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Gender similarities in language learning preferences among Indian and Omani school students in Oman: implications for gender-equitable education and sustainable development

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Abstract

Claims that girls and boys learn in different ways remain common in classrooms and teacher education, and cross-national studies are often cited as showing that such differences depend on culture. Few such studies, however, test the Culture × Gender interaction directly or check whether survey artefacts could explain apparent differences. This study compared self-reported language learning style preferences of upper-secondary English learners in Indian-curriculum schools and Omani private schools in Oman using the 110-item Learning Style Survey. After duplicate online submissions were removed, the analytic sample comprised 400 students. Two-way analyses of variance with false-discovery-rate correction, multivariate tests, Bayes factors and within-person standardisation for response style were applied to all 23 subscales. No Culture × Gender interaction was detected on any subscale or in the multivariate test, and Bayes factors favoured the absence of an interaction on every subscale (BF_{01} = 4.67–19.99). No country difference on any single subscale survived correction. Female students reported stronger preferences on six subscales, with the same direction in both countries (d = 0.31–0.45; 82–88% distributional overlap), but much of this reflected higher overall endorsement: after standardisation, female students relatively favoured synthesising and metaphoric approaches and male students auditory and literal approaches. Apparent country differences in the unscreened data did not survive duplicate removal. Gender differences in learning preferences were therefore modest and consistent across two contrasting educational contexts, supporting a gender similarities account and cautioning against gendered or culturally essentialised teaching. The findings also show that duplicate screening and response-style correction can change the substantive conclusions of cross-national survey research. Implications are discussed for teacher education and for Sustainable Development Goals 4 and 5.

Introduction

Beliefs about how girls and boys learn shape what happens in classrooms. Teachers who expect boys to be visual or hands-on learners and girls to be verbal or reflective learners may, often unintentionally, offer different tasks, feedback and opportunities to participate, and students may come to see some ways of learning as belonging to their gender (Kutuk 2025; Li et al. 2025). The idea that people have distinct learning styles is itself one of the most widespread beliefs among teachers (Dekker et al. 2012; Newton and Salvi 2020), even though evidence that matching instruction to a preferred style improves learning is weak (Pashler et al. 2008). Establishing whether gender differences in learning preferences are large, universal or dependent on context therefore matters for classroom practice, for teacher education and for efforts to eliminate gender disparities in education under Sustainable Development Goals (SDG) 4 and 5 (United Nations 2015).

Two positions can be distinguished in the literature. One holds that gender differences in learning approaches are real and are shaped by culture, so that their direction or size varies across educational systems and social norms (Holtbrügge and Mohr 2010; Mayan and Mishra 2022). The other, the gender similarities hypothesis, holds that men and women are more alike than different on most psychological

variables and that differences, where they exist, are small (Hyde 2005; Zell et al. 2015). These positions make different predictions for cross-national comparisons. If culture produces gender differences, the pattern should differ between contexts, which appears statistically as a Culture × Gender interaction. If the similarities account is correct, any gender differences should be modest and broadly consistent.

Cross-national learning style studies rarely test this interaction formally, and they face two methodological threats that are seldom addressed. First, groups may differ in response style, such as a general tendency to agree with statements, so that one group appears to score higher on every subscale (Chen et al. 1995; Johnson et al. 2005). Second, online surveys are vulnerable to duplicate and careless submissions (Meade and Craig 2012; Curran 2016), which can create group differences that do not exist among actual respondents. Both threats can produce apparent cultural effects.

This study compares upper-secondary English learners in Indian-curriculum schools and Omani private schools in Oman, who are educated within two systems often contrasted as examination-driven and multilingual on the one hand and rapidly modernising but teacher-centred on the other (Sheorey 1999; Kashoob and Jawhar 2022; Mahapatra and Anderson 2023). If gender differences in learning preferences are shaped by such contextual factors, these two settings should reveal them. The study goes beyond describing each group separately: it tests the Culture × Gender interaction directly across all 23 subscales of the Learning Style Survey, screens the data for duplicate records, and corrects for response style, so that any differences found can be attributed to the students rather than to survey artefacts. Two research questions are addressed:

RQ1: Do Indian and Omani students differ in their learning style preference profiles after response style is accounted for?

RQ2: Do gender differences in learning style preferences differ in direction or size between Indian and Omani students?

Because a null interaction cannot be interpreted as evidence of similarity from significance tests alone, Bayes factors are also reported to quantify the evidence for and against an interaction.

