STEM Uptake Among Children in India and Ireland: A Technology Acceptance Model

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***Abstract*—This paper presents a quantitative, cross-sectional analysis of technology acceptance in STEM education among students and parents in India and Ireland. The study was driven by the Technology Acceptance Model (TAM) which uses survey data to operationalize as well as measure the following key constructs: acceptance of Perceived Usefulness (PU), Perceived Ease of Use (PEOU) and Attitude. The examination shows that the Indian students along with the parents depicted a greater level of perceived usefulness (PU) and aspiration of STEM, whereas, the Irish students exhibited a greater degree of perceived ease of use (PEOU) in regard to coding-confidence. The study found no significant correlation between PEOU (coding confidence) and PU (STEM interest) (r=0.12,p=0.45), suggesting independence of these constructs. It was also found that there was a higher degree of gender stereotyping against technology that is more pronounced in India as shown by the analysis of the results. These results demonstrate the differences in cross-cultural and generational technology acceptance, thus allowing establishing an educational intervention based on context.**

***Index Terms*—Technology Acceptance Model (TAM), STEM education, cross-cultural studies.**

I. Introduction

The 21 st century is marked by technologically fast changes, which is why a level of adaptedness in Science, Technology, Engineering, and Mathematics (STEM) becomes a basis of individual and national success. The education systems of Ireland and India both strive to develop talented STEM workforces although one is different than the other. Supporting national curricula and industry partnerships, Ireland has a strong ecosystem that involves integration of STEM across preschool through primary school stage [1]. Irish students perform strongly on PISA and rank among the top EU countries in TIMSS for mathematics and science, so maintaining engagement beyond mandatory education as well as resolving the workforce shortage on ICT/engineering remains a problem [2], [3]. The STEM education in India, characterised by fast institutional development, puts a strong focus on science and mathematics as part of K-12 education, with engineering and technology commonly not followed at K-12 level [1]. The inquiry-based STEM strategies cannot be successful with traditional teaching methods [4]. Efforts such as Atal Tinkering Laboratories focus on best students and most of the time overlook larger audiences, spending barely on education and R&D amounts that do not measure up on the international scale.

A. Gender Disparities in STEM

Gender gaps in STEM persist globally, with men favoring STEM and women leaning toward arts, humanities, or medicine [5]. In Ireland, a narrow mathematics gender gap exists, but women are underrepresented in technology and engineering[2]. Factors like early exposure, career guidance, and low self-efficacy among girls contribute [6].

B. Student and Parental Perceptions, Confidence, and Technology's Role

Parenthood and student attitudes play a huge role in the relationship with Science, Technology, Engineering, and Mathematics (STEM) disciplines. STEM is well regarded by primary school pupils in Ireland and boys are somewhat more enthusiastic than girls [7]. STEM confidence is highly correlated with preceding academic achievement and instruction with active, practical modes, but transferring to lectures indicates a decrease in it [8].

Positive Stem attitudes fuel careers in India, and the female students show a lack of confidence because of gender double-expectations and the lack of role models [9]. Parental expectations are quite powerful in persuading students to aim towards high-status careers like engineering and medicine but it is particularly threatening to poor students, who cannot afford the resources [10].

C. TAM in Educational Contexts

TAM has been popular in the educational sector where it is used to evaluate the adoption of technology among students and teaching staffs [11]. As an example, [11] concluded that TAM can successfully serve to predict student adoption of e-learning platform, wherein PU proves a better predictor than PEOU in the academic context. In the same way, [12] emphasized, that perceived benefits and ease of use determine attitudes toward technology, especially in STEM education, where it is essential to use technology.

More recent advances in improving educational decision-making with technology involve the creation of integrated systems such as the University Hub that brings together the information of Indian universities to make informed decisions [13]. This aligns with TAM's emphasis on Perceived Usefulness (PU) and Perceived Ease of Use (PEOU).

Figure 1 illustrates the Technology Acceptance Model (TAM), originally developed by Davis [14], which is widely used to understand users' acceptance and use of technology.

Description of Model:

1) External Variables: Factors like user traits or system characteristics that influence perceptions.
2) Perceived Usefulness (U): The degree to which a user believes the system enhances their performance.
3) Perceived Ease of Use (E): The degree to which a user believes the system is free of effort.
4) Attitude Toward Using (A): The user's overall affective reaction to using the system.
5) Behavioral Intention to Use (BI): The user's plan or willingness to use the system.
6) Actual System Use: The real-world adoption and usage of the system.

