to continue using tools in my studies.	
Application	Degree of AI integration in specific activities.	I will use AI tools to solve complex problems in my tasks.	

Source: Own elaboration

In accordance with the operationalization of variables based on TAM, a structured survey was designed, with 20-item considering a Likert scale. The questionnaire was submitted to expert review to validate its content, according to the criteria established in the following table 5.

Box 6

Table 5
Criteria to validate the survey's content by experts' review

Indicators	Criteria
Clarity	Appropriate language.
Objectivity	Expressed in observable behaviors.
Organization	Logical organization.
Sufficiency	Comprises aspects that are investigated.
Intentionality	Suitable for assessing the research object.
Coherence	Manifested in the questions asked.
Methodology	It is adequate.

Source: Own elaboration

The shown criteria were applied to each of the items of the survey. Then the experts could judge each item in a scale from 0 to 100 points, considering Deficient [0-40], Regular [41-60], Good [61-90] and Excellent [91-100].

Next, to measure the relevance of each item with respect to its construct, Aiken's V coefficient [V] was considered based on five expert judges in Educational Technology. Equation 1 shows how to calculate the mentioned coefficient.

$$V = \frac{\tilde{x}-l}{k}$$

[1]

Where:
V: Aiken's V coefficient
 \tilde{x} : average rating from judges
k: grade range [Max-Min]
l: lowest possible rating

In order to measure the instrument's reliability, the survey was applied to 42 students and the correlation of each item was determined using Cronbach's alpha coefficient, to assess the internal consistency of the instrument according to equation 2.

$$\alpha = \frac{K}{K-1} \left[1 - \frac{\sum_{i=1}^K S_i}{St} \right]$$

[2]

Where:
K: number of items
S_i: variance of each item
S_t: variance of all the items

The next step in the methodology was to apply the instrument to a sample of the population. The sample size was calculated based on the enrolment in the Mechatronics Engineering program for the May-August 2025 quarter, corresponding to 236 students. The finite sample was calculated using the following statistical formula [equation 3].

$$n = \frac{N \cdot Z_{\alpha}^2 \cdot p \cdot q}{e^2 \cdot (N-1) + Z_{\alpha}^2 \cdot p \cdot q}$$

[3]

Where:
n: size of the finite sample
N: population size
Z : statistical parameter that depends on the Confidence Level [CL]. Value of 1.96
e: maximum acceptable estimation error. Value 5%.
p: probability of occurrence of the studied event [success]. Value 50%.
q = [1 – p]: Probability of non-occurrence of the studied event. Value 50%.

The structured questionnaire in Google Forms was administered to 146 Mechatronics Engineering students at the Technological University of Durango to measure the dimensions of perception of AI use. For the correlational statistical analysis, SPSS version 27 software was used to identify the effect of the independent variables [perception of ease of use, attitude toward technology acceptance and intention to use] on the dependent variable [perceived usefulness] measured with Spearman's coefficient.

Results

Starting with the design and instrument’s validation stage, the results from the statistical analysis of the experts’ judgement are presented. Five expert judges in Educational Technology analyzed the items taking into account the criteria mentioned in the Methodology section, and from that a mean value of 3.99 was obtained, with a standard deviation of 0.14.

Applying equation 1, a value of 0.97 for Aiken’s V coefficient was found. This is considered a very high score for Aiken’s V coefficient, which, according to Charter [2003], means that the instrument is considered to have adequate content validity.

To determine reliability of the instrument, the responses from 30 questionnaires administered during the pilot phase were analyzed using the same SPSS software, to get the Cronbach’s alpha value, which was of 0.951.

According to the criteria established by George and Mallery [2003], Cronbach’s alpha values above 0.90 indicate an excellent level of reliability, which means that the items have high internal consistency and measure the proposed construct in a consistent manner.

Likewise, the correlations between the elements were analyzed to determine the degree to which the items measure the same variable [table 6].

Box 7

Table 6
Statistics for the correlations between the elements

	Mean	Mín	Max	Range	Max / Mín	Variance
Element’s means	3,715	3,233	4,033	,800	1,247	,048
Covariances between elements	0,475	,094	1,057	,963	11,220	,035
Correlations between elements	0,507	,086	,862	,776	10,043	,037

Source: Own Elaboration

The table above shows the descriptive statistics associated with the internal consistency analysis of the instrument. Regarding the correlations between items, the average was 0.507, with a minimum of 0.086 and a maximum of 0.862, with a range of 0.776. The maximum relationship was 10.043 and the variance was 0.037.

These values suggest that most items have moderate to high correlations, indicating that they measure aspects related to the proposed construct.

After applying the survey, a statistical analysis of the instrument was performed, to assess perceptions of AI use. From the 146 sample of students, it was determined that 125 were male [85.6%] and 21 female [14.4%], indicating a predominance of male participants in the study.

The gender frequency difference does not influence the use of AI tools in the learning process; it is simply due to the normal behavior in careers with this profile, given historical, sociocultural, and educational factors.

Next, the analysis of each dimension is shown. Starting with Perceived Usefulness [PU], the analysis revealed a central value [median] of 4 corresponding to the “Agree” level, where students agree that the use of AI improves their academic performance as it allows them to increase their productivity, as shown in the following table 7.

Box 8

Table 7
Frequency analysis of the dimension Perceived usefulness [PU]

PU levels according to Likert scale	Frequencies	% from total	Cumulative %
1	2	1.4%	1.4%
2	2	1.4%	2.7%
3	12	8.2%	11.0%
4	81	55.5%	66.4%
5	49	33.6%	100.0%

Source: Own Elaboration

As can be seen in the previous table, most participants rate the usefulness of the tool positively, and this influences its acceptance and use in accordance with the Technology Acceptance Model [TAM].