Background

Learning styles in language education

In language education, Oxford (1995) described learning styles as a bridge between personality and the strategies learners choose, and individual-difference research continues to treat styles as one of several interacting learner characteristics rather than as fixed categories (Oxford 2003; Griffiths and Soruç 2020). Most learners report using several modalities (Shuib and Azizan 2015; Yotta 2023). The construction nevertheless has a contested evidence base. A review of the so-called meshing hypothesis found almost no methodologically adequate studies showing that instruction matched to a learner's style improves outcomes (Pashler et al. 2008), and belief in style-matching persists among educators

despite this (Dekker et al. 2012; Newton and Salvi 2020). The present study therefore treats learning style scores as self-reported preferences that describe how students say they approach learning, not as fixed traits or as a basis for sorting students.

Gender and learning preferences

Several studies report that female students more often describe reflective, verbal or multimodal approaches and male students kinesthetic or visual-spatial ones (Wehrwein et al. 2007; Halili et al. 2015; Mayan and Mishra 2022), and neurodevelopmental research suggests earlier language development in girls (Adani and Cepanec 2019; Leisman et al. 2016). Yet reported differences vary between studies: tests of the Dunn and Dunn and Honey and Mumford models found only small gender differences (Penger and Tekavčič 2009), whereas other studies report clear differences in preferred modalities (Baharu 2019). A meta-analysis concluded that gender effects on learning styles are modest (Severiens and ten Dam 1994), consistent with evidence from psychology more broadly that most gender differences are small (Hyde 2005; Zell et al. 2015).

Culture as a moderator

Cultural values and educational systems influence which learning approaches students report (Holtbrügge and Mohr 2010), and studies in Asian and Middle Eastern contexts have reported varying gender patterns (Gilakjani 2012; Ambusaidi et al. 2021; Kashoob and Jawhar 2022; Zhu 2022), while others find minimal gender effects (Shuib and Azizan 2015; Buowari et al. 2025). Much of this evidence comes from single-country studies, so it is unclear whether differences between studies reflect culture, instruments, samples or analysis. A direct test within one design, using the same instrument and analysis in both contexts, is needed.

Response styles and data quality

Two survey artefacts can masquerade as cultural effects. Acquiescent and extreme response styles vary between cultural groups (Chen et al. 1995; Johnson et al. 2005); if one group uses higher scale points generally, it will appear to score higher on every subscale, including subscales describing opposite poles of the same dimension. Standardising scores within each respondent removes this general level and leaves the relative profile (Fischer 2004). Separately, online surveys can contain duplicate or careless submissions (Meade and Craig 2012; Curran 2016). If duplicates are concentrated in one group, they reduce effective sample size, distort group means and inflate the apparent precision of group differences. Neither artefact is routinely checked in learning style research.

Methods

Design and participants

The study used a cross-sectional 2 (country: India, Oman) × 2 (gender: female, male) between-subjects survey design. Participants were students in Grades 11 and 12 enrolled in English language courses in Indian schools in Oman and in Omani private schools in Muscat province. The Omani private (bilingual) schools were assigned by the Ministry of Education, Sultanate of Oman, and access to the Indian-curriculum schools was arranged after consultation with the Board of Directors of Indian Schools in Oman, whom the researcher contacted in December 2021 (10 Indian and 10 Omani schools). The Ministry distributed the online survey link to the Omani schools, and the link was shared with the Indian schools following the consultation with the Board; in both groups, students completed the survey in class. All participating schools, including the Indian-curriculum schools, are located in Oman, and no data were collected in India. For brevity, the two groups are labelled 'India' and 'Oman' (or 'country') in the text, tables and figures; 'India' refers to Indian students attending Indian-curriculum schools in Oman. Students completed the survey as an online form between 30 December 2021 and 11 July 2022. The form recorded gender, grade and group (Indian student from an Indian school; Omani student from a private school) but not school, so school-level clustering could not be modelled.

Instrument

The Learning Style Survey (LSS; Cohen et al. 2002), developed at the Center for Advanced Research on Language Acquisition, University of Minnesota, comprises 110 items in 11 parts (Table 1). Part 1 contains three perceptual subscales: each remaining part contrasts two opposite tendencies, giving 23 subscales. Items are rated from 0 (never) to 4 (always) and summed within each subscale. Because opposing subscales are scored separately, a respondent can score high on both poles of a dimension, which makes response style a particular concern for this instrument.

Data screening

Before analysis, the data were screened for duplicate submissions by comparing each record's responses with those of every other record. Of the 502 records received, 154 (151 from Oman and 3 from India) matched another record on at least 100 of the 110 items, forming 52 sets of duplicates. The earliest record in each set was retained and the remaining 102 removed, giving an analytic sample of 400 students (India: 154 female, 96 male; Oman: 55 female, 95 male; Table 2). The findings did not depend on this decision: they were the same when all duplicated records were excluded (N = 348) and under alternative screening thresholds (Supplementary Tables S1 and S2; Supplementary Fig. S1). Nine ambiguous responses to a single item were coded as missing, and the affected subscale scores were prorated from the remaining items.

