Student Perception of an Online Course on Intellectual Property and Technology Transfer

Jesús Rigoberto Herrera García [1], Noemí Lizárraga Osuna [1], Marlene Zamora Machado [1], Rosa Citlalli Anguiano Cota [1]

[1] *Facultad de Ingeniería, Universidad Autónoma de Baja California, Blvd. Benito Juárez S/N, Parcela 44, 21280, Mexicali, México*

Abstract **– This article analyzes students' perception of an online course on intellectual property and technology transfer, evaluating the structure, learning activities, and the effectiveness of the instructional design. The study adopts a predominantly cross-sectional approach with a quantitative-descriptive methodology and highlights the positive assessment of the course design, which features organized modules and clear objectives. However, the need to improve interaction through forums and collaborative activities is noted. The evaluation reflects effective monitoring by instructors and an upbeat assessment of the activities, although optimizing the evaluation mechanisms for continuous monitoring of student progress is recommended. The sections on the legal and historical framework require adjustments in activities and evaluation rubrics. Despite these areas for improvement, the overall perception of achievement is high, emphasizing the effectiveness of the instructional design.**

Keywords **– Online learning, intellectual property, technology transfer, learning objectives.**

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Corresponding author: Jesús Rigoberto Herrera García,
Facultad de Ingeniería, Universidad Autónoma de Baja California, Blvd. Benito Juárez S/N, Parcela 44, 21280, Mexicali, México
Email: herrera.jesus27@uabc.edu.mx

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1. Introduction

Student perception is a relevant aspect in evaluating the effectiveness of online courses, particularly in specialized areas such as intellectual property and technology transfer. In this sense, [1] compare students' perceptions in a virtual course and a MOOC, highlighting aspects such as the clarity and quality of the content, the perception of accompaniment, and collaborative learning. Along the same lines on collaborative learning, the integration of technology is studied from the perception of students, showing how it increases peer cohesion and active learning [2].

Several studies analyze students' perceptions of learning practices, objectives and outcomes, assessment processes, and the impact of using technologies. Regarding this last point, students' perceptions of using Socrative in their learning process have been assessed [3], while transferable skills acquired in a simulation environment have been explored, highlighting the importance of self-reflection in learning [4].

On the other hand, a comparative study was conducted on students' perception of the difficulty of traditional exams in contrast to those taken from home during the COVID-19 pandemic, highlighting how these experiences influence student satisfaction and performance [5]. Similarly, the importance of aligning student perception with curricular learning objectives is underlined [6]. This research concludes that greater transparency in objectives and the inclusion of reflective activities improve students' understanding of their acquired skills, promoting the development of metacognitive skills that facilitate applying knowledge in real contexts.

This context encourages universities and other educational institutions to promote distance education in their development plans through strategies that reinforce the practical design of online courses.

These strategies range from training academic staff in the design, planning, and operation of online programs to creating teaching materials, advising students, selecting and administrating technological platforms, and establishing institutional guidelines that contribute to the overall success of these activities.

However, beyond the design and implementation, it is crucial to understand how students perceive these courses to ensure their effectiveness. Evaluating students' perceptions allows identifying which course elements meet their expectations and which need improvement. As [7] highlights the importance of the most significant criteria for students regarding overall quality, using a satisfaction scale's mean and standard deviation as indicators. On the other hand, [8] integrates relevant aspects of course preparation and identifies the fundamental principles for evaluation, such as reliability, validity, objectivity, and authenticity. In addition, presented is a list of learning assessment instruments for in-person and distance learning activities, which can be considered in the planning stage of course designs.

In this context, solid models for designing distance learning courses are essential. The main instructional design models reported in the literature are described, whose essential elements are analysis, design, development, implementation, and evaluation [9]. In turn, each of these elements and their requirements in instructional design are detailed, classifying them based on the taxonomies of instructional models, considering their orientations and specific selected characteristics, including teamwork, resources, skills, and experience in instructional design [10].

Along these lines, [11] proposes some parameters for assessing online learning, including aspects related to the automation of assessment. Highlighted is the assessment opportunities found in the literature and makes recommendations on the assignment of grades, such as the quality of responses, group work, and essays, as well as highlights the advantages and disadvantages of automation in online assessment. These aspects are relevant in the planning and operation stages and in informing the student about the assessment process.

Effective feedback to the student is another essential aspect in the design of distance courses. As [12] analyzes the quality of feedback, studying the roles of the professor and aspects such as the volume, tone, generality, and relevance of the comments.

