



# Do Favourable Attitudes Guarantee Aptitude? Attitude Toward Technical Education, Numerical Ability, and Mechanical Reasoning Among Higher Secondary Students in Kerala, India

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## ABSTRACT

Engineering education in Kerala today presents a puzzle. Nearly 20,000 of the state's roughly 56,000 undergraduate engineering seats went unfilled in 2024, demand has tilted sharply toward computer science and artificial intelligence while mechanical and civil branches struggle to attract applicants, and yet a large share of the students who do enrol fall behind or fail to finish. One explanation is that career decisions at the higher secondary stage rest heavily on how students feel about technical education rather than on what they can actually do. The present study put that explanation to the test by measuring three characteristics in the same students and asking how closely they align. A stratified sample of 501 science-stream higher secondary students (253 boys, 248 girls) from eight government and aided schools of Kasaragod district completed a 43-item Likert-type Attitude Toward Technical Education Scale developed and standardised for the study (test-retest reliability .82), together with the Numerical Ability and Mechanical Reasoning subtests of the Differential Aptitude Tests. Pearson correlations with Fisher's t-tests and critical-ratio comparisons of group means were computed. Attitude proved strongly related to numerical ability ( $r = .676$ ,  $p < .01$ , 46% shared variance) yet only moderately related to mechanical reasoning ( $r = .361$ ,  $p < .01$ , 13% shared variance), and this uneven pattern held in every gender, school-type, and locality subgroup. Girls significantly outscored boys on both attitude and numerical ability, with no gender gap in mechanical reasoning. The results suggest that enthusiasm for technical education travels with quantitative skill but not with mechanical insight, and that career guidance should therefore pair attitude assessment with aptitude testing before students commit to technical courses.

**Keywords:** technical education, career guidance, aptitude, attitude, higher secondary students

## INTRODUCTION

For decades, an engineering seat has been the destination most Kerala families imagine for a child who takes the science stream at the higher secondary stage. What has changed dramatically is the health of the sector receiving those children. After the 2024 admission season, close to 20,000 of the roughly 56,000 B.Tech seats in the state lay vacant in the non-government colleges, and the government responded by allowing candidates to enter with a bare 45 per cent in the qualifying examination even without clearing the entrance test (Kerala Kaumudi, 2024). The picture is similar nationally: the Union Ministry of Education informed the Rajya Sabha that a third of all sanctioned engineering seats, over four lakh places, found no takers in 2021–22 (Careers360, 2022). Completion tells an equally sobering story; the first cohort of Kerala's technological university managed a pass rate of only 36.41 per cent (The New Indian Express, 2019). Plenty of students want to become engineers, and plenty of those who try cannot get through.

Something further has been happening inside the sector. Preference has swung decisively toward computer science, artificial intelligence, and related software programmes, while the traditional core of engineering, the mechanical, civil, and electrical branches, empties out; institutions across South India have been converting core-branch capacity into computing seats simply because nobody applies for the former (Careers360, 2024). The swing is usually explained by salaries and placement prospects. This paper suggests a complementary



explanation rooted in the psychology of the students themselves: their liking for technical education may be attached to some of the abilities engineering requires and not to others.

The reasoning is straightforward. If a student's favourable feeling toward technical education generally comes bundled with the aptitudes technical study demands, then choosing on feeling alone is fairly safe. If the bundle can come apart, if warm attitudes coexist easily with weak aptitude, then guidance that reads enthusiasm as readiness will keep delivering students into programmes that defeat them. India's National Education Policy 2020 leans clearly toward the second worry, urging that vocational exposure reach at least half of all learners and that career guidance respond to what learners can do, not merely what carries prestige (Government of India, 2020). Yet direct Indian evidence on how attitude and aptitude actually co-vary within the same students, at the exact stage when the decision is made, remains thin. The study reported here was designed to supply such evidence from Kasaragod, the northernmost and one of the least-studied districts of Kerala.

