

# A Factor-Based Framework for Understanding Students' Selection of TVET: A Psychometric Exploration of Perceived Barriers and Social Support

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## ABSTRACT

Understanding the factors associated with students' selection of Technical and Vocational Education and Training (TVET) is essential for identifying the underlying perceptions embedded in educational choice. As these perceptions may originate from different social, academic, and career considerations, establishing a coherent structure among the observed factors remains challenging. This study presents a preliminary psychometric exploration to identify the underlying factor structure of students' perceptions regarding TVET pathways and subsequently proposes a factor-based TVET Selection Factors Framework (TSFF). Relying on survey data from 218 students at Universiti Teknikal Malaysia Melaka (UTeM), the study examined 17 perception items through reliability analysis, factorability assessment, and parallel analysis. Exploratory Factor Analysis (EFA) results using Principal Axis Factoring and Varimax rotation established a two-factor structure comprising Perceived Barriers and Negative Stereotypes, and Social Support and Career Opportunities. Following item refinement, 15 items were retained, with the two factors demonstrating high internal consistency, with Cronbach's alpha values of 0.921 and 0.841, respectively. The design of the TSFF was based on these empirically derived dimensions to organise the factors associated with students' TVET selection. The proposed framework provides a structured representation of students' perceptions by integrating barrier-related perceptions with supportive and career-oriented considerations. The contribution of this study is an empirical psychometric exploration that connects data-driven factor discovery with framework design, providing a foundation for further evaluation and confirmatory validation of the proposed TSFF.

**Keywords:** TVET selection; EFA; perceptual; vocational education; psychometrics

## INTRODUCTION

Technical and Vocational Education and Training (TVET) is widely recognised as a critical pathway for producing skilled workers capable of meeting the evolving demands of industry and contributing to sustained economic growth. Defined by UNESCO and the International Labour Organization (ILO) as an educational process that emphasises practical competencies and occupational knowledge, TVET occupies a strategic role in national human capital development agendas. Despite this recognised importance, TVET continues to face persistent challenges in attracting students, particularly in contexts where academic pathways carry greater social prestige.

In Malaysia, governmental commitment to TVET has intensified in recent years. Substantial public investment amounting to RM6 billion in 2021 alone has been directed toward expanding TVET infrastructure, programme

quality, and industry alignment. Yet despite this investment, the perceptual landscape that shapes students' orientation toward TVET pathways remains insufficiently understood at the institutional level. While national enrolment statistics document participation rates, they do not reveal the underlying perceptual dimensions barriers, stereotypes, social support, and career expectations that students bring into their TVET experience. Understanding these perceptual structures is essential for institutions seeking to strengthen student engagement, retention, and pathway commitment.

Prior research has consistently identified several categories of influence on students' TVET decisions. Parental attitudes and socioeconomic background represent prominent determinants, shaping students' aspirations and their interpretations of what constitutes a desirable educational outcome (Alnaqbi, 2016; Efthymiadou et al., 2025). Teacher and peer influences further mediate how students construct their understanding of vocational pathways (Khaizer Omar et al., 2020). At the same time, negative social stereotypes and perceived stigma around TVET remain recurrent barriers, with many students and families associating vocational training with diminished social status or limited career prospects (Cui & Zhao, 2025; Pimpa & Suwannapirom, 2008; Wang et al., 2022). Conversely, perceptions of strong employability outcomes and clear career pathways can serve as motivating factors (Murshed, 2025).

Despite substantial research documenting individual factors such as parental attitudes, teacher influence, and career expectations, the underlying perceptual structure of students already enrolled in TVET programmes remains underexplored. Enrolled students carry with them a complex set of perceptions some reflecting resolved barriers, others reflecting ongoing social support or career optimism that shape their engagement with their chosen pathway. Without a structured empirical representation of these perceptual dimensions, educators and institutions lack a diagnostic tool for understanding how students relate to their TVET choice and where targeted support is most needed.

Addressing this knowledge gap requires an empirical approach grounded in the perceptions of students who have actively chosen TVET pathways. Rather than assuming that theoretically proposed factor categories reflect the actual perceptual structure of this population, the factor structure itself needs to be empirically examined and validated.

This To address this knowledge gap, an empirical psychometric approach is required to examine the perceptual landscape of students who have chosen TVET pathways. Rather than assuming that theoretical constructs represent the true dimensional structure of this cohort, the factor structure must be empirically derived and evaluated. This study utilizes Exploratory Factor Analysis (EFA) to discover the underlying dimensions of students' perceptions regarding TVET selection. Examining 17 observed items from 218 engineering undergraduates at Universiti Teknikal Malaysia Melaka (UTeM), the study applies parallel analysis, factorability testing, and Principal Axis Factoring with Varimax rotation to establish a preliminary factor-based blueprint: the TVET Selection Factors Framework (TSFF).

The main contributions of this work are summarized as follows:

1. **Empirical factor discovery:** The study empirically examines the underlying structure of students' perceptions rather than assuming that the original questionnaire categories represent the final factor structure.
2. **Two-dimensional factor structure:** The EFA identifies two interpretable dimensions, namely Perceived Barriers and Negative Stereotypes and Social Support and Career Opportunities, based on the retained survey items.
3. **Preliminary framework design:** Translates empirical factor structures into the preliminary TSFF, offering a diagnostic foundation for institutional guidance and future structural validation.
4. **Measurement refinement:** The study refines the initial 17-item structure to a 15-item empirical structure by removing items that demonstrated problematic contribution to their respective factors.
5. **Empirical grounding for psychometric modeling:** The study demonstrates how exploratory factor analysis provides empirical grounding for the initial design of a conceptual framework, connecting data-driven knowledge discovery with framework design.

The following is the structure of the paper. Section 1 presents the introduction and establishes the research

problem and contributions of the study. Section 2 elaborates the related works concerning TVET selection, student perceptions, influencing factors, and the application of factor analysis in educational research. Section 3 describes the research methodology, including the survey data, data preparation, reliability analysis, exploratory factor analysis, and framework development. Section 4 presents the empirical results, including the factorability assessment, factor extraction, item refinement, and reliability results. Section 5 presents the proposed TSFF and discusses its design implications. Section 6 discusses the findings, including sampling limitations regarding post-enrolment cognitive dissonance and future validation roadmaps. Finally, Section 7 concludes the study by summarizing the contributions, limitations, and directions for future research.

## RELATED WORK

### Factors Influencing TVET Choice

International studies have identified a broad range of factors that shape students' decisions to pursue TVET pathways. These factors are generally categorised into social influence variables encompassing the attitudes and behaviours of parents, teachers, and peers and individual-level perceptions of academic competence, social status, and career prospects.

Parental influence is among the most consistently documented determinants of TVET uptake. Research conducted in sub-Saharan Africa, Southeast Asia, and the Gulf region has found that parents who view vocational education positively are more likely to encourage their children to pursue it (Alnaqbi, 2016; Efthymiadou et al., 2025). In Ghana, fathers' encouragement has been identified as a primary motivating factor alongside students' own interest in practical learning and the availability of clear job prospects (Boateng et al., 2024). In the Malaysian context, surveys similarly confirm that parental influence, student interest, and prevailing social attitudes are key determinants of TVET uptake or avoidance (Shaari et al., 2025).

Teacher influence represents a second important channel. Teachers serve as information intermediaries and academic role models: their expressed beliefs about the value and appropriateness of vocational pathways can either validate or discourage students' consideration of TVET. Khaizer Omar et al. (2020) demonstrated that the effectiveness of information delivery by teachers, parents, peers, and media is significantly correlated with students' TVET choices, suggesting that the quality of guidance received matters as much as its source.

Peer dynamics also play a role, though the direction of influence is less consistent in the literature. While peer encouragement and social belonging can support vocational aspirations, peer stigma, which refers to the perception that TVET represents a less prestigious or less academically capable pathway, can deter students who are sensitive to peer judgement. Wang et al. (2022) developed a stigma scale specifically measuring secondary school students' negative associations with vocational education, documenting the pervasive nature of such perceptions in Chinese educational contexts. Cui and Zhao (2025) further demonstrated that subjective family socioeconomic status moderates the internalisation of vocational stigma, with lower-SES students being simultaneously more likely to consider TVET and more vulnerable to its negative connotations.