In the background review, studies were also found that evaluate the impact of learning activities on achieving objectives. For example, hypotheses are raised related to the correlation between the time spent watching instructional videos and performance on midterm or final quizzes [13].

Following this line of research, this study also identifies the relationship between student perception and the results obtained in the final evaluation.

The specialized literature details the learning outcomes, activities, materials, and evaluation processes used in various educational modalities. For example, [14] conducts an exhaustive analysis of education in neurobiology, reviewing various instructional designs. This research extracts relevant information on the learning outcomes, the proposed objectives and activities, the key concepts addressed, the resources used, and the evaluation methods. This same structure is applied in this article for the intellectual property course.

Regarding the teaching of intellectual property, [15] defines a series of activities, expected learning outcomes, and forms of assessment in a face-to-face higher education system, in addition to assessing prior knowledge and the materials used. In practice, implementing these elements is facilitated by using platforms, where both information and activities can be organized according to the structure of the instructional design.

2. Methodology

A predominantly cross-sectional study was carried out, using a quantitative-descriptive research methodology to evaluate student perception and perform a statistical treatment of the data obtained at the end of the course, taught to a group of 39 students during the winter inter-semester period, lasting three weeks between December 2022 and January 2023. This approach allows for the observation of learning achievement, which contributes to understanding the effectiveness of instructional design.

At the end of the course, a set of instruments was applied to assess the achievement of the objectives, the relevance of the learning activities, the alignment with the typology of the activities, and the instructional design. Statistical parameters were calculated, including means and standard deviations for each learning objective, and the homogeneity of perceptions was analyzed using the standard deviation. In addition, hypotheses were formulated and validated using the t-student test with a significance level of $\alpha = 0.05$, allowing the statistical relevance of the findings to be established.

This comprehensive analysis covered all four modules of the course: Fundamentals of Intellectual Property (I), Copyright (II), Industrial Property (III), and Fundamentals of Technology Transfer (IV). A comparative study of the participants' perceptions of achievement in the Winter 2022 and Summer 2023 courses was also conducted based on the average course closure survey.

This comparative approach provides additional insight into the evolution of learning and the effectiveness of instructional design.

A correlation was established between the final assessment score and the perception of achievement, as well as between the assessment score and the assessment of the relevance of the learning activities. This study allows a better understanding of the relationships between variables and their impact on learning.

Additionally, data were collected on the learning activities that generated the most significant interest among students and their evaluations of the course's instructional design. Previous research reports results on students' preferences regarding assessment methods, that is, their perception of fairer assessment processes in disciplines such as mathematics and education [16]. Along these lines, patterns of student perception and attitudes toward continuous summative assessment were identified, considering aspects such as motivation, understanding, and performance [17].

As part of this comprehensive research, a survey was administered to participants in the Winter 2023 course. The survey focused on obtaining detailed perceptions about the use and skill of artificial intelligence tools in the educational field and considering the associated risks and good practices linked to their implementation.

3. Results

In the survey administered to all students, studentswere asked how they assessed their level of knowledge and/or skills about each of the objectives presented, using a Likert scale where 5 represents very high, 4 high, 3 neutral, 2 low, and 1 null. The data revealed that the mean (M_f) of the level perceived by the students in the objective addressed in Module I, "Understand the relevance of the protection of products or works resulting from intellectual work," was 4.6, with a standard deviation (SD_f) of 0.55. This figure indicates a very high level of achievement and greater consistency in the students' responses compared to the initial diagnostic assessment, highlighting that this unit presents the highest perception of achievement.

Table 1 also details the results of assessing the activities' (A) relevance and corresponding objectives (O). A clear increase in the level of achievement is observed, together with a reduction in the standard deviations at the end of the course. In this regard, it is noteworthy that in the initial diagnosis, analyzed by M_i and SD_i, the students could not adequately identify the historical background of intellectual property, which shows the most significant difference between the initial and final assessment.

Nevertheless, all the activities presented a very high level of relevance to recognize the relevance and impact of intellectual property as the one with the highest perception of achievement. In contrast, the objective of describing the most important aspects of international agreements on intellectual property obtained the lowest score.