Statistical analysis

Internal consistency was estimated with Cronbach's α for each subscale in each country. An acquiescence index was computed as each respondent's mean rating across all 110 items. Within-person standardised (ipsatised) scores were obtained by subtracting each respondent's mean rating

from each of their item ratings before summing subscales (Fischer 2004). Raw scores describe how strongly students endorse each approach; ipsatised scores describe which approaches students favour relative to their own overall level of endorsement.

For each subscale, a two-way analysis of variance (ANOVA) with Type III sums of squares and sum-to-zero contrasts tested the main effects of country and gender and their interaction; partial eta squared (η^2p) is reported as the effect size. ANOVA was chosen because it provides a direct test of the interaction and is robust to moderate non-normality with samples of this size. Residual skewness ranged from − 0.48 to 0.37 and excess kurtosis from − 0.40 to 0.87 across subscales, indicating approximately normal distributions. Levene's test indicated unequal variances for 2 of 46 subscale-by-scoring combinations; because cell sizes were unequal, all tests were repeated with heteroscedasticity-consistent (HC3) standard errors. All tests were two-tailed with $\alpha = 0.05$. Within each family of 23 tests (country, gender, interaction), p-values were adjusted using the Benjamini–Hochberg false discovery rate procedure (Benjamini and Hochberg 1995); both unadjusted p-values and the outcome of the correction are reported.

To obtain a single test of each effect across the whole profile, multivariate analyses of variance (MANOVA) were run on all 23 raw subscales and on 22 ipsatised subscales (one ipsatised subscale was omitted because ipsatised scores are linearly dependent). To quantify evidence for the absence of an interaction, a Bayes factor (BF_{01}) comparing the main-effects model with the model including the interaction was computed for each subscale from the Bayesian information criterion approximation (Wagenmakers 2007); BF_{01} values above 3 and 10 are conventionally interpreted as moderate and strong evidence for the absence of an effect (Lee and Wagenmakers 2013). Gender differences within each country are reported as Cohen's d (female minus male) with 95% confidence intervals, and the similarity of the gender-difference profiles in the two countries was summarised by the correlation between the two countries' 23 d values, with a 95% percentile bootstrap interval from 2000 resamples within the four groups. For pooled gender differences, the overlap coefficient and the probability that a randomly chosen female student scores higher than a randomly chosen male student were derived from d. A further sensitivity analysis added grade as a covariate. With N = 400, the design had 80% power to detect an interaction of $\eta^2p = 0.019$ ($f = 0.14$) at an unadjusted α of 0.05. Analyses were conducted in Python 3.12 with statsmodels (Seabold and Perktold 2010) and SciPy; the code is available as described under Code availability.

Results

Sample, reliability and response style

Table 2 summarises the analytic sample, and Table 3 reports descriptive statistics. Internal consistency was low for most subscales: Cronbach's α ranged from 0.36 to 0.70 in India and from 0.23 to 0.77 in Oman, was below 0.60 for 15 subscales in India and 19 in Oman, and reached 0.70 in both countries only

for Synthesizing. Low reliability attenuates observed effect sizes, which is considered in interpreting the results.

Female students had higher acquiescence scores than male students (India: mean 2.35, s.d. 0.26 vs 2.28, s.d. 0.32; Oman: 2.42, s.d. 0.32 vs 2.26, s.d. 0.25), $F(1, 396) = 15.50$, $p = 9.7 \times 10^{-5}$, $\eta^2p = 0.038$. Indian and Omani students did not differ, $F(1, 396) = 0.61$, $p = 0.434$, and there was no interaction, $F(1, 396) = 2.16$, $p = 0.143$. Female students thus endorsed learning-related statements more strongly across the board, which makes the ipsatised analysis important for interpreting gender differences.

Country differences (RQ1)

No country main effect on any individual subscale survived false discovery rate correction, in raw or ipsatised scores (Tables 4 and 5). The largest raw difference was on Visual, where Omani students scored slightly higher than Indian students, $F(1, 396) = 7.19$, unadjusted $p = 0.008$, adjusted $p = 0.175$, $\eta^2p = 0.018$. The multivariate test of country was not significant for raw scores (Pillai's $V = 0.086$, $F(23, 374) = 1.54$, $p = 0.055$) and only just reached conventional significance for ipsatised scores (Pillai's $V = 0.085$, $F(22, 375) = 1.58$, $p = 0.048$). This suggests at most a small difference in the relative profile of preferences that could not be localised to any specific subscale.

