

Awareness and Utilization of Intellectual Property Rights Among Engineering Students Engaged in Research and Innovation Activities: A KAP Study

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ABSTRACT

Background: Intellectual Property Rights (IPR) play a vital role in promoting innovation, protecting intellectual assets, and supporting technological advancement. Engineering students actively engaged in research and innovation are expected to possess adequate knowledge and practical understanding of IPR; however, evidence regarding their knowledge, attitudes, and practices (KAP) remains limited.

Aim: To assess the knowledge, attitudes, and practices related to Intellectual Property Rights among engineering students involved in research and innovation activities.

Materials and Methods: A cross-sectional descriptive-analytical KAP study was conducted among 300 undergraduate engineering students from a technical university in northern India between August and November 2024. Participants were selected using stratified random sampling. Data were collected using a validated 21-item questionnaire covering knowledge, attitude, and practice domains (Cronbach's $\alpha = 0.81$). Descriptive statistics and chi-square tests were performed using IBM SPSS Statistics version 26, with statistical significance set at $p < 0.05$.

Results: Adequate knowledge of IPR was observed in 64.7% of participants, while 69.3% demonstrated a positive attitude toward intellectual property protection. However, only 32.3% reported active IPR-related practices, revealing a substantial knowledge–practice gap. Students with prior IPR training and research exposure exhibited significantly higher knowledge, more positive attitudes, and better practical engagement than their counterparts ($p < 0.001$).

Conclusion: Engineering students demonstrated satisfactory awareness and favorable attitudes toward IPR but limited practical engagement in intellectual property activities. Integrating compulsory IPR education, practical workshops, technology transfer support, and patent facilitation into engineering curricula may help bridge the knowledge–practice gap and strengthen innovation outcomes.

Keywords: Intellectual property rights, KAP study, Engineering students, Patent, Innovation, Awareness.

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1. INTRODUCTION

Intellectual Property Rights (IPR) are a wide range of legal tools that grant control over the innovations and creative expressions of the human intellect, to the inventors or creators and institutions.¹ With the current knowledge-based economy and the technological innovation, protection and commercialization of intellectual assets have become essential components of sustainable development and national competitiveness.² Engineering students, being future technologists, entrepreneurs and researchers, play a crucial role in this ecosystem as they are the main drivers of the development of patentable technologies, software innovations and new designs that can revolutionize the industrial progress in the future.³

The global IP landscape is based on IP frameworks under the World Intellectual Property Organization (WIPO) and IP treaties like the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which requires signatory countries to provide a minimum level of IP protection.⁴ As a signatory to these international agreements, India has a relatively comprehensive IP regime which includes patents (Patents Act, 1970, as amended), copyrights (Copyright Act, 1957), trademarks, geographical indications, and industrial designs.⁵ Furthermore, the National IPR policy (2016) emphasized on the importance of IP education, awareness creation and commercialization, which highlighted that universities and technical institutions are key nodes in IP culture development in India.⁶

In spite of these policy requirements, empirical evidence indicates that IP awareness of university students in developing countries is still far from adequate. Knowledge gaps have been consistently reported in Southeast Asia, Sub-Saharan Africa and South Asia, especially in the procedural aspects of IP protection like the patent application process, prior art searches and technology transfers.^{7,8} The gaps are especially alarming for engineering students as their training is geared towards innovation and they are expected to play a role in national R&D ecosystems after graduation.⁹

Studies based on Knowledge, Attitude, and Practice (KAP) are a validated and widely-used epidemiological

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approach, initially developed in public health research, that has been growing in use for measuring awareness and patterns of practice in educational and policy areas.¹⁰ A KAP study is a three-dimensional evaluation that includes knowledge, attitude, and practice elements; knowledge is what a respondent knows, attitude is what he feels or perceives, and practice is what he does based on the knowledge and attitude.¹¹ This three-part framework is especially applicable to the IPR research among students, and a common finding across the research is the so-called knowledge-practice gap: students might be aware of IP concepts, but either do not practice them or do not do so for commercial purposes.¹²