Table 1. Breakdown of activities and perception of learning in module I "fundamentals of IP"

Activities and learning objectives	**M_i M_f**	**SD_i SD_f**
A.1.1: Types and categories of Intellectual Property (IP) [Quiz, Synoptic table]	- 4.89	- 0.33
O.1.1.1 Recognize the relevance and impact of intellectual property.	3.74 4.65	0.78 0.48
O1.1.2 Identify the categories and types of intellectual property.	2.97 4.46	0.95 0.61
A.1.2: Historical and legal framework of IP. [Explain the historical stages. Timeline of agreements. Overview of agreements.]	- 4.89	- 0.33
O.1.2.1 Identify the historical background of intellectual property.	3.74 4.65	0.78 0.48
O.1.2.2 Describe the most important aspects of international agreements.	2.97 4.46	0.95 0.61
A.1.3: Economic and cultural impact of Intellectual Property [Reflect on IP's social and cultural impact.]	- 4.89	- 0.33
O.1.3.1 Recognize mechanisms that promote economic development through IP.	3.74 4.65	0.78 0.48

In order to further analyze the evolution of students' perceptions of the objective "Recognise the relevance and impact of intellectual property," a Student's t-test was carried out. The hypotheses proposed were the null hypothesis (H0), which maintains no significant difference between the initial and final perceptions, and the alternative hypothesis (Ha), which suggests a significant difference. The results indicated a statistically significant difference ($t = 5.900$, $p < 0.0001$), which allowed rejecting the null hypothesis and support the idea of a positive evolution in students' perception throughout the course. This finding is relevant, as it suggests that the teaching strategies implemented have positively impacted the perception of learning.

Table 2 shows the results of evaluating the perception of the relevance of the activities and the degree of achievement of the objectives corresponding to Module II: "Analyze the characteristics of the various works that can be registered at the *Instituto Nacional del Derecho de Autor* (INDAUTOR)."

A notable increase in the objectives' achievement level is highlighted, accompanied by lower standard deviations in the final survey. It is important to note that, in the diagnostic stage, this module was identified as the most familiar to students before starting the course, although with a neutral level of knowledge in the area. Regarding the specific competence of this module, a mean (M) of 4.4 and a standard deviation (SD) of 0.69 were obtained.

Table 2. Breakdown of activities and learning perception for module II

Activities and learning objectives	**Mi Mf**	**SDi SDf**
A.2.1: Types of copyrighted works. [Infographic on works Review of the "*Ley Federal del Derecho de Autor*" as an essential resource (LFDA).]	- 4.63	- 0.65
O.2.1.1 Identify the characteristics of works eligible for protection.	3.06 4.57	0.97 0.61
A.2.2: Legal framework of copyright and administrative authorities. [Questionnaire on WIPO functions, moral and property rights. Multiple choice questionnaire.]	- 4.43	- 0.85
O.2.2.1 Explain the scope of the LFDA	2.97 4.57	1.12 0.65
A.2.3: Related rights Questionnaire on related rights. [Case study on copyright disputes.]	- 4.54	- 0.70
O.2.3.1 Identify the possible disputes that arise in copyright matters.	3.11 4.51	0.86 0.66

Regarding Module III, "Analyze the characteristics and elements of industrial property," the results of the students' perception are presented in Table 3. Regarding the level of achievement in the competency of this unit, a mean (M) of 4.28 was obtained with a standard deviation (SD) of 0.71, which places this unit as the one with the lowest level of achievement compared to the other units in the final evaluation. It is observed that the learning objective with the lowest score corresponds to the explanation of the process for the international protection of a patent, while the highest-rated objective is to recognize industrial property. This discrepancy can be explained by the cognitive process required in each objective since most of the activities in this unit are more oriented toward recognizing industrial property concepts rather than a detailed understanding of the international protection process.

Table 3. Breakdown of activities and learning perception for module III

Activities and learning objectives	**Mi Mf**	**SDi SDf**
A.3.1: Types of industrial property [Questionnaire on fundamental concepts. Database queries.]	- 4.63	- 0.69
O.3.1.1 Recognize industrial property.	2.89 4.80	0.93 0.47
O3.1.2 List the characteristics of a patent, a utility model, and an industrial design.	2.82 4.63	1.04 0.55
A.3.2: *Ley Federal de Protección a la Propiedad Industrial* (Federal Law on Industrial Property Protection) and its administrative authorities [General consultation of the "Ley Federal" (LFPPI). Multiple choice questionnaire on selected articles of the LFPPI.]	- 4.69	- 0.53
O.3.2.1 Identify the scope of the LFPPI.	2.66 4.60	1.14 0.60
O.3.2.2 Recognize industrial property rights.	2.74 4.49	1.09 0.56
O.3.2.3 Identify the functions of the IMPI.	2.66 4.49	1.14 0.61
A.3.3: National and international industrial property registration process. [Review of the patent application process. Develop an algorithm with a sequence of steps to obtain a patent.]	- 4.4	- 0.95
O.3.2.1 Identify the process to register a national patent.	2.48 4.66	1.01 0.54
O.3.2.2 Explain the process followed for the international protection of a patent.	2.37 4.46	1.14 0.70