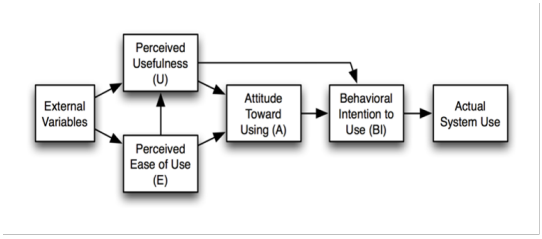

Fig. 1. Technology Acceptance Model (TAM)

D. Cross-Cultural Influences

Technology acceptance and gender perception depend on culture [15]. Their gender roles based on traditional societal roles would contribute to even more biases towards boys when it comes to technical disciplines in collectivist societies such as India [16]. By contrast however, less discriminatory perceptions could be seen in individualistic societies like Ireland because of progressive gender norm [17]. According to Dutt and Kumar [15], outside of their two natural talents, students in India will put an emphasis on PU because of the economic reasons in the STEM professions whereas students in the West will put an emphasis on PEOU due to access to more technology. It is because of these cultural differences that a comparative analysis must be done in order to derive the effect of the differences on education.

The present study adds to these existing sources since it outlines the ways in which Irish and India cultural situations impact gender stereotypes and TAM constructs in STEM education, filling in the gaps regarding cross-cultural parental and student perspectives comparisons.

II. METHODOLOGY

This study adopts a quantitative approach, analyzing survey data from students and parents in Ireland and India to explore gender stereotypes and technology acceptance.

A. Data Collection

Data were collected via surveys from secondary school students and parents in Ireland and India:

- Students Ireland: 34 responses, including gender, confidence in coding and computer skills (1-4 scale), and interest in STEM subjects (1-4 scale).
- Parents Ireland: 33 responses, including perceptions of children's technology and coding ease (1-9 scale) and gender stereotype scores (0-100 scale for girls' and boys' technology abilities).
- Students India: 45 responses, with the same variables as Students Ireland.
- Parents India: 44 responses, with the same variables as Parents Ireland.

The surveys were administered to secondary school students and their parents, targeting perceptions of technology in STEM education. The sample sizes, though modest, provide sufficient statistical power for initial comparison

B. Data Analysis

Data analysis was conducted using Python with libraries including pandas, numpy, scipy, scikit-learn, and plotly. The following analyses were performed:

- TAM Scores: PU was the mean of STEM interest items (1–4 scale); PEOU was the mean of coding/computer skill confidence items (1–4 scale for students, rescaled from 1–9 for parents); Attitude was derived from overall technology perception items. Parent scales (1–9, 0–100) were normalized to 0–1 for comparison. For example, PU was derived from items assessing STEM interest, PEOU from confidence in coding/computer skills, and Attitude from overall technology perceptions.
- Gender Stereotypes: Computed as mean agreement scores (0-100) for parental perceptions of girls' and boys' technology abilities.
- Statistical tests included paired t-tests for gender stereotypes and Cohen's d for TAM score differences.

C. Research Hypotheses

The study tests the following hypotheses:

- H1: Indian parents exhibit a stronger gender bias in technology perceptions than Irish parents.
- H2: Indian students have higher PU but lower PEOU scores than Irish students.
- H3: Confidence (PEOU) and interest (PU) are positively correlated across Ireland and India..

III. RESULTS

The comparison showed the disparities that existed between Ireland and India in gender stereotypes and technology acceptance, which hold water to some of the research hypotheses. Nevertheless, according to the study, there would also be no confirmation regarding H3, since no significant correlation was found on confidence (PEOU) and interest (PU) ($r=0.12$, $p=0.45$).

