BEYOND AWARENESS: MAPPING THE INTELLECTUAL PROPERTY CAPABILITY GAP AMONG ENGINEERING STUDENTS IN SOUTHERN TAMIL NADU

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ABSTRACT

Intellectual Property Rights (IPR) education is increasingly important in engineering institutions because innovation, research and technological entrepreneurship depend not only on the generation of ideas but also on the ability to recognise, protect and strategically use intellectual property. This study examines the intellectual property awareness and institutional support environment among engineering students in southern Tamil Nadu and develops a conceptual framework for moving from awareness towards IP capability. Primary data were collected from 1,384 engineering students from 11 southern districts of Tamil Nadu. The study examined awareness of patents, industrial designs, trademarks, layout designs of semiconductor integrated circuits, trade secrets, copyright and geographical indications, together with curriculum, resource availability, innovative teaching practices, incentives and strategic institutional support. The findings reveal a strong relationship between institutional initiatives and IPR awareness ($R=.686$, $R^2=.471$, $p<.001$) and a particularly strong relationship between IPR awareness and student attitude towards intellectual property ($R=.879$, $R^2=.773$, $p<.001$). Incentives and strategic support emerged as an important institutional predictor. Structural equation modelling also indicated acceptable model fit. However, the findings suggest that awareness alone should not be treated as equivalent to capability. Accordingly, the paper proposes a five-stage IP Capability Development Framework: Discover–Recognise–Protect–Develop–Commercialise. The study contributes a regionally grounded perspective to IPR education and offers implications for engineering institutions, higher education agencies and innovation-policy stakeholders.

Keywords: *Intellectual Property Rights, IPR awareness, engineering students, innovation capability, patent education, higher education, Tamil Nadu*

INTRODUCTION

Intellectual Property Rights (IPR) have become an important component of the innovation ecosystem. In engineering education, students are continuously exposed to projects, prototypes, software applications, designs, technological processes and other forms of creative output. However, the creation of an innovative idea does not automatically result in its protection or effective utilisation. Students need to recognise whether an innovation has intellectual property potential, understand the appropriate form of protection and develop an orientation towards responsible and strategic use of intellectual property.

International initiatives increasingly recognise the importance of introducing intellectual property concepts to young learners and future innovators. Intellectual property education is therefore moving beyond the traditional legal orientation towards innovation, entrepreneurship and knowledge creation. In India, the expansion of engineering education and institutional innovation initiatives has created a growing need for systematic IPR awareness. Yet awareness may remain fragmented if it is not supported by curriculum, learning resources, practical exposure, mentoring, institutional incentives and access to innovation-support mechanisms.

The present study focuses on engineering students in southern Tamil Nadu. The empirical study covers 1,384 students from 11 districts and examines awareness across seven major IPR domains along with institutional dimensions and student attitudes. Rather than presenting awareness as the final outcome, this paper interprets the findings from a broader perspective: how can educational institutions move students from knowing about intellectual property towards developing the foundations of IP capability?

The paper therefore makes a conceptual distinction between IPR awareness and IP capability. The present research directly measures awareness, institutional initiatives, attitude and entrepreneurial aspiration. IP capability is not claimed as a directly measured variable; instead, the study uses the empirical findings to propose a conceptual pathway through which awareness can be transformed into innovation-protection capability.

REVIEW OF LITERATURE AND RESEARCH GAP

Research on intellectual property education has generally emphasised awareness, knowledge and the importance of patent education among students, researchers and innovators. Studies have also identified differences in awareness across educational and demographic groups and have highlighted the importance of institutional support.

Recent scholarship has begun to examine how STEM students understand patents and how educational and information environments influence their learning experiences. This indicates that patent education cannot be considered solely as a legal-information exercise; it is connected with the broader innovation-learning ecosystem. Studies in India have also identified gaps in patent awareness and patenting knowledge among potential inventors. However, much of the existing work concentrates on general awareness or knowledge of particular forms of intellectual property. There is comparatively less emphasis on the institutional conditions that may help students move from awareness towards practical readiness for identifying, protecting and developing innovation.