When all 502 submitted records were analysed, eight country differences appeared in raw scores (Supplementary Table S4), but none remained at any clustering threshold of five or more differing items (Supplementary Table S1), indicating that they arose from the duplicated records.

Gender differences and the Culture × Gender interaction (RQ2)

No Culture × Gender interaction was significant on any subscale, in raw or ipsatised scores, before or after correction; the smallest unadjusted p-value was 0.090 and the largest η^2p was 0.007. The multivariate interaction test was clearly non-significant (raw: Pillai's $V = 0.034$, $F(23, 374) = 0.57$, $p = 0.948$; ipsatised: Pillai's $V = 0.029$, $F(22, 375) = 0.51$, $p = 0.971$). Bayes factors favoured the model without an interaction on every subscale, with BF_{01} between 4.67 and 19.99 for raw scores (above 10 for 17 of 23 subscales) and between 6.41 and 19.98 for ipsatised scores. The data therefore provides moderate to strong evidence that the gender pattern was the same in both countries, rather than merely a failure to detect a difference.

Figure 1 shows this directly. On every subscale where a gender difference was detected, it had the same direction in India and Oman, and the confidence intervals overlapped on all 23 subscales. The gender-difference profiles of the two countries were positively correlated ($r = 0.68$, 95% bootstrap interval 0.13 to 0.73).

In raw scores, female students reported stronger preferences than male students on six subscales: Metaphoric ($F(1, 396) = 20.02$, $p = 1.0 \times 10^{-5}$, $\eta^2p = 0.048$); Visual ($F(1, 396) = 17.82$, $p = 3.0 \times 10^{-5}$, $\eta^2p = 0.043$); Synthesizing ($F(1, 396) = 17.62$, $p = 3.3 \times 10^{-5}$, $\eta^2p = 0.043$); Tactile/kinesthetic ($F(1, 396) = 15.98$, $p = 7.6 \times 10^{-5}$, $\eta^2p = 0.039$); Random-intuitive ($F(1, 396) = 14.75$, $p = 1.4 \times 10^{-4}$, $\eta^2p = 0.036$); Closure-oriented ($F(1, 396) = 8.05$, $p = 0.005$, $\eta^2p = 0.020$). The pooled differences were modest ($d = 0.31$ to 0.45). Expressed as distributional overlap, the male and female score distributions overlapped by 82% to 88%, and the probability that a randomly chosen female student scored higher than a randomly chosen male student ranged from 0.59 to 0.63, where 0.50 indicates no difference.

In ipsatised scores, four gender effects remained: relative to their own overall endorsement, female students favoured Metaphoric ($F(1, 396) = 10.82$, $p = 0.001$, $\eta^2p = 0.027$) and Synthesizing ($F(1, 396) = 9.03$, $p = 0.003$, $\eta^2p = 0.022$) approaches, whereas male students favoured Literal ($F(1, 396) = 10.27$, $p = 0.001$, $\eta^2p = 0.025$) and Auditory ($F(1, 396) = 7.40$, $p = 0.007$, $\eta^2p = 0.018$) approaches. The raw gender differences on Visual, Tactile/kinesthetic, Random-intuitive and Closure-oriented subscales did not remain, which indicates that they largely reflected female students' higher general endorsement. The multivariate gender effect was significant for both raw (Pillai's $V = 0.184$, $F(23, 374) = 3.66$, $p = 6.7 \times 10^{-8}$) and ipsatised scores (Pillai's $V = 0.165$, $F(22, 375) = 3.36$, $p = 8.7 \times 10^{-7}$).

Robustness

The conclusions were unchanged in the strict sample, at clustering thresholds of 5 and 20 differing items, with HC3 standard errors, and with grade as a covariate (Supplementary Tables S1–S3). In no analysis was any Culture × Gender interaction significant after correction (the only unadjusted $p < 0.05$ was for Reflective in ipsatised scores in the strict sample, $p = 0.025$), and in no analysis that removed near-duplicate records was any country effect significant. The set of gender effects varied slightly at the margins: in raw scores, Impulsive (female higher) reached significance with HC3 standard errors, with grade as a covariate and at the 20-item threshold, Leveler at the 5-item threshold, and Deductive in the strict sample. In ipsatised scores, Random-intuitive (female higher) also reached significance in the strict sample, and Auditory did not reach significance at the 20-item threshold. Synthesizing and Metaphoric favoured female students in every analysis of de-duplicated data.

Discussion

This study tested whether gender differences in language learning style preferences depend on educational and cultural context. Across two contrasting settings, the answer was no: the gender pattern was the same in India and Oman, Bayes factors supported the absence of an interaction on every subscale, and gender differences were modest. Nor did the two groups of students differ reliably on any single subscale once duplicate records were removed.