Indian engineering education system is a very interesting field for such investigations. India has one of the world's biggest engineering education ecosystems with more than 6,000 engineering colleges and about 2.9 million students graduating each year.¹³ The IP output of technical institutions, however, is still comparatively small in comparison to this scale, and one reason for this has been suggested to be due to lack of IP awareness and IP in the curriculum.¹⁴ A number of institutions have a strong focus on IP literacy as one of their graduate attributes, with emphasis from the National Assessment and Accreditation Council (NAAC) and All India Council for Technical Education (AICTE).¹⁵

The critical review of the literature shows that previous studies have mainly examined either awareness or attitude and practice as a secondary issue. Comprehensive KAP studies of engineering students who are actively involved in research and innovation activities (R&I) are rare, since these students are most likely to come up with a protectable IP. Moreover, the particular domain of practice such as patent database search, technology disclosure and patent clause insertion into research proposals have rarely been

studied in engineering contexts in India.¹⁶ The present study thus is designed to address these gaps in the available evidence, by engaging a structured KAP assessment among engineering students who are actively involved in research activities, to generate data for curriculum reform, institutional IP policy, and specific awareness interventions.

2. METHODOLOGY

2.1. Study Design and Setting

The study evaluated the Knowledge, Attitude, Practices of the subjects using cross sectional descriptive-analytical KAP approach from the technical university of the northern part of India from August to November 2024. The institution was chosen purposively because of their active research environment, having a technology transfer office and having an institutional incubation center.

2.2. Study Population and Sampling

The study population included undergraduate engineering students (Years 1-4) studying all branches and involved in research or innovation in the last 6 months. The sample size was calculated at 300 with a 95% confidence level, an estimated prevalence of 50%, and an allowable error of 5.6% with 10% for non-response. Stratified random sampling was employed and the strata were determined by year of study and branch of engineering.

2.3. Data Collection Instrument

A QA pre-validated questionnaire was drawn up and approved by three experts in the field on IP law and engineering education. The final instrument included 21 items divided into four domains A (sociodemographic characteristics) B (Knowledge domain) C (Attitude domain) and D (Practice domain) with 5 items in each. The reliability coefficient of Cronbach's α was 0.81. The full questionnaire with items, response options and scoring criteria are given in **Table 1**.

Table 1: Complete KAP Questionnaire – All 21 items with response types and scoring criteria

S. No.	Question / Statement	Response Type	Scoring Criteria
Section B: Knowledge Domain (K1–K7) – Response options: Correct / Incorrect / Unsure			
K1	Define Intellectual Property Rights (IPR) in your own words: which of the following best describes IPR?	—	
K2	Which of the following are recognized types of Intellectual Property? (Select all that apply): Patent / Copyright / Trademark / Trade Secret / Industrial Design	—	
K3	Which statement correctly describes the patent filing process in India (application to grant timeline)?	—	
K4	Under Indian copyright law, how long is the copyright protection period for literary works?	—	
K5	What is the key difference between a trade secret and a patent for protecting an invention?	—	
K6	Which institution is responsible for granting patents in India?	—	
K7	What is the primary role of the World Intellectual Property Organization (WIPO)?	—	
Section C: Attitude Domain (A1–A7) – Response options: Agree / Neutral / Disagree			
A1	IPR knowledge is an essential professional competency for engineering students.	Likert 3-pt	
A2	Intellectual property protection mechanisms encourage innovation and creativity among student researchers.	Likert 3-pt	

Table 1 Continued....

A3	Filing a patent is a realistic and achievable goal for an engineering student during their undergraduate study.	Likert 3-pt
A4	Universities should formally integrate dedicated IPR modules into the engineering curriculum.	Likert 3-pt
A5	Submitting another person's academic work as one's own constitutes a serious violation of intellectual property.	Likert 3-pt
A6	Awareness of IPR significantly improves a student's employability and entrepreneurial readiness.	Likert 3-pt
A7	Open-source software projects should still adhere to relevant intellectual property licensing norms.	Likert 3-pt
Section D: Practice Domain (P1–P7) – Response options: Yes / No		
P1	Have you ever applied for a patent, copyright registration, or any other form of intellectual property protection?	Yes/No
P2	Have you attended any IPR-related workshop, seminar, or formal training program?	Yes/No
P3	Have you ever included an intellectual property ownership or confidentiality clause in a research proposal or project collaboration agreement?	Yes/No
P4	Have you conducted a prior art search using patent databases (e.g., Google Patents, Espace net, Indian Patent Office database)?	Yes/No
P5	Have you formally disclosed a potential invention or innovative idea to your institution's technology transfer or innovation office?	Yes/No
P6	Do you currently use only licensed or legally permitted software tools for your academic and research activities?	Yes/No
P7	Have you participated in any intellectual property-based quiz, competition, or awareness event at institutional or national level?	Yes/No

Scoring Criteria:

Knowledge: 1 point per correct answer (max 7). Adequate knowledge = score $\geq 4/7$ ($\geq 57.1\%$).