The results of the assessment of the relevance of the activities of Module IV, "Examining the technology transfer potential of an invention," are presented in Table 4. Regarding the level of achievement of the competency of this unit, a mean (M) of 4.34 and a standard deviation (SD) of 0.76 were recorded. This module stands out for having the highest standard deviation among all the modules analyzed, indicating more significant variability in students' perceptions. The activity with the lowest weighting corresponds to understanding the level of technological maturity, while the highest-rated objective is defining technology transfer. It is important to note that the lowest-rated objective is assimilating the stages of transfer, which could indicate learning difficulties or the approach used to address this topic.

Table 4. Breakdown of activities and learning perception for module IV

Activities and learning objectives	**Mi** **Mf**	**SDi** **SDf**
A.4.1: Background to technology transfer [Conceptual framework research. Questionnaire.]	- 4.65	- 0.85
O.4.1.1 Define technology transfer.	2.77 4.65	1.16 0.48
O4.1.2 Explain the relevance and impact of technology transfer.	2.71 4.51	1.10 0.61
A.4.2. Technological maturity level (TRL). [Questionnaire on TRL methodology. Case study.]	- 4.26	- 0.92
O.4.2.1 Understand the level of development of a technology.	3.00 4.57	1.06 0.50
A.4.3 Mechanisms for leveraging intellectual property. [Questionnaire on examples of intangible assets and their management. Infographic on technology transfer mechanisms.]	- 4.63	- 0.60
O.4.3.1 Understand the mechanisms for carrying out technology transfer.	2.40 4.54	1.12 0.56
O.4.3.2 Assimilate the stages of technology transfer.	2.34 4.4	1.16 0.81

Table 5 compares the perceived level of achievement of module objectives in the winter and summer courses. A slight decrease is observed in the summer course; however, module I maintains the highest level in both periods, while module III registers the lowest level. This trend suggests that, despite the general decrease in summer, certain modules show a relatively stable performance.

Table 5. Perception of achievement level by course modules

	M (2022)	M (2023)
Module I	4.6	4.32
Module II	4.4	4.13
Module III	4.28	3.93
Module IV	4.34	4.1

Regarding the final assessment conducted in the summer 2023 course, it was observed that the average time to complete the exam was 27 minutes, with a total of 37 students completing it. This activity was conceived as a formative self-assessment tool intended to provide feedback on the learning process and was not considered for the final grade of the course or its accreditation.

Item discrimination indicates how effectively the questions distinguish between students who master the subject and those who do not. In the self-assessment provided, this indicator is considered adequate in 87% of the items and acceptable in 13%. Regarding item difficulty, measured as the percentage of students who answered correctly, the results indicate that 57% of the items have a medium difficulty. In comparison, 37% are considered manageable, and the remaining 6% are considered difficult, where the percentage of students who answered correctly is less than 30%. The discrimination and difficulty indicators partially validate the reliability of the student self-assessment within the conditions established for its execution.

Figure 1 presents a boxplot comparing the distributions of the final self-assessment score and the perceived achievement level; both normalized using a min-max scale. The diagram reveals that the final self-assessment score displays a broader dispersion, indicating more significant variability in student performance on the exam. In contrast, the perceived achievement level is more concentrated, suggesting that students tend to evaluate their achievement within a narrower range, generally leaning towards higher values.

Additionally, the higher median of the perceived achievement level compared to the self-assessment score supports the idea that students may overestimate their learning progress relative to their current performance.