Gender similarities, not culturally reversed differences

The results fit the gender similarities hypothesis (Hyde 2005; Zell et al. 2015). Female students reported somewhat stronger preferences on several subscales, but male and female distributions overlapped by more than 80%, and the direction of every detected difference was the same in both countries. This matters because a culturally reversed pattern, with girls ahead in one country and boys in the other, would have implied that teachers in each context should expect different things of girls and boys. The evidence here points the other way: in both contexts, girls and boys described broadly similar ways of learning.

The response-style analysis refines what the gender differences mean. Much of the raw female advantage reflected a general tendency to endorse learning-related statements more strongly. This may reflect greater engagement with, or reflection on, study habits among female students, or a gender difference in how the rating scale was used; self-report data cannot distinguish these explanations. Relative to their own overall level, female students leaned towards synthesising information and using metaphor and association, and male students towards auditory input and literal interpretation. These relative differences were small ($\eta^2p = 0.018–0.027$) and are best viewed as tendencies within largely overlapping groups.

Why were countries' differences absent?

The absence of reliable country differences is notable given the contrasts commonly drawn between examination-driven Indian schooling and more teacher-centred Omani classrooms. One explanation is that the participants were more similar than national labels suggest: all were upper-secondary English learners in private or Indian-curriculum schools in Oman, whose academic aims and classroom experiences may be closer to each other than to those of national student populations. It is also possible that small differences exist, as the marginal multivariate result for ipsatised scores hints, but that the LSS subscales are not reliable enough to locate them. Either way, the results caution against attributing learning preferences to national education cultures without direct evidence.

Methodological implications

Two findings have implications beyond this study. First, apparent country differences in the unscreened data disappeared once duplicate submissions were removed. Pairwise comparison of response vectors, as used here, is simple to implement and could usefully become routine in online survey research, alongside established checks for careless responding (Meade and Craig 2012; Curran 2016). Second, most LSS subscales had low internal consistency, particularly the short two- and three-item subscales. The LSS was designed as a self-assessment tool to help learners reflect on their preferences; these results suggest that many of its subscales need further validation before being used to compare groups, including tests of measurement invariance in larger samples (Putnick and Bornstein 2016), of the kind that large multi-country studies have conducted across nations, languages and gender identities (Swami et al. 2023).

Implications for teaching, teacher education and the SDGs

SDG target 4.5 calls for the elimination of gender disparities in education, and SDG 5 for ending discrimination against women and girls (United Nations 2015). The present findings support these aims in a specific way: they provide evidence against the gendered assumptions about learning that can lead teachers to offer girls and boys different opportunities. Because gender explained at most about 5% of the variance in any subscale, and style-matching itself lacks empirical support (Pashler et al. 2008), the practical implication is not to tailor instruction to presumed styles, but to give all students varied modes of presentation and practice, including visual, oral, written and hands-on activities; differentiated and technology-supported approaches to EFL instruction designed for diverse learner profiles offer one practical route to this (Pitychoutis and Al Rawahi 2024). Teacher education and professional development programmes, which have received growing attention in Omani higher education (Thumiki and Magd 2022), can use findings such as these to address the learning styles neuromyth (Dekker et al. 2012; Newton and Salvi 2020) and gender stereotypes about learning (Kutuk 2025; Li et al. 2025) together. Where modest relative differences exist, such as the stronger relative preference for synthesising and metaphor among female students, teachers can make sure that all students practise these approaches, rather than treating them as gendered strengths.

Limitations

Several limitations apply. First, after duplicate removal the Omani sample comprised 150 students, including 55 female students, so the Omani estimates are less precise, although the conclusions held across all screening definitions. Second, most subscales had low reliability, which attenuates effect sizes and reduces power; small interactions cannot be excluded, although the Bayes factors indicate that the data are better explained without them. Third, schools were assigned by the Ministry of Education or recruited after consultation with the Board of Directors of Indian Schools in Oman rather than randomly sampled by the researcher, school membership was not recorded, and the samples came from one type of school in each group, so the results cannot be generalised to national populations. In particular, all data were collected in Oman: the Indian group comprised Indian students attending Indian-curriculum schools in Oman, so the findings describe these students and should not be taken to represent students or schooling in India. Fourth, the LSS measures self-reported preferences, not ability, behaviour or achievement. Fifth, formal measurement invariance testing was not possible with subscales of two to six items and the available sample sizes. Future studies should use survey platforms that prevent repeated submission, record school membership, include public and rural schools, and link reported preferences to observed learning behaviour and outcomes.