This creates an important research gap. Engineering students may possess knowledge of the existence of patents, trademarks or copyrights without necessarily understanding how their academic projects or innovations can be protected. Similarly, institutional programmes may increase awareness without establishing a clear pathway from student idea generation to intellectual property protection and subsequent innovation utilisation.

The present study addresses this gap by integrating IPR awareness, institutional initiatives and student attitude and interpreting their relationships through an IP capability perspective.

CONCEPTUAL PERSPECTIVE

The central proposition of this paper is:

Awareness is necessary for IP capability, but awareness alone is not IP capability.

The study's empirical variables support the development of a conceptual progression:

Awareness → Recognition → Protection Readiness → Innovation Development → Strategic Utilisation

Based on this progression, a five-stage framework is proposed:

Discover → Recognise → Protect → Develop → Commercialise

Discover: Students become aware of different forms of intellectual property and their relevance to innovation.

Recognise: Students learn to identify the intellectual property potential in projects, designs, inventions, brands, creative works and technological outputs.

Protect: Students develop basic readiness to understand appropriate protection mechanisms and the importance of documentation, confidentiality and filing.

Develop: Protected or protectable ideas are connected with further research, product development, entrepreneurship and innovation-support systems.

Commercialise: Intellectual property is viewed not merely as a legal asset but as a potential knowledge and economic resource.

This framework is conceptual and is derived from the relationships observed in the present study; the five stages were not directly tested as separate capability constructs.

OBJECTIVES OF THE STUDY

The study was undertaken with the following objectives:

1. To assess the level of IPR awareness among engineering students in southern Tamil Nadu.
2. To examine the relationship between institutional initiatives and IPR awareness.
3. To examine the relationship between IPR awareness and student attitude towards intellectual property.
4. To identify the role of curriculum, resources, innovative delivery and incentives/strategic support.
5. To examine variations in IPR awareness across engineering disciplines and selected demographic dimensions.
6. To develop a conceptual framework for progressing from IPR awareness towards IP capability.

METHODOLOGY

The study adopted a quantitative empirical research design. The population consisted of engineering students from engineering colleges in the southern districts of Tamil Nadu. The study covered 11 districts and 1,384 students. Cluster sampling was used for selecting respondents. The sample included 943 male and 441 female students. A pilot study involving 50 students was undertaken to assess the reliability of the instrument. The overall Cronbach's alpha was 0.85, indicating satisfactory internal consistency. Reliability values for the major dimensions were also satisfactory, including patent awareness (.844), patent filing awareness (.866), patent publication awareness (.879), industrial design (.892), trademark (.886), layout design (.848), trade secrets (.861), copyright (.894), geographical indications (.907), curriculum (.872), resource use (.879), new delivery (.876), incentives/strategic support (.803) and attitude (.908).

The instrument covered seven IPR areas:

- Patents
- Industrial designs
- Trademarks
- Layout designs of semiconductor integrated circuits
- Trade secrets
- Copyright
- Geographical indications

Awareness was examined at different levels, including conceptual understanding, filing awareness and publication-related awareness. Institutional dimensions included curriculum, resources, innovative delivery and incentives/policy/strategic support. Descriptive statistics, correlation, regression, ANOVA and structural equation modelling were used to examine the relationships among the study variables.

RESULTS AND DISCUSSION

Institutional Initiatives and Overall IPR Awareness

The regression analysis indicates a significant relationship between institutional initiatives and overall IPR awareness:

$R = .686$; $R^2 = .471$; Adjusted $R^2 = .418$; $F(4,1379) = 162.262$; $p < .001$.

Thus, the institutional dimensions collectively explain a substantial proportion of the variation in overall IPR awareness.

The regression coefficients were:

Institutional Dimension	B	Beta	Significance
Curriculum	.766	.130	.012
Resource Used	.838	.125	.021
New Delivery	1.075	.123	.015
Incentives & Strategic Support	2.057	.227	<.001

The findings demonstrate that IPR awareness is not solely an individual learning outcome. Institutional arrangements have an important role in creating an environment in which students encounter, understand and engage with intellectual property.