Attitude: Agree=2, Neutral=1, Disagree=0 (max 14). Positive attitude = ≥ 4 items agreed.

Practice: Yes=1, No=0 (max 7). Active practice = $\geq 3/7$ items affirmed ($\geq 42.9\%$).

2.4. Statistical Analysis

Data were entered and analyzed using IBM SPSS Statistics v26. Descriptive statistics (frequencies, percentages) summarized demographic and KAP variables. Chi-square tests assessed associations between sociodemographic variables and KAP categories. A p-value of <0.05 was considered

statistically significant. Ethical approval was obtained from the Institutional Ethics Committee (IEC/2024/ETH/IPQUAD-112).

3. RESULTS

3.1. Sociodemographic Characteristics

The 300 engineering students who were studied (94.3% response rate). As seen in Table 2, majority of respondents were males (56.0%, $n=168$). The largest number of students (32.0%, $n=96$) were in their third year. The highest number of students (24.0%, $n=72$) represented Computer Science. Of those who had done research, more than half (58.0%, $n=174$) had been exposed to it before and 31.0% ($n=93$) of those had received any formal IPR training.

3.2. Knowledge of Intellectual Property Rights

The knowledge assessment results are summarized in **Table 3**, which shows the results by items. The highest percentage of correct answers was obtained in K1 – ability to define IPR (73.3%) and K2 – types of IPR (65.0%). Procedural knowledge items were significantly less successful — just 44.0% were able to differentiate between patents and trade secrets (K5), and 39.3% had knowledge of the role of WIPO (K7). In total, 194 (64.7%) participants had adequate knowledge (scores $\geq 4/7$). **Figure 1** shows that the knowledge scores were close to being normally distributed but with a long tail to the right comprising 106 (35.3%) participants who scored below the adequate knowledge level.

3.3. Attitude Toward Intellectual Property Rights

A table showing the summary of attitude responses is presented here (**Table 4**). The most reached

agreements were obtained for A5 (plagiarism is serious IP violation: 79.0%), A4 (universities should include IPR in curriculum: 73.7%) and A2 (IP protection promotes innovation: 66.0%) as presented in **Figure 2**. Students felt a psychological distance from the practical aspects of IP protection in the lowest agreement structures A7 (open-source software and IP norms: 49.7%) and A3 (patent filing as a realistic student goal: 47.3%). In total, 208 of the participants (69.3%) showed positive attitudes. As per the stacked bar chart in **Figure 2**, it is evident that the items related to systemic IP integration (A4, A5) had the highest agreement scores whereas the items related to personal engagement (A3, A7) had the lower scores, indicating an external locus of IP responsibility.

Table 2: Sociodemographic characteristics of study participants (n=300)

Characteristic	Category	Frequency (n=300)	%
Gender	Male	168	56.0
	Female	132	44.0
Year of Study	1st Year	58	19.3
	2nd Year	84	28.0
	3rd Year	96	32.0
	4th Year	62	20.7
Branch	Computer Science	72	24.0
	Electronics	66	22.0
	Mechanical	60	20.0
	Civil	54	18.0
	Others	48	16.0
Research Exposure	Yes	174	58.0
	No	126	42.0
Prior IPR Training	Yes	93	31.0
	No	207	69.0

Table 3: Item-wise knowledge responses among engineering students (n=300)