Conclusions

Among upper-secondary English learners in Indian and Omani schools, gender differences in learning style preferences were modest and followed the same pattern in both countries, and the two groups of students reported similar profiles. Apparent country differences in the raw data were artefacts of duplicated online submissions. These findings support a gender similarities account of learning preferences, caution against gendered or culturally essentialised assumptions about how students learn

and show that basic data-quality and response-style checks can change the conclusions of cross-national educational surveys.

Declarations

Data availability

The following materials underpinning this study are provided as supplementary files with this article: (1) raw data (LSS_data_package.xlsx, sheet raw_responses): all 502 records received, as exported from the online form; (2) processed data (same file, sheets coded_items and scores): responses coded 0–4, the duplicate-screening flags defining the primary (N = 400) and strict (N = 348) samples, subscale scores, the acquiescence index and within-person standardised (ipsatised) scores; (3) variable details (Codebook_and_protocol.docx and the item_key, response_coding and variables sheets): definitions of all variables, the response coding, the item-to-subscale scoring key, the treatment of ambiguous responses and prorating, and the formulae for all transformations and for duplicate screening; (4) the data collection protocol (Codebook_and_protocol.docx); and (5) the analysis code (see Code availability). The Learning Style Survey items themselves are not reproduced because the instrument is published by the Center for Advanced Research on Language Acquisition, University of Minnesota (Cohen et al. 2002), from which it is freely available; the item numbering and scoring key are given in the codebook. The datasets contain no names, school identifiers or other directly identifying information, so no restrictions apply to access.

Code availability

The Python scripts that perform the duplicate screening and scoring (screen_and_score.py) and all analyses (analysis.py), reproducing every table and figure in the article and the Supplementary Information, are provided as supplementary files, with a README describing how to run them and a requirements file listing the exact package versions used (Python 3.12.3).

Competing interests

The authors declare no competing interests.

Author contributions

Redacted for double-anonymised review; provide in the cover letter.

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Ethics declarations

Ethical approval

This study was conducted entirely in the Sultanate of Oman. All participants, including the Indian students, were enrolled in schools located in Oman (Indian-curriculum schools and Omani private schools), and no data were collected in India. Ethical approval was therefore obtained from the competent authority in the country where the research was conducted: the Ministry of Education, Sultanate of Oman, through its Directorate General of Education in Muscat Governorate, authorised the study by letter No. 158 dated 15 November 2021, before data collection began on 30 December 2021. The letter instructed the principals of private bilingual schools with Grades 11–12 in Muscat Governorate to facilitate the administration of the study questionnaires to their students. Access to the Indian-curriculum schools in Oman was arranged after consultation with the Board of Directors of Indian Schools in Oman, which the researcher contacted in December 2021. Approval from a body in India was not sought because no part of the research was carried out in India. All research was performed in accordance with relevant guidelines and regulations, namely the Ministry of Education, Sultanate of Oman, requirements for research conducted in schools, and with the ethical principles of the Declaration of Helsinki.

Informed consent

Individual informed consent was not obtained from participants or their parents or legal guardians. The survey was distributed to the Omani private schools by the Ministry of Education, Sultanate of Oman, under its letter of authorisation (No. 158, 15 November 2021), and to the Indian-curriculum schools following consultation with the Board of Directors of Indian Schools in Oman; in both groups, students completed it in class. The form was anonymous: it recorded no names, contact details or schools, and no identifying information is reported in this article.

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44. Ethics declarations

Tables

Table 1. Parts and subscales of the Learning Style Survey.

LSS part	Subscales	Items per subscale
1. Using physical senses	Visual; Auditory; Tactile/kinesthetic	10
2. Exposing oneself to learning situations	Extraverted vs Introverted	6
3. Handling possibilities	Random-intuitive vs Concrete-sequential	6
4. Dealing with ambiguity and deadlines	Closure-oriented vs Open	4
5. Receiving information	Global vs Particular	5
6. Further processing information	Synthesizing vs Analytic	5
7. Committing material to memory	Sharpener vs Leveler	3
8. Dealing with language rules	Deductive vs Inductive	3
9. Dealing with multiple inputs	Field-independent vs Field-dependent	3
10. Dealing with response time	Impulsive vs Reflective	3
11. Literal vs figurative thinking	Metaphoric vs Literal	2

Items are rated 0 (never), 1 (rarely), 2 (sometimes), 3 (often) and 4 (always) and summed within each subscale.

Table 2. Records submitted and analytic sample by group.