Career and employment prospects emerge as the third major cluster of influences. Students who perceive TVET as offering viable, dignified employment outcomes demonstrate higher willingness to enrol (Singh et al., 2019). Murshed (2025) drawing on Bangladeshi data, finds that TVET graduates are more likely to secure employment than general education graduates, supporting the view that perceptions of TVET's labour market value are not simply ideological but grounded in measurable economic returns. Diego-Rodríguez et al. (2026) found that first-year university students who doubted the labour market returns of their vocational training pathway reported higher dropout intentions, underscoring the salience of career return expectations across the life course.

Collectively, this literature indicates that TVET choice is shaped by two broad perceptual dimensions. The first is a barrier dimension, which includes social stigma, negative social signals, and academic discouragement. The second is a support and opportunity dimension, which includes positive social reinforcement, perceived career relevance, and expected returns. The present study treats these two dimensions as an empirical hypothesis to be tested through factor analysis rather than as a pre-established typology.

## Conceptual Frameworks in Educational Design

Theoretical and conceptual frameworks serve a vital role in educational research by organizing empirical observations into diagnostic models for practitioners. In vocational education, developing structured frameworks bridges academic findings with practical decision-support tools. Moving from exploratory factor discovery to a structured conceptual model provides institutions with actionable insights to address recruitment, retention, and student engagement challenges.

### Theoretical Grounding

Three established theoretical frameworks inform the interpretation of the empirical findings. First, Social Cognitive Career Theory (SCCT); Lent et al., (1994) posits that career interests, choices, and performance outcomes are shaped by self-efficacy beliefs, outcome expectations, and perceived environmental supports and barriers. This framework maps directly onto the two empirically identified dimensions: perceived barriers and stereotypes correspond to the barrier and self-efficacy inhibition components of SCCT, while social support and career opportunities align with the support and outcome expectation components.

Second, Self-Determination Theory (SDT); (Ryan & Deci, 2020) distinguishes between intrinsic and extrinsic motivational sources and emphasises the role of social context including the behaviour of significant others and in supporting or undermining autonomous motivation. The presence of supportive parents and teachers, as captured in the Social Support dimension of the TSFF, can be understood as satisfying students' needs for relatedness and competence, thereby fostering more autonomous engagement with TVET pathways.

Third, Gottfredson's Theory of Circumscription and Compromise provide an additional theoretical lens for understanding how vocational choices are narrowed through developmental evaluations of social prestige and gender/class appropriateness. The Perceived Barriers and Negative Stereotypes dimension reflects the circumscription process wherein vocational pathways are compromised or rejected due to perceived social stigma or low academic standing.

Together, SCCT, SDT, and Gottfredson's theory provide a theoretically coherent backdrop for the TSFF, linking its empirically derived dimensions to well-established psychological constructs. These theoretical alignments strengthen the construct validity of the framework, though they do not constitute confirmatory validation of the factor structure, which remains a task for future research.

## METHODOLOGY

The identification of factors influencing students' TVET-related perceptions requires a methodology that is simultaneously empirically rigorous and oriented toward producing a practical, actionable artifact. This study combines quantitative psychometric analysis with a DSR framework to meet both objectives. The empirical component is a structured survey followed by EFA that yields a statistically grounded account of the latent dimensions underlying students' perceptions. The DSR component translates those dimensions into the TSFF artifact. This section describes the research design, the survey instrument, the sampling and data collection process, the analytical procedures, and the design requirements governing the TSFF.

### Research Design

This study adopts a Design Science Research (DSR) methodology, guided by Hevner's three-cycle model comprising the Relevance Cycle, the Rigor Cycle, and the Design Cycle (Hevner et al., 2004). DSR is a problem-solving paradigm that generates prescriptive knowledge through the deliberate construction and evaluation of artifacts designed to address identified real-world problems. Unlike descriptive or explanatory research, which seeks to understand or predict phenomena, DSR aims to produce actionable artifacts whose utility can be evaluated against practical requirements. This orientation makes DSR particularly appropriate for the present study, in which the goal is not only to identify the factors that influence students' TVET selection but to organise them into a structured framework that practitioners can apply. As illustrated in **Fig. 1**, the research process operated across three interconnected cycles and four sequential phases.

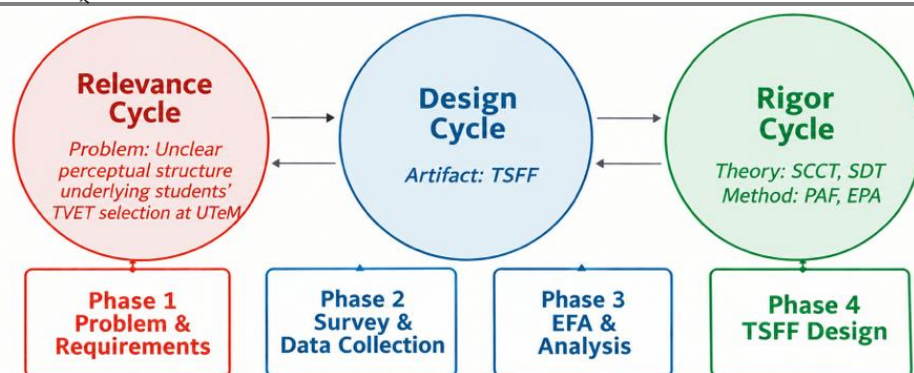


**Fig. 1** Design Science Research (DSR) Framework for TVET Selection Factor Development.

The three cycles of the DSR process operate as follows in the present study. In the Relevance Cycle, the practical problem was identified, TVET-related faculties at UTeM face challenges related to students' self-perceptions and social stigma surrounding vocational education, which may affect student engagement, retention, and career confidence. Five design requirements (DRs) for the TSFF artifact were formalised prior to data collection (Section 3.5). In the Rigor Cycle, the study draws on SCCT (Lent et al., 1994) and SDT (Ryan & Deci, 2020) as theoretical grounding, and on established psychometric procedure's reliability analysis and EFA as the empirical backbone. In the Design Cycle, the TSFF is constructed iteratively: this paper reports TSFF, based on the survey findings.

The research process proceeded through four sequential phases: (1) problem identification and design requirement specification; (2) instrument development and data collection; (3) empirical analysis encompassing reliability assessment and exploratory factor analysis; and (4) artifact design and initial evaluation planning. The process is showing how the three DSR cycles interact with each phase of the study. This sequential structure ensures that both the empirical rigour and the practical relevance of the TSFF are maintained throughout the research process.

## Survey Instrument

The data collection instrument comprised a 17-item questionnaire using a five-point Likert response scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). Items were organised around five a priori thematic constructs derived from the TVET choice literature: Parental Influence (PI; 4 items), Teacher Influence (TI; 3 items), Peer Influence (PE; 4 items), Grades and School Achievement (GSA; 4 items), and Career and Job Potential (CJP; 3 items). The total of 17 items was considered appropriate for the intended factor analytic procedures, satisfying the minimum item-to-factor ratio recommended for stable EFA solutions (Costello & Osborne, 2005). Both positively and negatively worded items were included within constructs to minimise acquiescence bias. Item development followed a three-stage process: (1) systematic review of validated instruments from the TVET and vocational stigma literature (Efthymiadou et al., 2025; Wang et al., 2022b); (2) adaptation to the Malaysian higher education context; and (3) pilot review by two subject-matter experts and a small pilot sample ( $n = 30$ ) to confirm item clarity.

Table 1 presents the five constructs with the number of items, representative item content, and the directional orientation of each item set. All items were scored such that higher values indicate stronger perceived influence in the direction stated (e.g., a high PI1 score reflects strong parental discouragement, while a high PI3 score reflects strong parental encouragement). This bidirectional structure was intentional, as it allows the factor analysis to identify whether positive and negative influences collapse onto a single dimension or separate into distinct latent factors.