Knowledge Item	Correct	Incorrect	Unsure
K1: Ability to define IPR	220 (73.3%)	52 (17.3%)	28 (9.3%)
K2: Types of IPR (patent, copyright, trademark)	195 (65.0%)	68 (22.7%)	37 (12.3%)
K3: Patent filing process awareness	148 (49.3%)	82 (27.3%)	70 (23.3%)
K4: Copyright protection duration	163 (54.3%)	79 (26.3%)	58 (19.3%)
K5: Trade secret vs patent differences	132 (44.0%)	91 (30.3%)	77 (25.7%)
K6: Institutions for IPR filing in India	141 (47.0%)	96 (32.0%)	63 (21.0%)
K7: Role of WIPO and national IP offices	118 (39.3%)	88 (29.3%)	94 (31.3%)
Overall Adequate Knowledge ($\geq 4/7$ correct)	194 (64.7%)	—	—

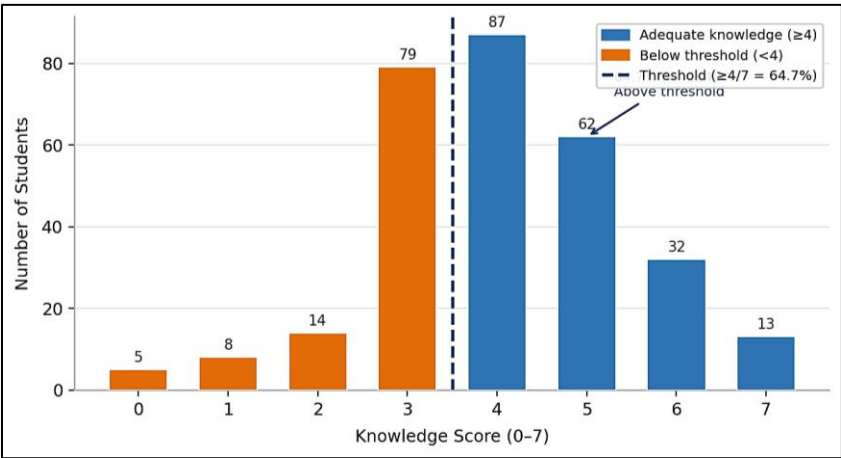


Figure 1: Distribution of knowledge scores (0–7) among study participants. The dashed line indicates the adequate knowledge threshold (≥ 4). Bars in blue represent participants above the threshold (64.7%; $n=194$); bars in orange indicate those below the threshold

Table 4: Item-wise attitude responses among engineering students ($n=300$)

Attitude Statement	Agree	Neutral	Disagree
A1: IPR essential for engineering students	183 (61.0%)	84 (28.0%)	33 (11.0%)
A2: IP protection encourages innovation	198 (66.0%)	72 (24.0%)	30 (10.0%)
A3: Filing a patent is a realistic student goal	142 (47.3%)	96 (32.0%)	62 (20.7%)
A4: Universities should integrate IPR in curriculum	221 (73.7%)	58 (19.3%)	21 (7.0%)
A5: Plagiarism is a serious IP violation	237 (79.0%)	42 (14.0%)	21 (7.0%)
A6: IPR awareness improves employability	176 (58.7%)	87 (29.0%)	37 (12.3%)
A7: Open-source software should follow IP norms	149 (49.7%)	93 (31.0%)	58 (19.3%)
Overall Positive Attitude (≥ 4 items agreed)	208 (69.3%)	—	—