	India female	India male	Oman female	Oman male	Total
Records submitted	154	98	98	152	502
Records in near-duplicate clusters	0	3	53	98	154
Primary analytic sample	154	96	55	95	400
Grade 11 / Grade 12	96 / 58	65 / 31	40 / 15	61 / 34	262 / 138
Strict sample (all clustered records removed)	154	95	45	54	348

Near-duplicate clusters comprise records differing on 10 or fewer of the 110 items from at least one other record. The primary sample retains the earliest record in each cluster.

Table 3. Subscale means (s.d.) and Cronbach's α by country and gender (primary sample, raw scores).

Subscale	Items	India F	India M	Oman F	Oman M	α India	α Oman
Visual	10	23.95 (4.36)	22.15 (4.95)	25.45 (4.40)	23.21 (4.25)	0.51	0.46
Auditory	10	21.35 (4.57)	22.02 (5.11)	21.65 (5.25)	21.03 (4.73)	0.49	0.52
Tactile/kinesthetic	10	20.82 (5.63)	19.39 (6.30)	22.89 (6.34)	19.34 (5.38)	0.65	0.66
Extraverted	6	12.32 (4.44)	13.02 (4.44)	12.95 (4.51)	12.65 (3.90)	0.69	0.62
Introverted	6	14.77 (3.70)	14.40 (3.86)	14.75 (3.23)	14.59 (3.28)	0.58	0.43
Random-intuitive	6	16.23 (3.52)	15.22 (3.83)	16.38 (3.73)	14.34 (3.92)	0.64	0.69
Concrete-sequential	6	14.79 (3.11)	14.35 (3.35)	14.53 (3.64)	14.07 (2.99)	0.47	0.47
Closure-oriented	4	10.44 (2.41)	9.71 (2.73)	10.36 (2.84)	9.51 (2.69)	0.54	0.55
Open	4	8.28 (2.33)	8.44 (2.39)	8.15 (3.28)	7.61 (2.51)	0.37	0.58
Global	5	12.27 (3.23)	12.35 (3.14)	12.73 (3.30)	12.43 (2.93)	0.59	0.51
Particular	5	12.52 (2.73)	12.21 (2.61)	12.96 (3.11)	12.42 (2.60)	0.39	0.37
Synthesizing	5	13.82 (2.82)	12.45 (3.42)	13.75 (3.46)	12.20 (3.60)	0.70	0.77
Analytic	5	11.49 (2.87)	11.59 (2.93)	11.91 (2.86)	11.08 (2.51)	0.42	0.23
Sharpener	3	7.26 (1.99)	7.06 (2.25)	7.36 (1.99)	6.84 (1.90)	0.62	0.41
Leveler	3	6.31 (1.70)	6.02 (1.99)	6.78 (1.64)	6.19 (2.13)	0.40	0.42
Deductive	3	7.24 (2.03)	6.66 (1.95)	7.44 (2.07)	7.09 (1.87)	0.50	0.32
Inductive	3	6.76 (1.97)	6.58 (1.87)	6.98 (2.27)	6.44 (1.95)	0.36	0.46
Field-independent	3	7.93 (2.11)	7.40 (2.12)	7.33 (1.94)	7.16 (2.36)	0.59	0.55

Subscale	Items	India F	India M	Oman F	Oman M	α India	α Oman
Field-dependent	3	5.80 (2.66)	6.15 (2.23)	6.60 (2.23)	6.45 (2.07)	0.66	0.33
Impulsive	3	7.20 (2.04)	6.97 (2.12)	7.75 (1.86)	6.93 (2.02)	0.62	0.43
Reflective	3	7.94 (2.26)	7.49 (2.21)	7.96 (2.16)	7.81 (2.09)	0.69	0.56
Metaphoric	2	5.02 (1.50)	4.39 (1.58)	5.25 (1.62)	4.40 (1.59)	0.55	0.55
Literal	2	4.23 (1.45)	4.55 (1.31)	4.31 (1.57)	4.46 (1.51)	0.37	0.36

F, female; M, male. n: India F = 154, India M = 96, Oman F = 55, Oman M = 95. Possible range is 0 to 4 × number of items. Values in parentheses are standard deviations.

Table 4. Two-way ANOVA results by subscale (primary sample, raw scores).