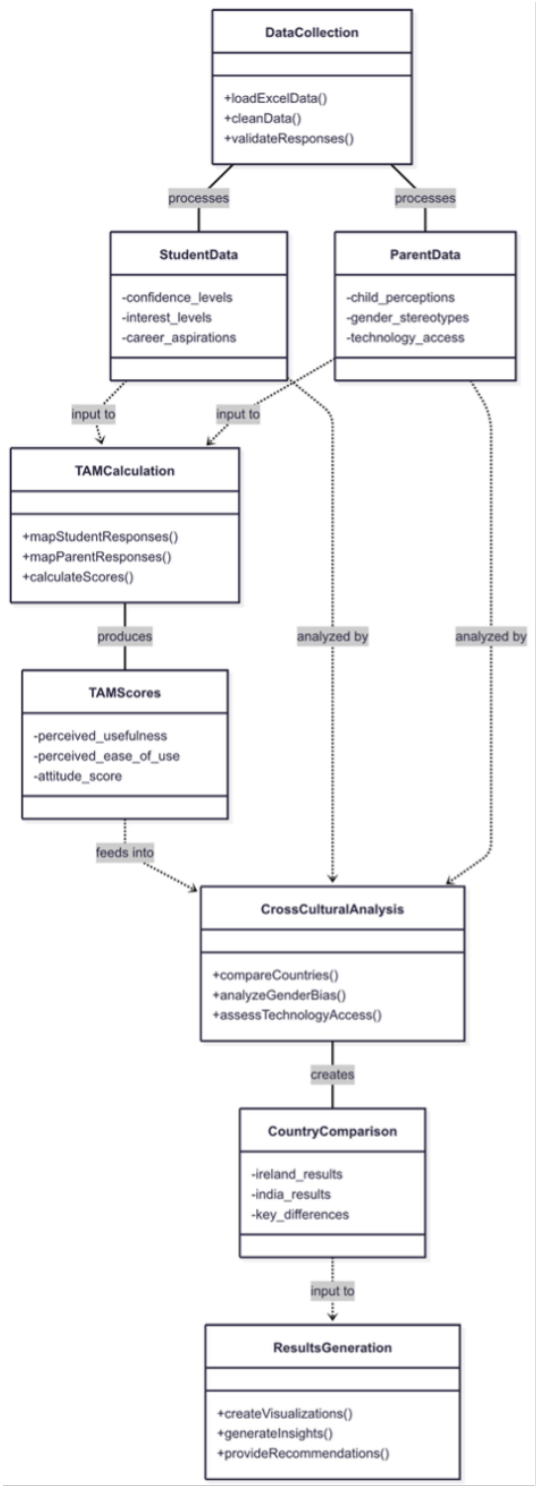

Fig. 2. TAM Analysis Flow Diagram

A. Sample Characteristics

The dataset included:

- Ireland: 34 students (18 male, 16 female), 33 parents.
- India: 45 students (24 male, 21 female), 44 parents.

The balanced gender distribution and sufficient sample sizes enable reliable statistical comparisons.

B. Sample Characteristics TAM Scores

The analysis reveals differences in technology acceptance between Irish and Indian students. Indian students reported higher perceived usefulness (PU Score: 2.933 vs. 2.103) but lower perceived ease of use (PEOU Score: 2.278 vs. 2.971) compared to Irish students. This suggests stronger STEM interest (PU) despite lower coding confidence (PEOU).

TABLE I
MEAN TAM SCORES FOR STUDENTS BY COUNTRY

Country	PU	PEOU
Ireland	2.103	2.971
India	2.933	2.278

The effect sizes (Cohen's d) indicate moderate to large differences, with PEOU showing the largest gap (-0.449), suggesting Irish students feel more comfortable with technology implementation. Irish students show more modest scores across all TAM dimensions, which may reflect different educational contexts or cultural attitudes toward technology adoption.

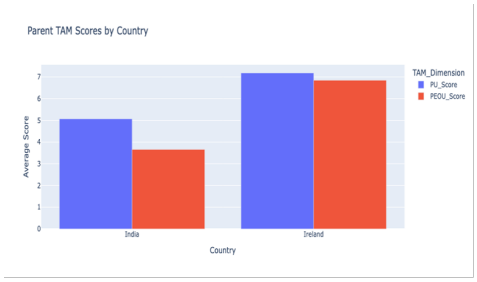

Fig. 3. Parent TAM scores by country

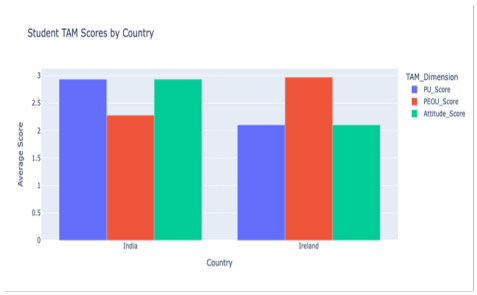

Fig. 4. Student TAM scores by country

Figure 5 illustrates the comparative study of the access to technology by households. The data tells that there is a high level of technological saturation in both Ireland and India when

it comes to core personal devices. Namely, the availability of smartphones and laptops is around 90-90 percent in both groups. A particular point of difference can be seen, however, in mobile data connectivity, with India showing a much higher reported rate of 3/4G Internet connection than Ireland. However, in comparison, the ownership of desktop computers is the lowest touch point of both countries. This study indicates that although the two countries have a very strong background of personal computing and internet infrastructure, some differences between countries still exist in terms of mobile access and desktop penetration and this can further affect subsequent use of technology.