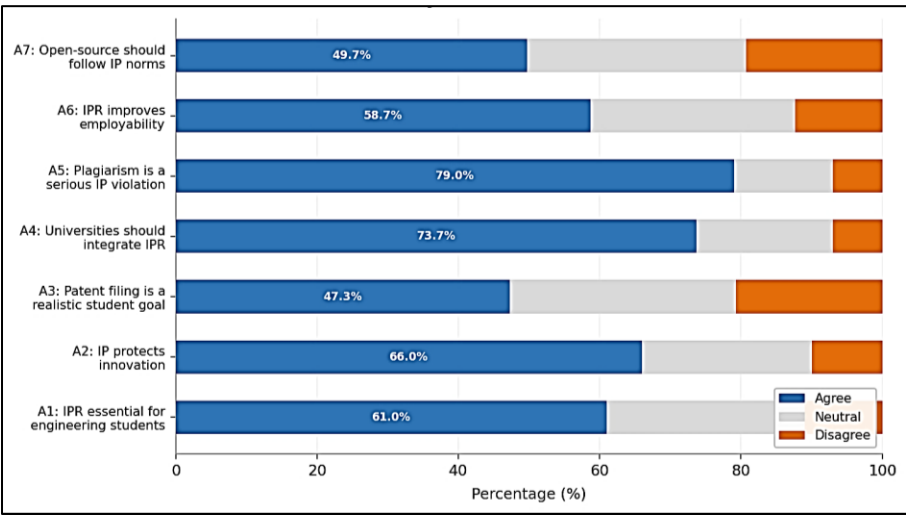


Figure 2: Stacked bar chart showing the proportion of participants agreeing, remaining neutral, or disagreeing with each attitude item (A1–A7). Items related to systemic IPR integration (A4, A5) received highest agreement, while personal engagement items (A3, A7) received lower agreement

3.4. Practice Related to Intellectual Property Rights

The domains of knowledge and attitude showed a significant improvement in practice scores as compared to these two domains (**Table 5**). Compliance with IT policy (P6: 71.3%) was the most frequently reported practice, probably due to institutional IT policy. The moderately reported modes of prior art searches (P4: 29.3%) and workshop attendance (P2: 34.0%) were moderately reported. Actual applications of IP, invention disclosures (P5) and IP clauses in proposals (P3) were all at critical low rates (P1: 13.0%, P5: 10.3%, P3: 15.7%). Of all those that made it to the active IPR practice, 97 (32.3%) did so. This study's main finding is the 37-percentage-point difference between the positive attitude (69.3%) and the active practice (32.3%) (**Figure 3**).

3.5. Factors Associated with KAP Domains

The results of the chi square analyses are presented in **Table 6**. Students who had received IPR training had significantly more adequate knowledge (89.2 vs. 51.8%), positive attitudes (90.3 vs. 59.4%), and active practice (61.3 vs. 18.6%) than students who had not ($p<0.001$) for all three domains. All three domains were also related to research exposure. The clear difference in KAP outcomes was observed between the trained and untrained in all three domains (**Figure 4**); active practice rates were over 3 times higher for the trained students than for the untrained students. The difference between the 4th year students and the junior students was in favor of 4th year students in terms of knowledge and attitude. The branch of study was significantly related with the students of Computer Science and Electronics being better than Mechanical and Civil engineering students with $p=0.004$.

Table 5: Item-wise practice responses among engineering students (n=300)

Practice Item	Yes	No
P1: Ever applied for IP protection	39 (13.0%)	261 (87.0%)
P2: Attended IPR workshops/seminars	102 (34.0%)	198 (66.0%)
P3: Included IP clause in research proposal	47 (15.7%)	253 (84.3%)
P4: Conducted prior art search in patent database	88 (29.3%)	212 (70.7%)
P5: Disclosed invention to technology transfer office	31 (10.3%)	269 (89.7%)
P6: Used only licensed software for academic work	214 (71.3%)	86 (28.7%)
P7: Participated in IPR quiz/competition	68 (22.7%)	232 (77.3%)
Overall Active IPR Practice ($\geq 3/7$ yes)	97 (32.3%)	—

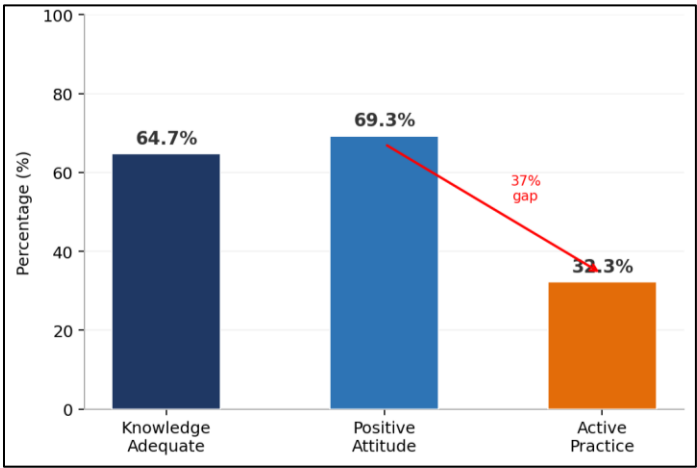


Figure 3: KAP gradient bar chart showing the proportion of participants achieving adequate knowledge (64.7%), positive attitude (69.3%), and active practice (32.3%). The red arrow highlights the 37-percentage-point knowledge-practice gap between attitude and practice domains