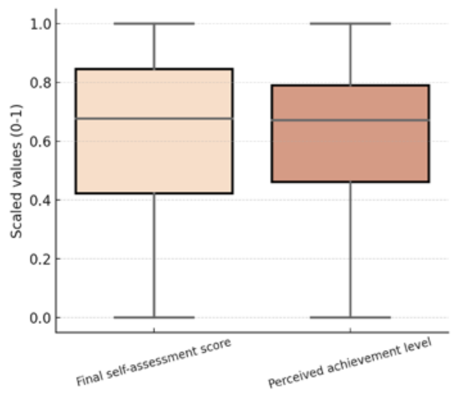

Figure 1. Boxplot of the distributions of the final self-assessment score and the perceived achievement level

Figure 2 shows a scatter plot of data between two variables: A = final self-assessment score completed by students and B = average of the perceived level of achievement of the different learning objectives.

The analysis revealed a moderate positive correlation (r = 0.33) between self-assessment scores and perceived achievement levels, suggesting that students who performed well on the self-assessment generally reported higher perceived achievement.

However, the presence of a subgroup of students with lower self-assessment scores (40–60) but high perceived achievement levels (>4.0) introduced variability into the data, indicating a potential misalignment between actual performance and self-perceived learning. The dispersion in self-assessment scores compared to the more concentrated distribution of perceived achievement suggests that some students may over- or underestimate their learning progress, emphasizing the need for additional assessment mechanisms to align self-perception with actual performance better.

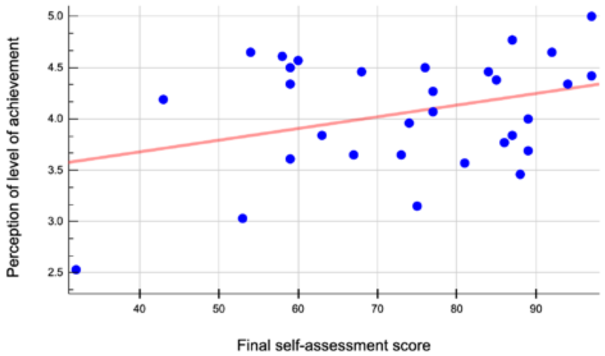

Figure 2. Scatter plot of assessment score data and perceived level of achievement of objectives

Additionally, as shown in Figure 3, a filter was performed, excluding data from the identified subgroup. The correlation increased significantly to 0.69, indicating a much stronger relationship between self-assessment scores and perceived achievement levels. This correlation coefficient suggests that students from this subgroup introduced inconsistencies in the data set, possibly due to an overestimation of their perceived learning.

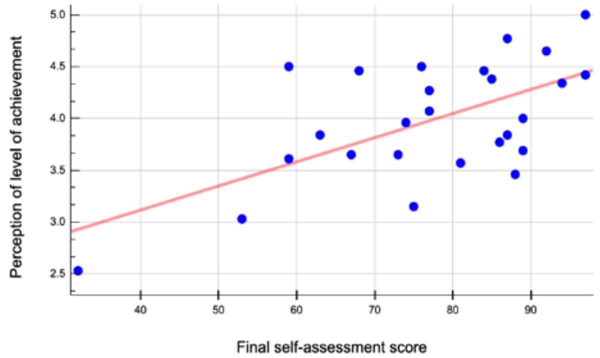

Figure 3. Scatter plot of self-assessment vs. perceived achievement (filtered data)

Figure 4 presents the dispersion of data between two variables: the x-axis represents the score of the self-assessment carried out at the end of the course, while the y-axis shows the assessment of the level of relevance assigned by the students to the course goals and activities. The calculated correlation coefficient is 0.3048; the correlation remains low even when excluding values of 5, representing the highest level assigned to all activities. This suggests that although students value the relevance of the activities positively, this assessment is not necessarily reflected in a proportional academic performance.

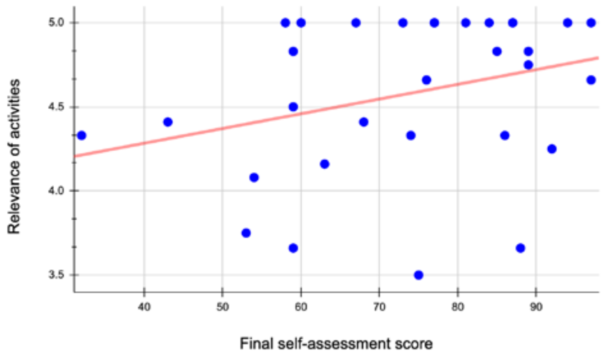

Figure 4. Scatter plot of assessment score data and rating of relevance of learning activities

Figure 5 presents the results obtained from the questionnaire given to the group of students in the winter course: “Rate the activities that you consider most attractive for online learning, using a scale where 5 represents very attractive and 1 not at all attractive.” It can be observed that the most attractive activities for students include multiple-choice questionnaires, closed questions, and topic research. In contrast, the least attractive is the development of algorithms, conceptual maps, and searching in databases. It is important to highlight that this type of evaluation of activities allows the identification of preferences and areas of improvement in the curricular design.