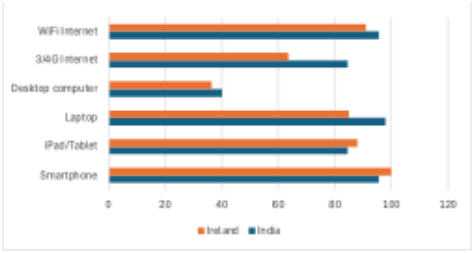

Fig. 5. Tech Usage by Country

C. Gender Stereotypes

Table II shows the mean gender stereotype scores for parents.

Paired t-tests revealed:

- Ireland: No significant gender bias (t = -0.875, p = 0.389).
- India: Significant gender bias favoring boys (t = -3.571, p = 0.001).

TABLE II
GENDER STEREOTYPE SCORES BY COUNTRY

Country	Girls' Ability	Boys' Ability
Ireland	77.4	78.8
India	54.8	62.0

Figure 6 (stereotype heatmap) shows parental perceptions of technology skills (0–100 scale). In Ireland, girls (M=77.4) and boys (M=78.8) scored similarly, indicating minimal bias. In India, girls (M=54.8) scored lower than boys (M=62.0), reflecting stronger gender bias. This inequality is well demonstrated in the visualization as Ireland has very high scores and India has a very low score differing notably between girl and boys. India's bias (7.2-point gap vs. Ireland's 1.4) reflects cultural stereotypes that may limit girls' opportunities in technology, necessitating targeted gender equity interventions in Indian education.

D. Educational and Career Aspirations

There are some fascinating cross-nation cultural trends that can be viewed in career aspirations. The students of India have a high preference to STEM/ Technology career, healthcare and engineering related fields due to the cultural bias towards technical studies. There is a wider range of career preferences of Irish students in various aspects such as arts, education and business. Everyone dreams of attending college and the majority of students in both countries have desires to be allowed to be given a chance to attend higher education facilities. The preferences of Indian students when it comes to STEM education are diverse, and computer science and engineering are most common. These aspirations align with TAM findings, While a direct link between confidence and interest was not found in this study.

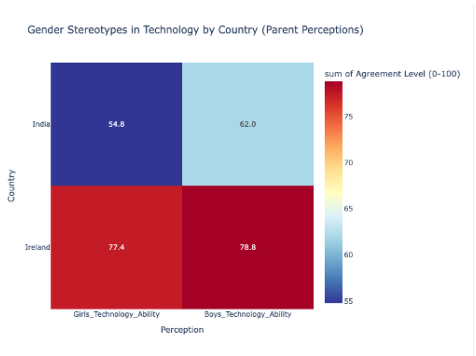

Fig. 6. Parent perceptions of gender stereotypes in technology

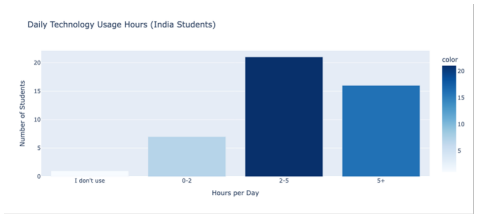

Fig. 7. Daily technology Usage Hours (India Students)

IV. CONCLUSION

This study reveals indicates how culture impacts gender stereotypes and use of technology in STEM. Indian Parents were more gender biased towards boys (difference: 7.2 points p=0.001) compared to Irish parents (difference: 1.4 points p=0.389) which may diminish the participation of Indian girls into STEM since they are jugged by their collectivist culture whereas Ireland is individualistic.Indian students had higher PU (2.933 vs. 2.103), as social and economic pressure in India focuses on technical careers, unlike in Ireland, where there is more egalitarian support for STEM participation. Cultural context likely influences PU, though further analysis is needed to quantify its impact. Additionally, no significant correlation was found between confidence (PEOU) and interest (PU) (r=0.12, p=0.45), suggesting that other intervening factors, such as a lack of hands-on technology exposure in India, may be influential. such as lack of actual exposure of computer technology in India. The implications of such findings are the need of going culturally specific with interventions (parental awareness campaigns and workshops on STEM in India among girls) and closer practical training in technology

to enhance PEOU. Limitations are small sample size (34-45), self-reported data tends to give biased results and the need to develop confidence-interest mediators. Future studies need to keep in mind future research by employing longitudinal studies, qualitative research and testing interventions to diminish differences and promote technology equitable STEM outcomes.

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