Table 1 *Survey instrument constructs, item counts, and directional orientation.*

| Construct          | Code | n | Orientation | Item Content (English translation)                       |
|--------------------|------|---|-------------|----------------------------------------------------------|
| Parental Influence | PI1  | 1 | Negative    | My parents have a negative attitude towards TVET studies |

|                             |      |   |          |                                                                       |
|-----------------------------|------|---|----------|-----------------------------------------------------------------------|
|                             | PI2  | 1 | Negative | My parents view TVET as suitable only for children from poor families |
|                             | PI3  | 1 | Positive | My parents support TVET as a career pathway                           |
|                             | PI4  | 1 | Positive | My parents encourage me to study TVET                                 |
| Teacher Influence           | TI1  | 1 | Positive | My teachers have provided counselling about TVET                      |
|                             | TI2  | 1 | Negative | My teachers have negative views about TVET                            |
|                             | TI3  | 1 | Positive | My teachers have sufficient knowledge about TVET                      |
| Peer Influence              | PE1  | 1 | Mixed    | I would choose the same pathway as my peers                           |
|                             | PE2  | 1 | Positive | My peers have a good perception of TVET                               |
|                             | PE3  | 1 | Mixed    | My peers influence my career selection decision                       |
| Grades & School Achievement | GSA1 | 1 | Negative | Students choose TVET because of low grades in school                  |
|                             | GSA2 | 1 | Negative | TVET is for those with low academic achievement                       |
|                             | GSA3 | 1 | Negative | Students choose TVET because they cannot enter other fields           |
|                             | GSA4 | 1 | Negative | Students choose TVET because they failed major examinations           |
| Career & Job Potential      | CJP1 | 1 | Positive | TVET helps guide students towards the job they want                   |
|                             | CJP2 | 1 | Positive | A TVET Diploma is attractive in the labour market                     |
|                             | CJP3 | 1 | Positive | TVET guarantees employment in the future                              |

*Note.* n = number of items per row. Orientation refers to whether the item content reflects a discouraging (negative), encouraging (positive), or ambiguous (mixed) perception of TVET.

## Sample and Data Collection

The survey was administered to undergraduate students enrolled in TVET-related engineering programmes at UTeM. Two faculties were included: FTKEK (Faculty of Electronics and Computer Engineering; n = 161) and FTKE (Faculty of Electrical Engineering; n = 57). Participants spanned Year 1 through Year 4, with Year 2 students comprising the largest group (n = 109, 50.0%), followed by Year 1 (n = 58, 26.6%), Year 3 (n = 31, 14.2%), and Year 4 (n = 20, 9.2%). The sample age ranged from 19 to 45 years (M = 23.1), and the majority had some prior working experience (n = 152, 69.7%).

A total of 218 questionnaires were distributed under supervised classroom conditions during regular academic sessions. All 218 returned questionnaires were complete and usable, yielding a response rate of 100%. No missing values were present due to the supervised administration protocol. The analytic sample of N = 218 satisfies established minimum-size recommendations for stable EFA solutions: Barbara G. Tabachnick (2018) recommend a minimum of 200 cases, and Comrey & Lee (2013) classify samples of 200 as fair and of 300 as good for factor analytic purposes. With all communalities exceeding 0.40, the present sample is considered adequate. All responses were anonymised, and ethical approval was obtained prior to data collection.

## Analytical Procedures

Data analysis proceeded through four sequential stages: data screening and cleaning, descriptive analysis and reliability assessment, factorability testing, and exploratory factor analysis with scale refinement. Each stage is described in detail below.

### Data Screening and Descriptive Analysis

All 218 cases were screened for missing values, out-of-range responses, and univariate outliers prior to analysis. No missing values were detected, as the supervised administration protocol allowed supervisors to prompt respondents to complete any omitted items at the time of collection. Univariate outliers were assessed by

examining standardised scores (z-scores) for each item; no items yielded z-scores exceeding  $\pm 3.29$ , the threshold recommended by Barbara G. Tabachnick (2018) for identifying extreme univariate outliers in samples of this size.

Descriptive statistics including means, standard deviations, skewness, and kurtosis were subsequently computed for all 17 items and for each of the five a priori constructs. Inspection of skewness and kurtosis values confirmed that item distributions were approximately normal, with no item exhibiting absolute skewness exceeding 2.0 or absolute kurtosis exceeding 7.0, the benchmarks below which maximum likelihood and principal axis factoring estimators remain robust (Curran et al., 1996). This confirmed the suitability of the dataset for EFA.

### ***Reliability Analysis***

Internal consistency reliability was assessed for each of the five a priori constructs using Cronbach's alpha ( $\alpha$ ). Cronbach's alpha estimates the proportion of total scale variance attributable to the common factor among items, providing a lower bound on the reliability of the composite score (Cronbach, 1951). Alpha coefficients were interpreted using the guidelines proposed by George (2003): values above 0.90 are classified as excellent, 0.80 – 0.89 as good, 0.70 – 0.79 as acceptable, 0.60 – 0.69 as questionable, 0.50 – 0.59 as poor, and below 0.50 as unacceptable.

This preliminary reliability analysis served a diagnostic purpose, constructs with poor or unacceptable alpha values indicate that the theoretically proposed item groupings may not reflect coherent empirical dimensions, motivating the subsequent exploratory factor analysis to allow the data to reveal the underlying structure without imposing the a priori groupings.

### ***Factorability Assessment***

Prior to conducting EFA, the suitability of the correlation matrix for factor analysis was assessed using two standard diagnostics. First, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy was computed. The KMO statistic ranges from 0 to 1, with values approaching 1 indicating that the patterns of correlations are relatively compact and therefore factor analysis will yield distinct, reliable factors. (Kaiser, 1974) classified KMO values as follows: 0.90 – 1.00 (marvellous), 0.80 – 0.89 (meritorious), 0.70 – 0.79 (middling), 0.60 – 0.69 (mediocre), 0.50 – 0.59 (miserable), and below 0.50 (unacceptable).

Second, Bartlett's test of sphericity was computed to test the null hypothesis that the correlation matrix is an identity matrix. A statistically significant result ( $p < .05$ ) is required to proceed with factor analysis, as it indicates that sufficient correlations exist among items to support the identification of underlying factors.

### ***Exploratory Factor Analysis and Factor Retention***

Exploratory factor analysis (EFA) was conducted using principal axis factoring (PAF) with Varimax orthogonal rotation. PAF was selected over principal components analysis (PCA) because it estimates the common variance among items rather than total variance, which is the appropriate choice when the goal is to identify latent constructs rather than data reduction (Costello & Osborne, 2005). Varimax rotation was employed to produce a factor structure in which each item loads highly on at most one factor, facilitating interpretability.

The number of factors to retain was determined using parallel analysis (Horn, 1965), which compares the observed eigenvalues from the actual data against the 95th percentile of eigenvalues derived from 1,000 randomly generated datasets of the same dimensions ( $218 \times 17$ ). Only factors whose observed eigenvalues exceed the corresponding simulated eigenvalue are retained. Parallel analysis was preferred over the traditional eigenvalue-greater-than-1 rule (Kaiser, 1974) because the latter is known to overestimate the number of factors in samples of moderate size (Hayton et al., 2004; Zwick & Velicer, 1986). The scree plot was examined as a supplementary criterion, with the inflection point in the plot providing additional evidence for the number of factors retained (Cattell, 1966).

Item retention decisions were based on the following criteria, consistent with best-practice guidelines for EFA (Barbara G. Tabachnick, 2018; Costello & Osborne, 2005): (i) items were required to load at  $\geq 0.40$  on at least

one factor; (ii) items exhibiting cross-loadings  $\geq 0.30$  on a secondary factor were flagged for potential exclusion; and (iii) communalities below 0.40 indicated that an item shared insufficient common variance with

the retained factors and warranted removal. Items failing to meet these criteria were excluded sequentially, with the EFA re-estimated after each exclusion to assess the impact on the remaining factor structure. The internal consistency of the resulting factor scales was then re-assessed using Cronbach's alpha.

## Design Requirements for the TSFF Artifact

Consistent with the DSR methodology, design requirements (DRs) for the TVET Selection Factors Framework were specified prior to data collection and analysis, drawing on the literature reviewed in Section 2. Design requirements serve as the bridge between the problem context and the artifact: they translate practitioner needs and theoretical insights into concrete criteria that the designed artifact must satisfy (Gregor & Hevner, 2013; Hevner et al., 2004). Table 2 presents the five design requirements for the TSFF, along with their theoretical and empirical justifications.