## Conceptual background

Social psychology treats an attitude as a learned evaluative tendency, a disposition to respond to some object with a degree of favour or disfavour (Eagly & Chaiken, 1998). Attitudes toward fields of study matter because they steer choices and sustain effort, but a consistent lesson of the international literature is that they are socially manufactured and can be strikingly positive even in groups whose later participation proves fragile; Dutch students entering vocational tracks, for example, arrived with high expectations that bore little relation to their subsequent risk of dropping out (Elffers & Oort, 2013). Favourable feeling, in short, is not evidence of readiness, which is exactly why its empirical relationship to ability needs measuring rather than assuming.

On the ability side, two constructs from the differential-aptitude tradition are most relevant to technical study. Numerical ability denotes facility in reasoning with numbers and handling quantitative relationships, and it underwrites achievement in mathematics and the physical sciences. Mechanical reasoning denotes the grasp of physical and mechanical principles as they operate in everyday devices and situations. Both are measured by well-established subtests of the Differential Aptitude Tests battery designed for secondary-school ages (Bennett, Seashore, & Wesman, 1974). They differ in origin as well as content: numerical skill is built and rewarded inside classrooms through a taught symbolic notation, while mechanical insight accumulates largely outside them, through tinkering, observation, and hands-on contact with the physical world. Cognitive research reinforces the distinction, showing that numerical capacities can dissociate sharply from other school abilities (Landerl, Bevan, & Butterworth, 2004). There is thus no *a priori* reason to expect a student's attitude to relate equally to the two.

## Objectives of the study

The study pursued three objectives: first, to estimate the relationship between attitude toward technical education and numerical ability among higher secondary science students, for the whole sample and separately by gender, type of school management, and locality; second, to estimate the corresponding relationships between attitude and mechanical reasoning; and third, to test whether boys and girls differ in the three characteristics themselves.

## METHODOLOGY

### Design and sample

A normative survey design was adopted, the method of choice for mapping conditions, attitudes, and abilities as they exist in a defined population (Kerlinger, 1973). The population comprised science-stream students of higher secondary schools in Kasaragod district, Kerala. Stratified sampling, with gender, school management, and locality as strata, yielded 501 students from eight schools: 253 boys and 248 girls; 242 from government schools and 259 from aided schools; 288 from rural schools and 213 from urban ones. Testing took place in the students' own classrooms during school hours, with the permission of the heads of the institutions, and participation was voluntary and anonymous.



The data derive from a dissertation project; they are read here against the present condition of technical education, to which the question they answer has only grown more pertinent.

## Instruments

Attitude was measured with the Attitude Toward Technical Education Scale, built for the study because no ready-made Indian instrument suited the purpose. Fifty-five draft statements were vetted by experts, 49 survived screening, and a tryout with 100 students followed. Item analysis by the extreme-groups method (upper and lower 27 per cent) retained 43 statements whose critical ratios were significant.

Respondents rate each statement on five points, from strongly agree to strongly disagree, with 11 negatively worded items reverse-scored; the ceiling score is 215. Test–retest reliability across a two-week gap was .82, and content validity rested on expert judgment. Numerical ability and mechanical reasoning were assessed with the corresponding subtests of the Differential Aptitude Tests (Bennett et al., 1974), administered and scored according to the manual. A short personal data sheet collected background information.

## Statistical treatment

Means, medians, standard deviations, skewness, and kurtosis were computed to check distributional properties. Pearson product–moment coefficients then quantified the attitude–aptitude relationships, with significance evaluated through Fisher's *t* and magnitude expressed as the percentage of shared variance ( $r^2 \times 100$ ). Gender differences in means were tested with the critical ratio appropriate to large independent samples (Best & Kahn, 1996).

## RESULTS

Distributions of all three variables were close enough to normal for parametric analysis. Attitude scores leaned toward the favourable end of the scale, showing mild negative skew, while both aptitude measures were mildly positively skewed. Table 1 gives the descriptive picture.