Table 6: Factors associated with adequate knowledge, positive attitude, and active practice (chi-square analysis)

Variable	Adequate Knowledge	Positive Attitude	Active Practice	p-value
Gender (Male vs Female)	57.3% vs 72.0%	73.2% vs 66.7%	74.4% vs 77.3%	0.032
Year of Study (4th vs 1st)	71.0% vs 44.8%	80.6% vs 58.6%	51.6% vs 20.7%	0.001
Research Exposure (Yes vs No)	78.7% vs 44.4%	82.2% vs 52.4%	47.1% vs 12.7%	<0.001
Prior IPR Training (Yes vs No)	89.2% vs 51.8%	90.3% vs 59.4%	61.3% vs 18.6%	<0.001
Branch (CS/ECE vs Others)	74.5% vs 52.3%	76.3% vs 61.7%	39.4% vs 23.5%	0.004

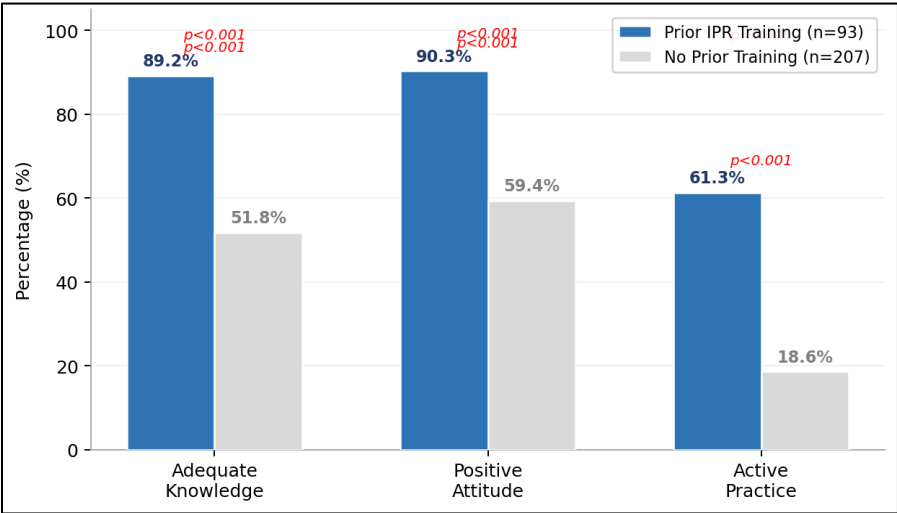


Figure 4: Grouped bar chart comparing KAP domain proportions stratified by prior IPR training status. All three domains were significantly higher in the trained group ($p<0.001$), with active practice showing the greatest disparity (61.3% vs 18.6%), underscoring the transformative role of formal IPR education

4. DISCUSSION

The present cross-sectional KAP study among 300 engineering students demonstrated a pattern of moderate knowledge, generally positive attitudes, and relatively low engagement in practical intellectual property rights (IPR) activities. This discrepancy between awareness and actual practice is consistent with previous studies suggesting that although university students recognize the importance of intellectual property, relatively few actively participate in patent filing, copyright registration, or other formal IP protection activities.

In the present study, 64.7% of students demonstrated adequate knowledge of IPR. Although direct comparisons with engineering students remain limited, this finding is broadly comparable to previous studies conducted among university students.¹⁷ Ong et al.¹⁸ reported that Malaysian undergraduate students generally recognized plagiarism and digital piracy as

forms of intellectual property infringement but identified substantial gaps in their understanding of broader IPR concepts, emphasizing the need for structured educational interventions. Likewise, Ravi and Janodia¹⁹ found that awareness of IPR among Indian academics was moderate, with many participants expressing inadequate knowledge regarding commercialization and protection of intellectual property, highlighting the continuing need for formal IP education within higher education institutions.

The marked gap observed between knowledge (64.7%) and active practice (32.3%) represents one of the most important findings of this study. Similar observations have been reported internationally, where students demonstrate awareness of plagiarism and copyright issues but have limited experience with patent applications, licensing, technology transfer, or commercialization activities. They concluded that awareness alone does not necessarily translate into

protective behavior and recommended stronger institutional support, awareness programs, and university-led initiatives to bridge this gap.