Table 2 *Design requirements for the TVET Selection Factors Framework (TSFF).*

| Design Requirement                  | Description                                                                                | Justification                                                                                                                                                                         |
|-------------------------------------|--------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DR1<br>Empirical Grounding          | The TSFF must be grounded in validated, data-driven findings.                              | DSR artifacts require empirical grounding to ensure prescriptive validity (Hevner et al., 2004). The EFA-derived factor structure provides this foundation.                           |
| DR2<br>Represent Perceived Barriers | The TSFF must capture perceptions of social discouragement, stigma, and academic barriers. | Recurrent literature identifies stigma and discouragement as primary deterrents to TVET uptake (Cui & Zhao, 2025; Wang et al., 2022).                                                 |
| DR3<br>Represent Social Support     | The TSFF must reflect positive social influences from parents, teachers, and peers.        | Family and school-based support are consistently identified as motivational enablers of vocational choice (Efthymiadou et al., 2025; Khaizer Omar et al., 2020; Shaari et al., 2025). |
| DR4<br>Include Career Prospects     | The TSFF must incorporate students' perceptions of TVET's employment outcomes.             | Perceived labour market returns are a key driver of TVET enrolment decisions (Diego-Rodríguez et al., 2026; Murshed, 2025).                                                           |
| DR5<br>Simplicity and Usability     | The TSFF must be parsimonious and interpretable by practitioners.                          | Practical utility is a defining criterion of DSR artifact evaluation (Hevner et al., 2004). Overly complex frameworks reduce adoption in applied settings.                            |

*Note.* DR = Design Requirement. Requirements were specified prior to data collection and informed both the EFA analysis decisions and the TSFF architecture.

The five design requirements guided both the analytical decisions made during the EFA (e.g., the decision to retain items that loaded on interpretable, theoretically coherent factors rather than maximising explained variance alone) and the subsequent architecture of the TSFF. Specifically, DR2 and DR3 motivated the expectation that a two-dimensional solution separating barrier perceptions from support and opportunity perceptions would be empirically identifiable and theoretically meaningful. DR4 informed the specific inclusion of career-related items (CJP1–CJP3) under the support dimension, rather than treating career perceptions as a separate construct. DR5 guided the decision to pursue the most parsimonious factor solution consistent with the data, prioritising interpretability over the extraction of additional factors with marginal explanatory gain.

## RESULTS

In this study, the empirical results are presented in four parts: descriptive statistics in Section 4.1, reliability

analysis of the a priori constructs in Section 4.2, exploratory factor analysis in Section 4.3, and factor reliability and the final measurement model in Section 4.4.

## Descriptive Statistics

Table 3 presents descriptive statistics for all 17 items. Items within the Barriers-oriented constructs (PI1–PI2, TI2, GSA1–GSA4) yielded low mean scores (M range: 1.57–2.08), indicating that most respondents disagreed with discouraging or stigmatising statements about TVET. Notably, the GSA items returned the lowest means in the entire instrument (M: 1.74–2.08), reflecting strong rejection of the view that TVET is a pathway reserved for academically weak students.

Items within the Support and Career constructs (PI3–PI4, TI1, TI3, PE2, CJP1–CJP3) yielded high mean endorsements (M range: 3.48–4.13), indicating that most respondents acknowledged parental encouragement, positive teacher guidance, and optimistic career expectations. The Career items returned the highest means overall (CJP1: M = 4.13; CJP3: M = 4.11), reflecting strong agreement that TVET provides clear career pathways and employment guarantees. This pattern is consistent with the view that students enrolled in TVET-oriented programmes perceive the career value of their pathway positively, while also rejecting the academic stigma sometimes associated with vocational education in the broader Malaysian context (Shaari et al., 2025).

Table 3 *Descriptive statistics for all 17 survey items (N = 218).*

| Item | Content (abbreviated)                        | M    | SD   | Skewness | Kurtosis |
|------|----------------------------------------------|------|------|----------|----------|
| PI1  | Parents: negative attitude towards TVET      | 1.57 | 0.98 | 1.95     | 3.43     |
| PI2  | Parents: TVET for poor families              | 1.58 | 0.98 | 1.86     | 3        |
| PI3  | Parents: support TVET career                 | 3.88 | 1.02 | −0.50    | −0.35    |
| PI4  | Parents: encourage TVET study                | 3.97 | 1.04 | −0.74    | 0.05     |
| TI1  | Teachers: counselling on TVET                | 3.51 | 1.06 | −0.29    | −0.49    |
| TI2  | Teachers: negative views on TVET             | 1.8  | 1.11 | 1.44     | 1.36     |
| TI3  | Teachers: sufficient TVET knowledge          | 3.48 | 1.03 | −0.28    | −0.15    |
| PE1  | Peers: choose same pathway (excluded)        | 2.6  | 1.2  | 0.28     | −0.75    |
| PE2  | Peers: good perception of TVET               | 3.99 | 0.91 | −0.96    | 1.16     |
| PE3  | Peers: influence career selection (excluded) | 3.23 | 1.23 | −0.26    | −0.75    |
| GSA1 | TVET due to low grades                       | 2.02 | 1.04 | 0.82     | 0.02     |
| GSA2 | TVET for low academic achievers              | 1.78 | 1    | 1.34     | 1.43     |
| GSA3 | TVET: no place in other fields               | 2.08 | 1.16 | 0.82     | −0.27    |
| GSA4 | TVET: failed major examinations              | 1.74 | 1.07 | 1.5      | 1.55     |
| CJP1 | TVET guides to desired job                   | 4.13 | 0.84 | −0.77    | 0.51     |
| CJP2 | TVET Diploma: labour market value            | 3.99 | 0.97 | −0.77    | 0.35     |
| CJP3 | TVET guarantees employment                   | 4.11 | 0.89 | −0.94    | 1.01     |

*Note.* Items PE1 and PE3 were subsequently excluded following EFA item refinement. M = mean; SD = standard deviation.

## Reliability of A Priori Constructs

Cronbach's alpha was computed for each of the five a priori constructs. Results were markedly mixed, as presented in Table 4. Career and Job Potential achieved good reliability ( $\alpha = 0.841$ ) and Grades and School Achievement achieved excellent reliability ( $\alpha = 0.920$ ), indicating that these two constructs formed coherent unidimensional scales as specified. Peer Influence was acceptable ( $\alpha = 0.696$ ). However, Parental Influence ( $\alpha = 0.508$ ) and Teacher Influence ( $\alpha = 0.530$ ) returned poor to unacceptable reliabilities, indicating that the a priori item groupings for these constructs did not reflect coherent empirical scales. These findings confirmed that the theoretically proposed five-construct structure did not adequately capture the empirical dimensional structure of the data, providing strong justification for the subsequent EFA.

Table 4 *Internal consistency reliability of a priori constructs.*

| Construct                   | Code | Items (n) | Cronbach's $\alpha$ | Interpretation |
|-----------------------------|------|-----------|---------------------|----------------|
| Parental Influence          | PI   | 4         | 0.508               | Poor           |
| Teacher Influence           | TI   | 3         | 0.53                | Poor           |
| Peer Influence              | PE   | 3         | 0.696               | Acceptable     |
| Grades & School Achievement | GSA  | 4         | 0.92                | Excellent      |
| Career & Job Potential      | CJP  | 3         | 0.841               | Good           |

*Note.* Interpretation follows George (2003). Poor reliability for PI and TI motivated the subsequent EFA to re-examine the dimensional structure empirically.

## Exploratory Factor Analysis

Exploratory Factor Analysis (EFA) was to examine the underlying structure of the 17-item instrument and identify the factors represented by the observed items. Principal axis factoring (PAF) with Varimax rotation was used, followed by factorability assessment, factor retention, item refinement, and evaluation of the final factor solution.

### Factorability Assessment

The KMO measure of sampling adequacy was 0.844, classified as meritorious (Kaiser, 1974) and substantially above the recommended minimum of 0.60. Bartlett's test of sphericity yielded  $\chi^2$  (136) = 2195.7,  $p < .001$ , confirming that the correlation matrix differed significantly from an identity matrix. Both results affirm the factorability of the 17-item dataset.

### Factor Retention

Parallel analysis was conducted by comparing observed eigenvalues against the 95th percentile of eigenvalues from 1,000 randomly generated datasets. As shown in **Fig. 2**, the observed eigenvalues for Factors 1 and 2 (5.285 and 4.114, respectively) substantially exceeded their corresponding simulated counterparts (1.633 and 1.483), supporting retention of two factors. The observed eigenvalue for Factor 3 (1.312) fell below its simulated threshold (1.388), indicating that it should not be retained. The scree plot corroborated this conclusion, showing a clear inflection point after the second factor.