Among the institutional dimensions, incentives and strategic support recorded the strongest standardised contribution. This finding is particularly important because students may require

more than classroom exposure. Mentoring, institutional encouragement, innovation activities and appropriate support mechanisms can create a bridge between theoretical awareness and practical engagement.

IPR Awareness and Student Attitude

A particularly strong relationship was identified between overall IPR awareness and attitude towards intellectual property:

$R = .879$; $R^2 = .773$; Adjusted $R^2 = .772$; $F(7,1376) = 669.367$; $p < .001$.

This indicates that the dimensions of IPR awareness have a strong collective association with student attitude.

The finding supports the argument that systematic exposure to intellectual property can influence how students perceive the relevance and value of IP. Nevertheless, positive attitude should not itself be interpreted as evidence of actual patent filing, registration or commercialisation behaviour. The distinction is important. A student may understand the importance of patents and have a positive attitude towards innovation protection while still lacking practical knowledge about searching prior art, preparing documentation, identifying appropriate protection mechanisms or accessing institutional support.

Entrepreneurial Aspiration

The study also examined entrepreneurial aspiration. The regression model produced:

$R = .719$; $R^2 = .517$; Adjusted $R^2 = .515$; $F(6,1377) = 245.284$; $p < .001$.

Institutional and student-level factors jointly contributed to entrepreneurial aspiration. Incentives and strategic support showed the strongest standardised contribution in the model ($\beta = .480$ in the reported analysis).

The result is relevant to the capability argument because intellectual property can form part of an entrepreneurial pathway. However, IP education should not be reduced to entrepreneurship alone. Intellectual property is relevant to students who may become researchers, employees, innovators, entrepreneurs or knowledge professionals.

Discipline-wise Variation

Differences were observed in IPR-related awareness across engineering disciplines. For **filing awareness**, the reported means were:

Discipline	**Mean**
Computer Engineering	30.12
Others	30.92

Discipline	Mean
EEE	31.07
Civil	31.62
Mechanical	32.38
ECE	32.73

For **patent publication awareness**, the means were:

Discipline	Mean
Computer Engineering	29.86
EEE	30.58
Civil	31.02
Others	31.08
Mechanical	31.98
ECE	32.41

The variation indicates that a uniform approach to IPR education may not produce identical outcomes across disciplines. Engineering education may therefore benefit from discipline-sensitive IPR examples and learning activities.

For example, patent-oriented learning may be particularly relevant to technological inventions, while design protection, copyright, trademarks or trade secrets may require greater contextualisation in other academic and innovation settings.

Structural Equation Modelling

The structural equation model produced acceptable overall fit:

- $\chi^2/df = 3.283$
- GFI = .948
- AGFI = .930
- NFI = .910
- CFI = .911
- RMR = .052
- RMSEA = .071

The standardised contributions of the major IPR categories were:

IPR Dimension	Standardised Beta
Patent	.213
Industrial Design	.192

IPR Dimension	Standardised Beta
Trademark	.188
Layout Design	.140
Trade Secrets	.208
Copyright	.156
Geographical Indications	.242

The model reinforces the multidimensional nature of IPR awareness. Intellectual property education should therefore avoid focusing exclusively on patents.

The relatively strong contribution of geographical indications, patents and trade secrets also demonstrates that students may benefit from exposure to forms of IP that are less frequently discussed in conventional engineering curricula.

FROM AWARENESS TO IP CAPABILITY

The major contribution of the present study is the conceptual interpretation of the empirical findings. The evidence demonstrates three important points.

First, institutional initiatives matter. Curriculum, resources, innovative delivery and strategic support are significantly associated with IPR awareness.

Second, awareness matters for attitude. The strong relationship between awareness and attitude indicates that knowledge can influence students' perception of intellectual property.

Third, there remains a conceptual step between awareness and capability. The present study did not directly measure whether students could independently identify a patentable invention, conduct a prior-art search, prepare a filing, manage IP documentation or commercialise an intellectual asset. Therefore, such capability cannot be claimed as an empirical outcome of this research.