Continuing the analysis of Perception of Ease of Use [PEU], in this dimension, items were evaluated using criteria such as the ease of use of AI interfaces. The results present a median score of 4, where students agreed that ease of use promotes the constant use of AI in academic activities [table 8].

Box 9

Table 8
Frequency analysis of the dimension Perception of Ease of Use [PEU]

PEU levels according to Likert scale	Frequencies	% from total	Cumulative %
1	2	1.4%	1.4%
2	2	1.4%	2.7%
3	15	10.3%	13.0%
4	57	39.0%	52.1%
5	70	47.9%	100%

Source: Own Elaboration

The next analyzed dimension was Attitude toward Technology Acceptance [ATA]. Here, 80.2% of the surveyed students reflect a generally positive attitude toward the use of technology, corresponding to the levels 4 and 5 on the Likert scale. This shows a favorable disposition toward the adoption and application of AI [table 9].

Box 10

Table 9
Frequency analysis of the dimension Attitude toward Technology Acceptance [ATA]

ATA levels according to Likert scale	Frequencies	% from total	Cumulative %
1	2	1.4%	1.4%
2	3	2.1%	3.4%
3	24	16.4%	19.9%
4	69	47.3%	67.7%
5	48	32.9%	100.0%

Source: Own Elaboration

Finally, for the dimension of Intention to Use [IU] a value of 4 was obtained for the median on a Likert scale, representing that at least 50% of the participants expressed a high level of intention to use the technology, with a general tendency toward a high predisposition to use it in their learning process. The frequencies of Intention to Use [IU] are shown in table 10 below.

Box 11

Table 10
Frequency analysis of the dimension Intention to Use [IU]

IU levels according to Likert scale	Frequencies	% from total	Cumulative %
1	3	2.1%	1.4%
2	2	1.4%	3.4%
3	21	14.4%	17.8%
4	70	47.9%	65.8%
5	50	34.9%	100.0%

Source: Own elaboration

The table above shows a negative asymmetry in the frequency distribution and a concentration toward the high values on the scale, suggesting that most participants perceive the technology positively and also show a strong intention to adapt and use it.

As a last step, a dimensional correlation analysis was applied. Spearman's coefficient was applied to find correlations between the dimensions: Perception of Usefulness, Perception of Ease of Use, Attitude toward Technology Acceptance, and Intention to Use.

The results showed positive and significant correlations [$p < 0.001$], ranging from moderate to high in magnitude, indicating that higher levels in one dimension tend to be associated with higher levels in the other dimensions [table 11].

Box 12

Table 11
Spearman's correlations matrix

Dimensions	PU	PEU	ATA	IU
PU	-			
PEU	0.381 ***	-		
ATA	0.576 ***	0.390 ***	-	
IU	0.647 ***	0.436 ***	0.664 ***	-

Note: H_a is positive correlation.
Note: * $p < .05$, ** $p < .01$, *** $p < .001$, one tail.
Source: Own Elaboration

Table 11 shows a moderate positive correlation in terms of perceived ease of use, meaning that the easier the technology is to use, the more useful students perceive it to be. Meanwhile, perceived usefulness has a considerable influence on students' attitudes toward technology, showing a correlation value r of 0.576.

Perceived usefulness is an important predictor of intention to use, showing a correlation r of 0.647, since if students find the technology useful, they will be more inclined to use it. In general, all the dimensions evaluated are significant in Perceived Usefulness according to the Technology Acceptance Model [TAM].

Conclusions

This research highlights students' genuine interest in integrating AI into their academic work and research as part of their learning process, as high scores were obtained on the Likert scale in terms of their intention to use this tool.

The results also showed positive and significant correlations between perceived usefulness, ease of use, attitude, and intention to use, thus reinforcing the hypothesis that a positive perception generates greater willingness and openness to adopt AI tools.

However, concerns arise regarding the handling and privacy of personal data, making it imperative for institutions to establish regulatory policies on the use of AI in academic contexts, since training in ethical values and the social implications of AI must be a priority in order to prevent malicious use of information.

Currently, the implementation of AI in educational institutions faces significant structural obstacles, with insufficient technological infrastructure, a lack of coordinated public policies, and a lack of teacher training in digital pedagogy constituting the main barriers. In addition, the marked difference in technology adoption between urban and rural public institutions creates a digital technology access gap. On the other hand, it is necessary to incorporate the use of AI more emphatically into academic curricula to promote formal and systematic learning, considering theoretical, practical, and ethical components.

Some of the authors' recommendations for integrating AI into educational environments are:

- Create an institutional critical digital literacy program that considers ethical, technical, and social components.
- Promote a program of continuous training for academic staff in digital technology and pedagogical methodologies that integrate multiple intelligences and active learning.

Declarations

Conflict of interest

The authors declare no interest conflict. They have no known competing financial interests or personal relationships that could have appeared to influence the article reported in this article.

Author contribution

Garcia-Arambula, Cintia Germania. Contributed to the research idea, the method and the writing of the article.

Beltran-Zhizhko, Gali Aleksandra. Contributed to the research technique, the translation and revision of the article.

Marrufo, Luis Fernando. Contributed with applying the technique and the statistical analysis.

Herrera-Gonzalez, Raul Ivan. Contributed with the statistical analysis and revision of the article.

Availability of data and materials

The data analyzed in this article was collected directly by the authors.

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Abbreviations

AI – Artificial Intelligence
 UTD – Universidad Tecnológica de Durango
 TAM – Technology Acceptance Model
 ATA – Attitude toward Technology Acceptance
 IU – Intention to Use
 PU – Perceived Utility
 PEU – Perception of Ease of Use

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Antecedents

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Basics

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Discussions

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