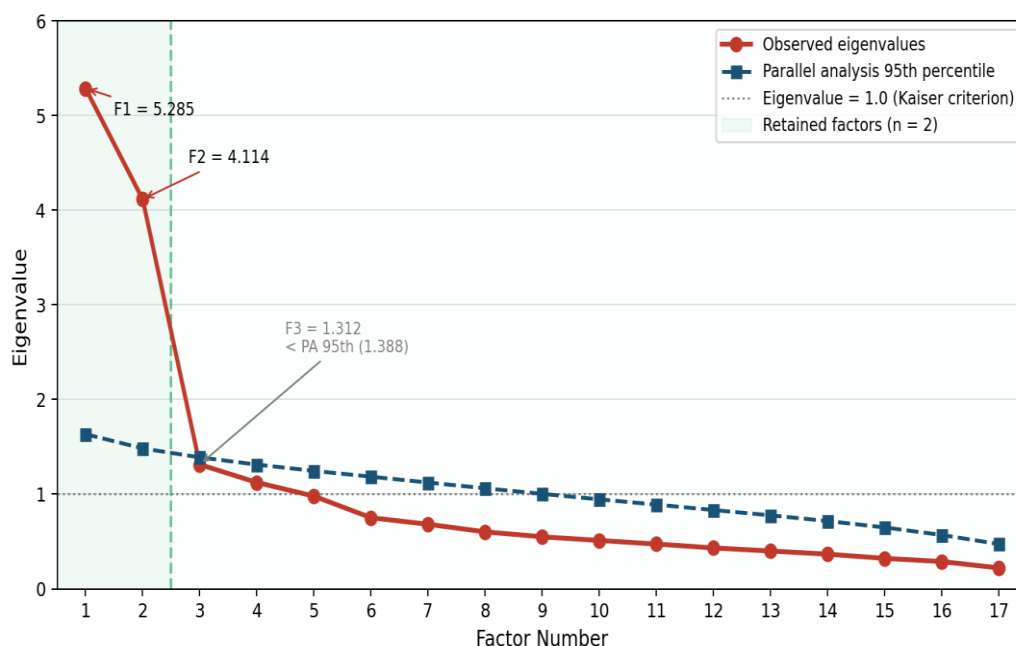


**Fig. 2.** Scree plot with parallel analysis criterion for factor retention. Observed eigenvalues for Factors 1 and 2 exceed the 95th percentile simulated threshold; Factor 3 does not.

## Item Refinement

An initial PAF solution on all 17 items was examined. Two Peer Influence items failed to satisfy the retention criteria: PE1 (“I would choose the same pathway as my peers”) exhibited a primary loading of 0.579 on Factor 1 but a substantial cross-loading of 0.315 on Factor 2, exceeding the 0.30 cross-loading threshold. PE3 (“My peers influence my career selection decision”) loaded at 0.504 on Factor 2 but with a cross-loading of 0.380 on Factor 1, also exceeding the threshold. Both items were excluded. All remaining 15 items demonstrated communalities above 0.40, confirming adequate representation by the two-factor solution.

## Final Factor Solution

The final PAF solution on 15 items yielded a two-factor structure. The rotated factor loadings are presented in Table 5 and visualised in the loading heatmap in **Fig. 3**. All items loaded on their primary factor at  $\geq 0.44$ , with no item exhibiting a cross-loading exceeding 0.18, indicating a clean and interpretable factor structure.

Factor 1 was labelled Perceived Barriers and Negative Stereotypes. This factor comprised seven items: PI1 (parents: negative attitude,  $\lambda = 0.672$ ), PI2 (parents: TVET for poor families,  $\lambda = 0.755$ ), TI2 (teachers: negative views,  $\lambda = 0.715$ ), and GSA1–GSA4 (academic stigma items,  $\lambda = 0.859$ – $0.942$ ). The extremely high loadings of the GSA items (range: 0.859–0.942) reflect the strong internal coherence of the academic stigma items. The clustering of parental discouragement, teacher discouragement, and academic stigma onto a single factor suggests that students perceive these as a unified barrier environment rather than as separate deterrents.

Factor 2 was labelled Social Support and Career Opportunities. This factor comprised eight items: PI3 (parents: support TVET career,  $\lambda = 0.708$ ), PI4 (parents: encourage TVET,  $\lambda = 0.720$ ), TI1 (teachers: counselling,  $\lambda = 0.453$ ), TI3 (teachers: knowledge,  $\lambda = 0.475$ ), PE2 (peers: good perception,  $\lambda = 0.668$ ), CJP1 (guides to job,  $\lambda = 0.612$ ), CJP2 (market value,  $\lambda = 0.662$ ), and CJP3 (employment guarantee,  $\lambda = 0.567$ ). The co-loading of parental encouragement, teacher guidance, peer support, and career items onto a single factor indicates that students perceive these elements as a coherent motivational environment.

Table 5 *Varimax-rotated factor loadings for the final 15-item EFA solution (N = 218).*

| Item | Item Content (abbreviated)               | Factor 1 | Factor 2 | $h^2$ |
|------|------------------------------------------|----------|----------|-------|
|      |                                          | Barriers | Support  |       |
| PI1  | Parents: negative attitude towards TVET  | 0.672    | —        | 0.453 |
| PI2  | Parents: TVET for poor families          | 0.755    | —        | 0.57  |
| TI2  | Teachers: negative views on TVET         | 0.715    | —        | 0.522 |
| GSA1 | Students choose TVET due to low grades   | 0.859    | —        | 0.74  |
| GSA2 | TVET is for low academic achievers       | 0.9      | —        | 0.811 |
| GSA3 | Students choose TVET: no other options   | 0.942    | —        | 0.899 |
| GSA4 | Students choose TVET: failed major exams | 0.936    | —        | 0.877 |
| PI3  | Parents support TVET as career pathway   | —        | 0.708    | 0.509 |
| PI4  | Parents encourage TVET study             | —        | 0.72     | 0.527 |
| TI1  | Teachers provided TVET counselling       | —        | 0.453    | 0.215 |
| TI3  | Teachers have TVET knowledge             | —        | 0.475    | 0.255 |
| PE2  | Peers have good perception of TVET       | —        | 0.668    | 0.446 |
| CJP1 | TVET guides students to desired job      | —        | 0.612    | 0.394 |
| CJP2 | TVET Diploma attractive in labour market | —        | 0.662    | 0.444 |
| CJP3 | TVET guarantees future employment        | —        | 0.567    | 0.337 |

*Note.* Factor loadings below 0.30 are suppressed (—).  $h^2$  = communality. PAF = principal axis factoring; rotation = Varimax. Items PE1 and PE3 excluded due to cross-loading  $\geq 0.30$ .