**Table 1. Descriptive statistics for the three variables (N = 501)**

| Variable                            | Mean   | Median | SD    | Skewness | Kurtosis |
|-------------------------------------|--------|--------|-------|----------|----------|
| Attitude toward technical education | 134.94 | 136    | 20.31 | −0.44    | 0.39     |
| Numerical ability                   | 18.09  | 18     | 6.36  | 0.16     | 0.47     |
| Mechanical reasoning                | 24.41  | 24     | 11.48 | 0.29     | 0.40     |

The headline result concerns the two correlations and the gap between them. Attitude and numerical ability were tightly linked:  $r = .676$  for the whole sample, equivalent to 46.24 per cent of variance in common. Attitude and mechanical reasoning were linked far more loosely:  $r = .361$ , only 13.03 per cent of common variance. Both coefficients clear the .01 significance threshold comfortably, but they describe very different degrees of alignment, and the contrast survives every way the sample can be cut, as Tables 2 and 3 show.



**Table 2. Correlation between attitude toward technical education and numerical ability, by subgroup**

| Sample             | n   | r      | Fisher's t | Shared variance (%) |
|--------------------|-----|--------|------------|---------------------|
| Total sample       | 501 | .676** | 20.57      | 46.24               |
| Boys               | 253 | .716** | 16.25      | 51.26               |
| Girls              | 248 | .636** | 13.03      | 40.45               |
| Government schools | 242 | .737** | 17.64      | 54.32               |
| Aided schools      | 259 | .625** | 10.45      | 39.06               |
| Rural schools      | 288 | .714** | 10.38      | 50.98               |
| Urban schools      | 213 | .678** | 11.52      | 45.97               |

Note: \*\*  $p < .01$ . Shared variance =  $r^2 \times 100$ .

**Table 3. Correlation between attitude toward technical education and mechanical reasoning, by subgroup**

| Sample             | n   | r      | Fisher's t | Shared variance (%) |
|--------------------|-----|--------|------------|---------------------|
| Total sample       | 501 | .361** | 4.15       | 13.03               |
| Boys               | 253 | .341** | 6.66       | 11.62               |
| Girls              | 248 | .329** | 4.69       | 10.82               |
| Government schools | 242 | .428** | 5.23       | 18.32               |
| Aided schools      | 259 | .258** | 3.48       | 6.66                |
| Rural schools      | 288 | .368** | 4.21       | 13.54               |
| Urban schools      | 213 | .340** | 6.65       | 11.60               |

Note: \*\*  $p < .01$ . Shared variance =  $r^2 \times 100$ .

Gender comparisons complete the picture. Girls averaged significantly higher than boys on attitude toward technical education and on numerical ability, while the small difference in mechanical reasoning did not reach significance (Table 4).

**Table 4. Gender differences in the three variables**

| Variable                            | Group | n   | Mean   | SD    | t    | p     |
|-------------------------------------|-------|-----|--------|-------|------|-------|
| Attitude toward technical education | Boys  | 253 | 132.36 | 21.36 | 2.72 | < .01 |
|                                     | Girls | 248 | 137.23 | 18.75 |      |       |
| Numerical ability                   | Boys  | 253 | 16.64  | 5.85  | 5.17 | < .01 |
|                                     | Girls | 248 | 19.51  | 6.55  |      |       |
| Mechanical reasoning                | Boys  | 253 | 23.75  | 11.56 | 1.35 | > .05 |
|                                     | Girls | 248 | 25.13  | 11.35 |      |       |

## DISCUSSION

Why should feeling and quantitative skill move so closely together? The traffic likely runs in both directions. Success with numbers earns marks and praise in precisely the subjects that lead toward engineering, and appreciation follows achievement; equally, a student who already dreams of engineering has a standing motive to labour at mathematics. Family and school environments that prize technical careers plausibly feed both at once. Correlational data cannot untangle these routes, but their combined effect in this population is unmistakable: nearly half the variability in the two characteristics is shared.