Instead, the findings support the need for a developmental pathway:

IPR Awareness

↓

Recognition of IP Potential

↓

Protection Readiness

↓

Innovation Development

↓

Strategic Utilisation

This leads to the proposed DISCOVER–RECOGNISE–PROTECT–DEVELOP–COMMERCIALISE framework.

Table 1: Proposed IP Capability Development Framework

Stage	Student Development	Institutional Support
Discover	Understand different IPR forms	Curriculum and awareness programmes
Recognise	Identify IP potential in projects	Project mentoring and IP clinics
Protect	Understand protection pathways	IPR experts and filing guidance
Develop	Connect IP with innovation	Incubation and research support
Commercialise	Understand value creation	Entrepreneurship and industry linkages

The framework provides a practical bridge between conventional IPR awareness programmes and innovation-oriented higher education.

INSTITUTIONAL AND POLICY IMPLICATIONS

The findings have implications beyond individual engineering colleges.

Integrating IPR into Engineering Education

IPR concepts should be embedded progressively into engineering education rather than being restricted to occasional awareness programmes. Students can encounter IPR through project work, innovation activities, entrepreneurship courses and research methodology.

Student IP Clinics

Institutions could establish periodic Student IP Clinics where students present project ideas and receive basic guidance on intellectual property identification, documentation and possible protection routes.

Project-to-Patent Pathway

Final-year projects and student innovations can be screened for potential intellectual property. A structured institutional pathway could connect project identification, mentoring, prior-art search, protection decisions and subsequent development.

Faculty IP Champions

Faculty members trained in basic IPR awareness can serve as institutional contact persons who identify promising student innovations and connect them with appropriate experts.

Incentives and Strategic Support

The strong role of incentives and strategic support in the empirical results suggests that institutional encouragement should accompany awareness programmes. Recognition of student

innovators, mentoring support and access to innovation ecosystems can strengthen engagement. At the policy level, higher education agencies can encourage institutions to develop measurable IPR outcomes such as:

- students exposed to IPR education;
- student projects screened for IP potential;
- students receiving IP mentoring;
- faculty trained in IPR;
- innovations referred to institutional IP/innovation centres; and
- student innovations progressing towards formal protection or further development.

These indicators should complement, rather than replace, conventional measures of IPR awareness.

THEORETICAL CONTRIBUTION

The study contributes to the literature by shifting the discussion from a simple awareness model towards an awareness-to-capability perspective. Traditional IPR awareness programmes can be represented as:

Knowledge → Awareness → Attitude

The present conceptual model extends this pathway:

Awareness → Recognition → Protection Readiness → Innovation Development → Strategic Utilisation

This does not imply that every student must progress to commercialisation. Rather, it establishes a developmental framework through which educational institutions can progressively build the foundations required for responsible innovation and intellectual property utilisation. The distinction between measured awareness and conceptual capability also provides a more cautious and academically defensible interpretation of the empirical findings.

CONCLUSION

The present study of 1,384 engineering students from 11 southern districts of Tamil Nadu demonstrates that IPR awareness is significantly associated with institutional initiatives and student attitude. Curriculum, resources, innovative delivery and particularly incentives and strategic support contribute to the development of an environment conducive to IPR awareness. The strong relationship between awareness and attitude further demonstrates the value of systematic IPR education.

However, the central argument of this paper is that awareness should be treated as the beginning of IP capability, not its endpoint. Knowing that patents, trademarks, designs, copyright or trade secrets exist does not necessarily mean that students can identify, protect, develop or strategically utilise intellectual assets.

The proposed Discover–Recognise–Protect–Develop–Commercialise framework provides a conceptual pathway for addressing this gap. It encourages institutions to connect classroom awareness with project-based identification, expert mentoring, protection readiness, innovation support and eventual value creation. For Tamil Nadu's emerging innovation ecosystem, such an approach can help reposition IPR education from an occasional awareness activity to an integrated component of engineering education and innovation development. The empirical evidence therefore provides a foundation for institutional reforms and future policy-oriented interventions while also opening a new research direction: the measurement and development of actual IP capability among students.

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DECLARATION

The author declares that this manuscript is based on the empirical findings of the TANSCHE-supported research project and that the conceptual IP capability framework proposed in the paper is derived from the findings of the present study.

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