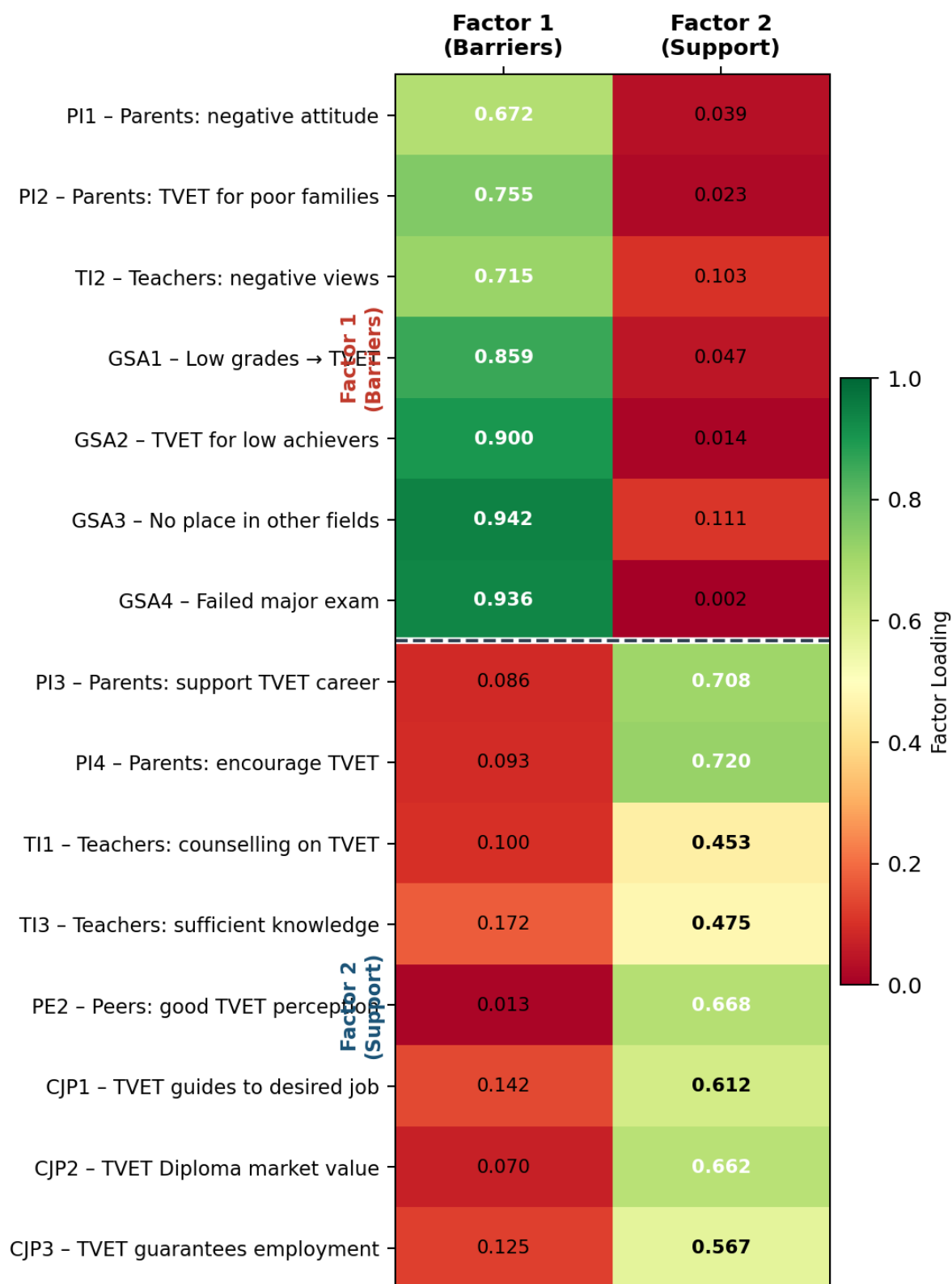


**Fig. 3.** Varimax-rotated factor loading heatmap. Loadings  $\geq 0.40$  are shown in bold. Colour intensity reflects loading magnitude (green = high, red = low).

### Factor Reliability and Measurement Model

Cronbach's alpha for the two refined factor scales is reported in Table 6. Factor 1 (Perceived Barriers and Negative Stereotypes; 7 items) achieved  $\alpha = 0.921$ , classified as excellent, representing a dramatic improvement over the individual a priori subscale reliabilities from which its items were drawn. Factor 2 (Social Support and Career Opportunities; 8 items) achieved  $\alpha = 0.840$ , classified as good. Both values substantially exceed the widely applied threshold of 0.70, confirming the internal coherence of the refined scales and the empirical superiority of the two-factor structure over the theoretically proposed five-construct arrangement.

Table 6 *Internal consistency reliability of the refined two-factor scales.*

| Factor   | Label                                     | Items (n) | Cronbach's $\alpha$ | Classification | M    | SD   |
|----------|-------------------------------------------|-----------|---------------------|----------------|------|------|
| Factor 1 | Perceived Barriers & Negative Stereotypes | 7         | 0.921               | Excellent      | 1.8  | 0.87 |
| Factor 2 | Social Support & Career Opportunities     | 8         | 0.84                | Good           | 3.88 | 0.67 |

*Note.* M and SD are computed from mean factor scores (1–5 scale). Classification follows George (2003).

The final measurement model comprises 15 items mapped to two dimensions. Factor 1 (Barriers) mean score of  $M = 1.80$  ( $SD = 0.87$ ) indicates that, on average, respondents strongly rejected barrier and stigma perceptions, a pattern consistent with the fact that these students are already enrolled in a TVET-related programme and have likely resolved initial stigma concerns. Factor 2 (Support) mean score of  $M = 3.88$  ( $SD = 0.67$ ) indicates strong endorsement of social support and career optimism, also expected for enrolled TVET students. The moderate negative inter-factor correlation ( $r = -0.31$ ) confirms that the two dimensions are empirically distinguishable while acknowledging partial conceptual overlap.

## TVET SELECTION FACTORS FRAMEWORK (TSFF)

This section presents the TVET Selection Factors Framework (TSFF v1.0), the primary DSR artifact of this study. Section 5.1 describes the artifact architecture. Section 5.2 maps the artifact components to the five design requirements. Section 5.3 describes the scoring procedure and practical application, including the four-quadrant student profiling system. Section 5.4 situates the TSFF within the theoretical frameworks.

### Artifact Architecture

The TSFF (v1.0) is a two-dimensional conceptual framework that organises the empirically identified influences on students' TVET-related perceptions into a structured, practitioner-accessible model. The framework is operationalised through two formally defined dimensions.

**Definition 1:** *Perceived Barriers and Negative Stereotypes (PBNS).* PBNS is defined as the composite of a student's beliefs that parents or teachers actively discourage TVET selection, and that TVET is a pathway associated with academic inadequacy or low social status. PBNS is operationalised as the mean score across seven items (PI1, PI2, TI2, GSA1–GSA4) on a 1–5 scale. Higher PBNS scores indicate stronger barrier perceptions. Within SCCT, PBNS corresponds to perceived barriers and negative outcome expectations. Within SDT, PBNS reflects conditions that frustrate students' needs for relatedness and competence.

**Definition 2:** *Social Support and Career Opportunities (SSCO).* SSCO is defined as the composite of a student's perceptions that parents, teachers, and peers encourage TVET, and that TVET provides viable employment outcomes. SSCO is operationalised as the mean score across eight items (PI3, PI4, TI1, TI3, PE2, CJP1–CJP3) on a 1–5 scale. Higher SSCO scores indicate a stronger supportive and opportunity-rich perceptual environment. Within SCCT, SSCO corresponds to perceived supports and positive outcome expectations. Within SDT, SSCO reflects conditions that satisfy students' needs for relatedness and positive future orientation.

The TSFF architecture is illustrated in **Fig. 4**. The two dimensions are conceptualised as operating simultaneously: students' TVET selection orientations are jointly determined by both PBNS and SSCO scores, with low PBNS combined with high SSCO representing the most favourable conditions for TVET engagement.