This same question was posed to the 2023 summer cohort, with similar results: the most highly rated activities were multiple-choice quizzes, topic research, and closed questions, while the least appealing included algorithm development, database searches, and timeline creation. The consistency in preferences of both groups suggests stable patterns in student preferences across different academic terms, which is useful for adjusting and optimizing the curriculum design in future course editions.

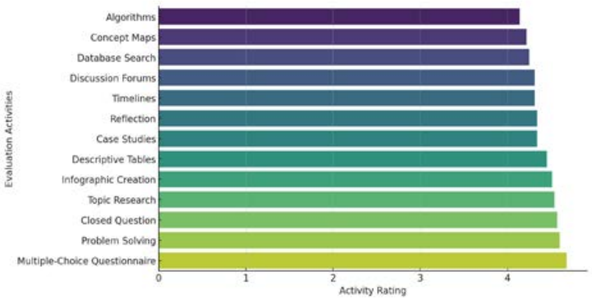

Figure 5. Evaluating types of online learning activities

As [18] classified assessment activities into 14 different types, suggesting that this course incorporates various assessment techniques. Notably, some activities mentioned in their classification, such as role-playing games and simulations, were not included in the present study.

3.1. Evaluation of Instructional Design

Table 6 presents the global results of evaluating the planning and execution of the winter course, which were obtained using the evaluation instrument developed for this purpose [19]. This same instrument has been applied in other educational contexts: it was used to evaluate 39 courses of the Civil Engineering program in b-learning mode, supported by the Moodle platform [20], while it was also applied to evaluate a distance learning self-training seminar, identifying, from the results, the opportunity to establish online coexistence standards according to the perception of the students [21].

The response options for each question in the instrument were: "5 (totally agree), 4 (agree), 3 (neutral), 2 (disagree) and 1 (totally disagree)". A primarily positive assessment is highlighted, close to the maximum level of agreement in the aspects evaluated. When comparing the results with the instrument used by [22], a discrepancy is observed in assessing the interaction between students, which suggests a lower perception in this aspect. Although the instruments used are not identical, similarities are highlighted in the axes evaluated, suggesting the possible application of this instrument in future course evaluations. The questionnaire results applied to the summer course students are consistent with those obtained from the winter group, indicating stability in the student's perception of the instructional design. However, a slight decrease is perceived in the average assessment, reaching 4.74, which could be due to specific contextual factors of the course.

Table 6. Assessment of the planning, monitoring and evaluation of the distance learning course

	M	SD
General orientation	4.89	0.33
Objectives	4.89	0.40
Contents	4.87	0.41
Interaction	4.8	0.43
Monitoring and tutoring	4.87	0.4
Evaluation	4.88	0.38

3.2. Integration of Artificial Intelligence Tools in the Course

A survey was implemented during the winter of 2024 to analyze the use of AI-powered tools, and 18 students participated. The objective was to identify the frequency and ability of use and the perceived challenges and benefits of these tools in their academic activities. According to the results presented in Figure 6, regarding the frequency of use of AI-based tools during the intellectual property and technology transfer course, students used them occasionally in some activities.

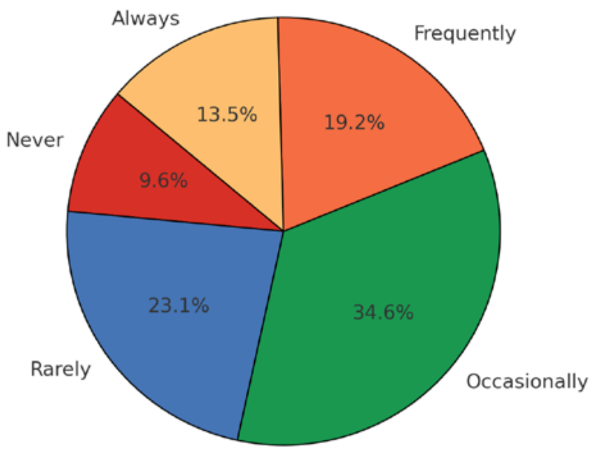

Figure 6. Frequency with which students used AI-based tools

Most students consider themselves moderately able to use these tools effectively. Also, Figures 6 and 7 show that only approximately 11% of students do not use the tool.