Students in the present study demonstrated favorable attitudes toward plagiarism prevention and the inclusion of IPR education within the curriculum. These findings are consistent with previous reports showing that university students generally appreciate the importance of protecting intellectual property and support educational initiatives aimed at improving awareness. Studies conducted among Malaysian university students and Indian healthcare professionals similarly reported positive attitudes toward intellectual property despite deficiencies in detailed procedural knowledge.¹⁹

Differences observed among engineering branches may reflect unequal exposure to innovation ecosystems. Computer Science and Electronics students are frequently involved in software development, hackathons, research projects, and startup activities where intellectual property issues arise naturally, whereas students from traditional engineering disciplines may receive fewer opportunities for practical exposure to patenting and commercialization. Although published comparative evidence across engineering disciplines remains limited, several institutional reports have emphasized the importance of integrating IPR education across all engineering programmers rather than concentrating primarily on innovation-oriented disciplines.²⁰

The low proportion of students reporting invention disclosure or patent-related activities despite substantial research participation suggests that institutional barriers continue to limit practical engagement. Previous literature has identified insufficient awareness of technology transfer processes, inadequate mentoring, and limited institutional outreach as common obstacles preventing students from translating innovative ideas into protected intellectual property.²¹

Licensed software usage represented the most frequently reported IP-related practice in the present study, indicating that students are more likely to comply with mandatory institutional policies than voluntarily

pursue intellectual property protection. Similar observations have been reported in studies examining university students' awareness, where compliance with copyright regulations exceeded participation in proactive IP activities such as patent filing or commercialization.²²

The findings have important implications for engineering education in India. The National IPR Policy and university innovation initiatives emphasize the need to strengthen innovation, patent generation, and commercialization within academic institutions. However, the present findings suggest that awareness alone is insufficient unless accompanied by structured curricular integration, institutional IP cells, practical workshops, mentorship programs, and technology transfer support. Such interventions may help bridge the observed knowledge-practice gap and promote greater participation in innovation and intellectual property protection among engineering students.

Future multicenter longitudinal studies should evaluate whether structured IPR training leads to sustained improvements in patent applications, invention disclosures, startup formation, and technology commercialization rather than relying solely on self-reported awareness measures.

5. CONCLUSION

The finding of this KAP study indicates that the students of engineering who are involved in research and innovation have relatively adequate knowledge (64.7%) and broadly positive attitude (69.3%) with respect to the IPR, while, they have systematically low active IPR practice level (32.3%) and significantly high knowledge-practice gap (KPG) (68.7%) which indicates that there is an ample gap between the knowledge and practice of these students in relation to IPR. All three KAP domains were best explained by previous IPR training and research exposure. This study separated a 21-item validated questionnaire to serve as a repeatable tool to assess IPR KAP in the future. The results emphasize the need for compulsory IPR education integrated into the curriculum, technology disclosure facilitation within institutions and patent filing clinics to reap the benefits of students' IP awareness in terms of tangible outputs of innovation that are in alignment with the goals of the National IPR Policy 2016.

AUTHOR CONTRIBUTIONS

Piyush Yadav: Conceptualization, methodology, investigation, formal analysis, writing - original draft, and project administration.

Apoorva Sharma: Methodology, validation, writing-review and editing.

Jaspreet Singh: Data curation, formal analysis, and visualization.

Urvashi Sharma: Investigation, supervision, and critical revision of the manuscript.

Poorva Pakhie: Data collection, literature review, and manuscript editing.

Priyanjal Jain: Resources, validation, supervision, and final approval of the manuscript.

All authors read and approved the final version of the manuscript and agree to be accountable for all aspects of the work

ETHICAL APPROVAL

Ethical approval was approved by the organization. (Ethical Number: IPQuad/2025/009).

DECLARATION OF PATIENT CONSENT

Not applicable.

FINANCIAL SUPPORT AND SPONSORSHIP

Nil

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI) - ASSISTED TECHNOLOGY FOR MANUSCRIPT PREPARATION

The authors confirm that no artificial intelligence (AI)-assisted technology was used to assist in the writing or editing of the manuscript, and no images were manipulated using AI tools.

DATA AVAILABILITY STATEMENT

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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