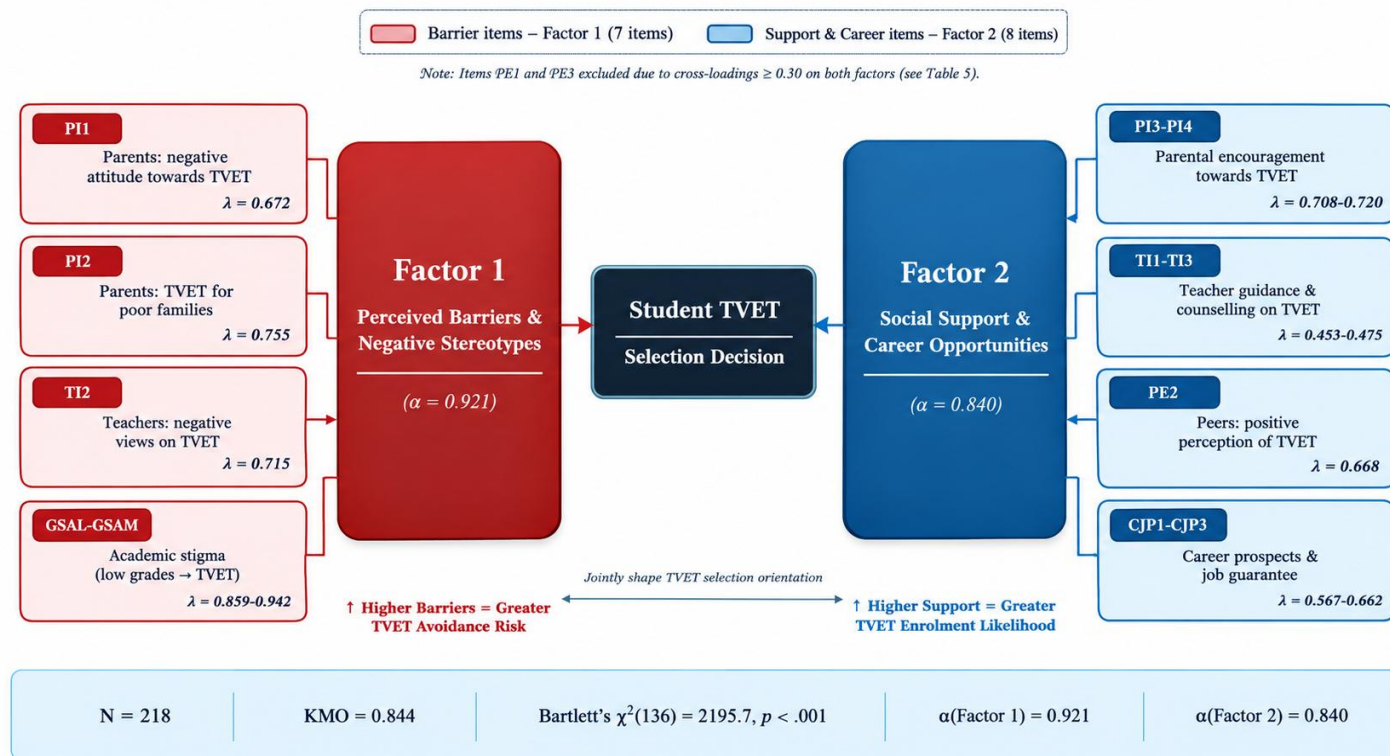


**Fig. 4.** TVET Selection Factors Framework (TSFF): empirically derived based on EFA, two-dimensional model showing item loadings ( $\lambda$ ), reliability coefficients ( $\alpha$ ), and key psychometric statistics.

## Design Requirements Mapping

Table 7 maps each design requirement to the corresponding TSFF component, demonstrating how the artifact fulfils its design specification.

Table 7 Mapping of design requirements to TSFF components and fulfilment evidence.

| DR  | TSFF Component                                                  | Fulfilment Evidence                                                                                                                                          |
|-----|-----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| DR1 | Two-factor EFA structure from PAF on N = 218                    | KMO = 0.844; Bartlett's $\chi^2(136) = 2195.7, p < .001$ ; parallel analysis retains 2 factors; 52.0% variance explained.                                    |
| DR2 | PBNS dimension: 7 items ( $\alpha = 0.921$ )                    | Items capture parental/teacher discouragement and academic stigma, consistent with Cui & Zhao (2025 & Wang et al. (2022b).                                   |
| DR3 | SSCO dimension (social items): PI3, PI4, TI1, TI3, PE2          | Items capture encouragement from parents, teachers, and peers, consistent with Efthymiadou et al. (2025), Khaizer Omar et al. (2020) & Shaari et al. (2025). |
| DR4 | SSCO dimension (career items): CJP1–CJP3                        | Items capture employment expectations and career pathway perceptions, consistent with Murshed (2025).                                                        |
| DR5 | Two-dimension model with 1–5 mean scores and quadrant profiling | Two dimensions are interpretable without specialist training; scoring is fully specified in Section 5.3.                                                     |

## Scoring and Practical Application

The TSFF generates two-dimension scores per student. The PBNS score is the arithmetic mean of Items PI1, PI2, TI2, GSA1, GSA2, GSA3, and GSA4. The SSCO score is the arithmetic mean of Items PI3, PI4, TI1, TI3, PE2, CJP1, CJP2, and CJP3. Both scores range from 1.0 to 5.0, with the midpoint of 3.0 serving as the interpretive threshold.

For practical application in student guidance and institutional monitoring, the two scores are plotted on a two-dimensional quadrant chart as in **Fig. 5**, yielding four student profiles with distinct intervention implications:

- **High SSCO, Low PBNS — TVET-Positive (Q1):** Students perceiving strong social support and career

opportunities, with minimal barrier perceptions. These students are the most likely to engage positively with TVET. Intervention: maintain and reinforce existing support networks.

- **Low SSCO, High PBNS — High-Risk Avoidance (Q2):** Students perceiving weak support and strong barriers. These students face the highest risk of disengagement or negative TVET self-concept. Intervention: priority counselling combining stigma-reduction (targeting PBNS) and active social support mobilisation (targeting SSCO).
- **High SSCO, High PBNS — Conflicted (Q3):** Students receiving mixed signals — support from some adults, discouragement from others. Intervention: counselling to resolve contradictory social messages and reinforce the positive support network.
- **Low SSCO, Low PBNS — Disengaged (Q4):** Students with neutral perceptions across both dimensions, potentially reflecting limited TVET awareness. Intervention: awareness-raising campaigns and proactive career information provision.

The sample mean profile (PBNS:  $M = 1.80$ ; SSCO:  $M = 3.88$ ) places the aggregate student cohort firmly in Quadrant 1 (TVET-Positive), as shown in **Fig. 5**. This is consistent with the fact that the respondents are enrolled TVET students who have already navigated the selection decision; their low barrier scores and high support scores reflect a post-selection affirmative orientation. Future longitudinal research comparing pre- and post-enrolment profiles would reveal whether TVET enrolment itself shifts students' perceptions along either dimension.

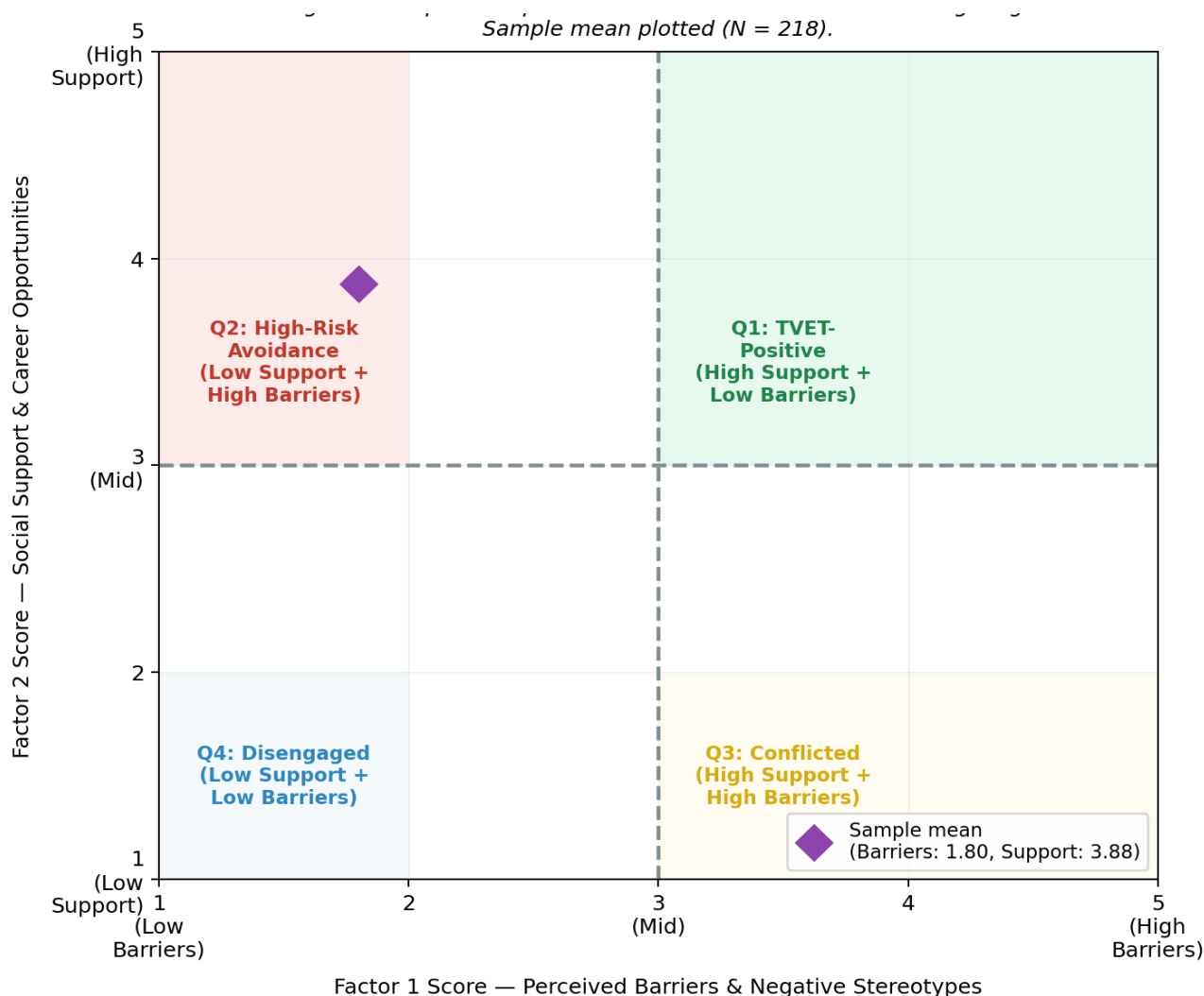


**Fig. 5.** TSFF quadrant profile chart for student intervention targeting. The sample mean ( $N = 218$ ) is plotted as a diamond marker in Quadrant 1 (TVET-Positive).