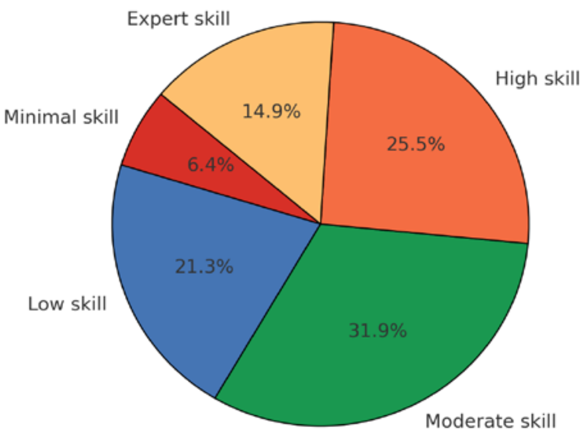

Figure 7. Ability of AI tools that students perceive for their use

In addition, opinions on the risks and effective practices of using artificial intelligence were collected through two questions asking participants to select three options. Among the main risks identified was the excessive dependence on technology, which can affect the development of analytical and critical skills and the possible loss of originality and creativity in academic works. On the other hand, the practices considered most effective in maximizing the benefits of artificial intelligence and minimizing its risks include verifying and validating the results generated by algorithms before their presentation and using multiple data sources to avoid biases and limitations in automated analyses.

4. Discussion

Regarding the assessment of the instructional design, the course shows an adequate organization of the information and learning modules, with intuitive access through a well-structured platform. Also noteworthy is the inclusion of clear and defined objectives in each activity, which facilitates understanding students' expected learning. Although most students accessed the platform without difficulties, greater interaction between participants, especially through discussion forums and collaborative activities, is needed.

Regarding the evaluation of the course, teachers received a positive evaluation for their monitoring and tutoring, as well as for the evaluation activities, both individual and group. However, the opportunity to optimize the self-assessment mechanisms is highlighted, mainly to measure the evolution and understanding of students more consistently throughout the course.

In the learning modules, it is detected that the sections on the legal and historical framework have a lower perception of achievement by the students, which suggests the need to improve the learning activities related to these specific topics. In addition, the importance of restructuring the evaluation rubrics to guide students more precisely and improve their performance in these activities is highlighted. The correlation between the self-assessment results and the assessment of the relevance of the activities is low, which suggests the need to implement more constant and transversal evaluation mechanisms throughout the course. Likewise, the importance of an initial diagnostic evaluation that provides a broader view of the learning processes in the virtual environment is identified.

Finally, students' perception of achieving course objectives is high, indicating that topics are effectively addressed through various learning activities and rigorous teaching materials. However, the need to improve certain less engaging activities, such as database searching, which is fundamental in the patent development process, is emphasized.

5. Conclusion

In conclusion, the findings of this study emphasize the crucial role of instructional design in shaping students' perceptions of learning effectiveness in online and hybrid environments. The strong alignment between learning objectives and activities, as perceived by students, reflects the successful integration of structured content and a well-articulated teaching method. Nevertheless, the results suggest the need to redesign lower-weighted activities with low perceived relevance or cognitive engagement to enhance their impact. The most challenging module identified is industrial property, particularly the learning objective related to explaining the steps required to obtain international protection for an invention, which should be refined for clarity and accessibility. Similarly, activities perceived as less relevant, such as those on technology readiness levels, should be recontextualized.

A positive correlation was observed between perceived achievement of learning outcomes and actual performance in summative assessments. However, to strengthen this relationship, it is necessary to incorporate strategies such as self-assessment and reflection activities that encourage deeper learning and foster greater autonomy in the learning process. In this regard, instructional design should continue evolving to include diverse learning activities that promote complex cognitive skills related to intellectual property and technology transfer.

The increasing use and self-reported proficiency in AI tools by students suggest opportunities to enrich the learning environment. While students report an awareness of ethics, instructional design must strike a balance between fostering innovation and maintaining academic integrity.

Building on these findings, future research should investigate the interaction and collaboration mechanisms in online environments to enhance communication processes that facilitate effective feedback and support collaborative learning. Furthermore, additional studies should focus on redesigning learning activities and developing assessment tools to promote higher achievement of learning objectives and strengthen students' perception of their progress.

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