The weakness of the second link deserves more attention than the strength of the first. Across every subgroup, students' liking for technical education told us little about their mechanical reasoning; among aided-school students the two shared under 7 per cent of variance. Yet mechanical insight, more than any other single aptitude, is what separates engineering from ordinary academic study. A student can adore the idea of engineering, and even calculate fluently, while possessing no particular feel for how physical mechanisms behave. Here, arguably, is a psychological root of the sector's twin troubles. It helps explain why demand and completion diverge, and it predicts the current branch migration with some precision: an attitude tethered to symbolic-numerical facility but not to mechanical sense should push its owners toward software, where the work is almost entirely symbolic, and away from the workshop branches, which is just what the admission figures now record (Careers360, 2024).

A further observation concerns measurement itself. The three instruments in this study address three different representational registers: written statements for attitude, mathematical notation for numerical ability, and pictures of physical arrangements for mechanical reasoning. Attitudes live in talk, and numerical skill lives in a taught symbol system that the same classrooms cultivate; mechanical understanding largely grows elsewhere. Some part of the strong first correlation and weak second one may reflect this shared versus separate provenance, a possibility that aptitude researchers would do well to examine deliberately rather than leave implicit.

The gender results overturn a stubborn assumption. In this sample it is the girls who bring the warmer attitude to technical education and the stronger numerical performance, while giving up nothing in mechanical reasoning. Findings elsewhere confirm that group differences in such attitudes are creatures of context rather than constants of nature (Elffers & Oort, 2013). Guidance and admission practice in the region should be audited for habits, spoken or otherwise, that steer girls away from technical courses their measured characteristics fully warrant.



## Implications for practice

Three practical lessons follow. Counsellors and teachers advising higher secondary students should treat expressed interest and tested aptitude as two distinct readings and take both, adding a mechanical reasoning measure in particular, since it is the component that enthusiasm predicts worst. Schools implementing the guidance provisions of the National Education Policy 2020 have in such testing an inexpensive tool that fits the policy's intent exactly (Government of India, 2020); it may also uncover mechanical talent in students whom the prevailing software-centred discourse never prompts to consider the core branches. Finally, those who shape classroom practice should remember that abilities are built, not merely found: activity-based and discovery-oriented mathematics teaching strengthens the very competence with which favourable attitudes keep company.

## Limitations

The findings come from one district, one academic stream, and a cross-sectional design that supports no causal claims. The fieldwork predates the most recent turns in the admission landscape, though the question it answers has only gained urgency. Extension to other streams, districts, and syllabi, to the remaining aptitudes of the Differential Aptitude battery, and to the post-NEP cohort would all be natural next steps.

## CONCLUSION

Among higher secondary science students of Kasaragod district, liking for technical education and numerical ability rise and fall together, but liking and mechanical reasoning barely do. A favourable attitude therefore certifies only part of the readiness technical study demands, and the missing part is the one most distinctive of engineering. Girls, meanwhile, match or exceed boys on every characteristic measured. For a state watching engineering seats empty while enrolled students struggle, the message for guidance practice is concrete: measure the aptitude, not just the appetite, before the choice is made.

## Ethical Considerations

The study was conducted as part of a Master of Education dissertation approved by Sahodaran Ayyappan Memorial College of Education (Mahatma Gandhi University, Kottayam). Formal ethics committee clearance was not required for survey research of this kind under the institutional rules then in force. Permission was obtained from the heads of all participating schools, and student participation was voluntary and anonymous.

## Conflict of Interest

The author declares no conflict of interest with respect to the research, authorship, or publication of this article.

## Data Availability

The data supporting the findings of this study are held by the author and are available on reasonable request, as they were collected before public data-archiving became standard practice and contain school-level information.

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