## Theoretical Alignment

The TSFF aligns with SCCT in that the PBNS dimension captures perceived environmental barriers and negative outcome expectations constructs that SCCT identifies as inhibitors of career interest and choice behaviour, while the SSCO dimension captures perceived environmental supports and positive outcome expectations, which SCCT identifies as promoters of career self-efficacy (Lent et al., 1994). The TSFF therefore operationalises the central SCCT barrier-support distinction at the level of students' immediate social environment and vocational future perceptions.

From an SDT perspective, the SSCO dimension captures conditions that satisfy students' psychological needs for relatedness (parental and teacher encouragement) and competence (positive career narratives affirming the value of vocational work) (Ryan & Deci, 2020). The PBNS dimension captures conditions that frustrate those needs: social discouragement undermines relatedness, while academic stigma undermines students' sense of competence within the TVET pathway. These alignments strengthen the construct validity of the TSFF while remaining consistent with the two major theoretical traditions in vocational psychology.

## DISCUSSION

The empirical results provide a structured, data-grounded account of the perceptual dimensions shaping TVET-enrolled students' orientations toward their vocational pathway. The two-factor solution, Perceived Barriers and Negative Stereotypes (PBNS) and Social Support and Career Opportunities (SSCO) is broadly aligned with recurrent themes in the international TVET literature, while the specific factor structure represents an empirical contribution of this dataset requiring confirmatory replication.

### Perceived Barriers and Negative Stereotypes

The PBNS dimension demonstrated excellent internal consistency ( $\alpha = 0.921$ ) with notably high factor loadings concentrated in the GSA items ( $\lambda = 0.859\text{--}0.942$ ). The coherence of parental discouragement, teacher discouragement, and academic stigma items onto a single factor suggests that students experience these as a unified discouraging force rather than as independent deterrents. This finding is consistent with the literature on TVET stigma (Cui & Zhao, 2025; Pimpa & Suwannapirom, 2008; Wang et al., 2022), which documents the deeply social nature of vocational stigma: negative parental and teacher attitudes tend to co-occur and reinforce the academic stigma narrative.

The low mean PBNS score ( $M = 1.80$ ) in the present sample enrolled TVET university students is noteworthy. It indicates that these students, having already chosen and committed to a TVET pathway, strongly reject the stigmatising narratives captured by the Barriers items. This is consistent with self-consistency theory, which predicts that individuals tend to adopt attitudes that are congruent with their self-concept and behavioural commitments. Future research comparing TVET-enrolled versus non-enrolled students on the PBNS dimension would reveal whether high barrier perceptions genuinely deter enrolment or whether they are attenuated after the enrolment decision is made.

### Social Support and Career Opportunities

The SSCO dimension ( $\alpha = 0.840$ ) captured the positive motivational landscape for TVET engagement. The high mean SSCO score ( $M = 3.88$ ) reflects strong endorsement of parental and teacher encouragement and optimistic career perceptions among enrolled students. The Career and Job Potential items returned the highest individual means in the entire instrument (CJP1:  $M = 4.13$ ; CJP3:  $M = 4.11$ ), indicating that students perceive TVET as providing clear career pathways and employment guarantees. This pattern aligns with SCCT's prediction that positive outcome expectations sustain career interest and commitment (Lent et al., 1994).

The exclusion of PE1 and PE3 from the final solution warrants comment. Both items crossed the 0.30 cross-loading threshold, indicating insufficient factorial clarity. PE1 ("I would choose the same pathway as my peers") reflects conformity motivation, which may be equally associated with both barrier-mediated and support-mediated decisions. PE3 ("My peers influence my career selection") captures general peer salience without specifying direction, and may therefore load ambiguously across both dimensions. Future research should

develop more directionally specific peer influence items distinguishing between peer encouragement and peer stigma.

### **The TSFF as a Preliminary Conceptual Contribution**

The TSFF represents a preliminary integration of psychometric findings and conceptual framework design. Unlike prior TVET studies that document influential factors descriptively, the TSFF translates those factors into a preliminary artifact with specified components, operational definitions, scoring guidelines, and a quadrant-based profiling system for student intervention targeting. Moving from individual variable analysis to a structured framework provides an organized representation for educational decision-making.

It is important to characterise the TSFF's current status accurately. Version 1.0 is a preliminary framework grounded in a cross-sectional dataset from two faculties of a single Malaysian institution. Its alignment with prior literature is interpretive, the barrier-versus-support distinction coheres thematically with the existing literature but the specific factor structure remains to be confirmed through Confirmatory Factor Analysis on an independent sample. The framework's utility for student profiling and intervention targeting remains to be fully evaluated through subsequent longitudinal research and practitioner evaluation.

### **Sampling Limitations and Post-Enrolment Perceptual Dynamics**

Several limitations must be acknowledged. A primary contextual limitation of this study lies in the composition of the respondent sample, which consisted exclusively of currently enrolled university engineering undergraduates. Because these individuals have already successfully navigated entry pathways and enrolled in higher education, their retrospective evaluations of TVET selection barriers may be subject to post-hoc rationalization, cognitive dissonance reduction, and self-consistency bias. Enrolled students naturally tend to attenuate past structural or social barriers ( $M = 1.80$ ) while emphasizing positive career opportunities ( $M = 3.88$ ) to validate their educational commitment. Consequently, potential ceiling and floor effects may obscure the true intensity of entry barriers experienced by prospective secondary school applicants who are actively deciding whether to enter TVET. Future research should extend this framework by testing the instrument on prospective secondary school students to capture real-time decision-making dynamics before enrollment commitment occurs.

### **Methodological Scope and Future Validation Roadmap**

The factor structure identified in this study represents an exploratory psychometric baseline. While Exploratory Factor Analysis (EFA) demonstrated strong internal consistency and clean factor loadings across both retained dimensions, EFA alone cannot establish full construct validity or structural fit. To establish robust construct validity and structural fit, Confirmatory Factor Analysis (CFA) on an independent secondary dataset is required. Furthermore, while the preliminary framework offers a conceptual blueprint for institutional intervention, future iterations should undergo formal practitioner validation such as expert panel review using Content Validity Index (I-CVI) scoring to fully evaluate its practical applicability in educational design.

## **CONCLUSION**

This study contributes to the understanding of TVET educational choice through two interconnected outputs: an empirically grounded factor structure of students' TVET-related perceptions, and a designed conceptual artifact, the TVET Selection Factors Framework (TSFF) that organises those perceptions for practical and research application. Drawing on survey data from 218 UTeM students and applying Exploratory Factor Analysis within a Design Science Research methodology, the study identified two robust perceptual dimensions: Perceived Barriers and Negative Stereotypes (7 items;  $\alpha = 0.921$ ) and Social Support and Career Opportunities (8 items;  $\alpha = 0.840$ ). These dimensions account for 52.0% of the variance in students' TVET-related perceptions and demonstrate excellent psychometric properties.

The TSFF translates these dimensions into a practical, two-dimensional framework grounded in SCCT, SDT, and Gottfredson's theory, and designed to meet five specified design requirements. The quadrant-based profiling system provides educational practitioners with a structured tool for diagnosing students' perceptual profiles and

targeting counselling and institutional interventions accordingly. As a DSR artifact, the TSFF is currently at version 1.0 and is preliminary pending expert evaluation and confirmatory validation.

For policy and practice, the TSFF highlights the need for targeted interventions addressing both the barrier and support dimensions: dismantling academic stigma narratives through positive role modelling and career information campaigns, while simultaneously strengthening parental, teacher, and peer support networks for TVET pathways. Future work should prioritise Confirmatory Factor Analysis on an independent sample, longitudinal studies comparing pre- and post-enrolment perceptual profiles, and application of the TSFF in guidance counselling contexts to assess its predictive utility for student engagement and retention.

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## DECLARATION

Conflict of Interest: The author(s) declare no conflict of interest.

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