Subscale	Country F	p	Gender F	p	Gender η^2p	C × G F	p	BF_{01} (C × G)
Visual	7.19	0.008	17.82	<0.001*	0.043	0.21	0.645	17.97
Auditory	0.44	0.507	0.00	0.964	0.000	1.57	0.211	9.08
Tactile/kinesthetic	2.63	0.105	15.98	<0.001*	0.039	2.89	0.090	4.67
Extraverted	0.07	0.785	0.19	0.663	0.000	1.15	0.285	11.23
Introverted	0.05	0.828	0.48	0.487	0.001	0.08	0.773	19.18
Random-intuitive	0.84	0.361	14.75	<0.001*	0.036	1.70	0.193	8.49
Concrete-sequential	0.63	0.427	1.69	0.195	0.004	0.00	0.982	19.99
Closure-oriented	0.24	0.623	8.05	0.005*	0.020	0.06	0.814	19.45
Open	3.15	0.077	0.48	0.487	0.001	1.64	0.201	8.75
Global	0.62	0.430	0.10	0.750	0.000	0.31	0.575	17.07
Particular	1.27	0.260	2.15	0.143	0.005	0.16	0.691	18.47
Synthesizing	0.21	0.645	17.62	<0.001*	0.043	0.06	0.801	19.37
Analytic	0.02	0.875	1.46	0.227	0.004	2.38	0.123	6.02
Sharpener	0.07	0.789	2.73	0.099	0.007	0.56	0.457	15.11
Leveler	2.60	0.108	4.79	0.029	0.012	0.59	0.442	14.84
Deductive	2.25	0.134	4.79	0.029	0.012	0.33	0.567	16.95
Inductive	0.04	0.849	2.85	0.092	0.007	0.73	0.393	13.82
Field-independent	3.33	0.069	2.33	0.128	0.006	0.62	0.430	14.60
Field-dependent	4.79	0.029	0.16	0.693	0.000	0.95	0.329	12.36
Impulsive	1.34	0.248	5.88	0.016	0.015	1.83	0.177	7.96
Reflective	0.54	0.465	1.67	0.197	0.004	0.41	0.524	16.29
Metaphoric	0.56	0.453	20.02	<0.001*	0.048	0.44	0.508	16.02
Literal	0.00	0.965	2.32	0.128	0.006	0.28	0.597	17.36

Two-way ANOVA with Type III sums of squares; all F tests have df = 1, 396; p-values are two-tailed and unadjusted. * Significant after Benjamini–Hochberg correction across the 23 subscales within each effect family (false discovery rate 0.05). No interaction was significant before or after correction. Country η^2p did not exceed 0.018 and interaction η^2p did not exceed 0.007. BF_{01} is the Bayes factor in favour of the model without the interaction (BIC approximation).

Table 5. Two-way ANOVA results by subscale (primary sample, within-person standardised scores).

Subscale	Country F	p	Gender F	p	Gender η^2p	C × G F	p	BF_{01} (C × G)
Visual	5.97	0.015	3.78	0.053	0.009	0.27	0.605	17.46
Auditory	1.69	0.195	7.40	0.007*	0.018	0.21	0.649	18.01
Tactile/kinesthetic	1.96	0.162	5.55	0.019	0.014	1.24	0.265	10.68
Extraverted	0.00	0.970	4.70	0.031	0.012	0.29	0.588	17.25
Introverted	0.03	0.865	1.69	0.195	0.004	1.20	0.275	10.94
Random-intuitive	2.41	0.121	6.24	0.013	0.016	0.60	0.439	14.77
Concrete-sequential	2.07	0.151	0.86	0.353	0.002	0.80	0.371	13.33
Closure-oriented	0.87	0.352	1.63	0.203	0.004	0.20	0.654	18.07
Open	5.26	0.022	1.31	0.252	0.003	0.46	0.500	15.89
Global	0.22	0.637	2.43	0.120	0.006	0.01	0.916	19.89
Particular	0.73	0.393	0.47	0.495	0.001	0.19	0.667	18.21
Synthesizing	0.94	0.333	9.03	0.003*	0.022	0.22	0.641	17.92
Analytic	0.43	0.514	0.84	0.360	0.002	0.90	0.342	12.67
Sharpener	0.50	0.481	0.00	0.988	0.000	0.03	0.874	19.75
Leveler	2.02	0.156	0.21	0.645	0.001	0.01	0.906	19.86
Deductive	1.80	0.180	0.33	0.563	0.001	1.92	0.166	7.60
Inductive	0.03	0.874	0.00	0.994	0.000	0.06	0.800	19.36
Field-independent	5.49	0.020	0.00	0.979	0.000	2.26	0.134	6.41
Field-dependent	3.85	0.050	3.44	0.064	0.009	0.22	0.643	17.94
Impulsive	0.90	0.345	0.79	0.374	0.002	0.71	0.400	13.97
Reflective	0.23	0.635	0.07	0.798	0.000	1.78	0.182	8.14
Metaphoric	0.25	0.615	10.82	0.001*	0.027	0.02	0.889	19.80
Literal	0.13	0.715	10.27	0.001*	0.025	0.00	0.965	19.98

As for Table 4, using scores standardised within each respondent by subtracting their mean rating across all 110 items.

Figures

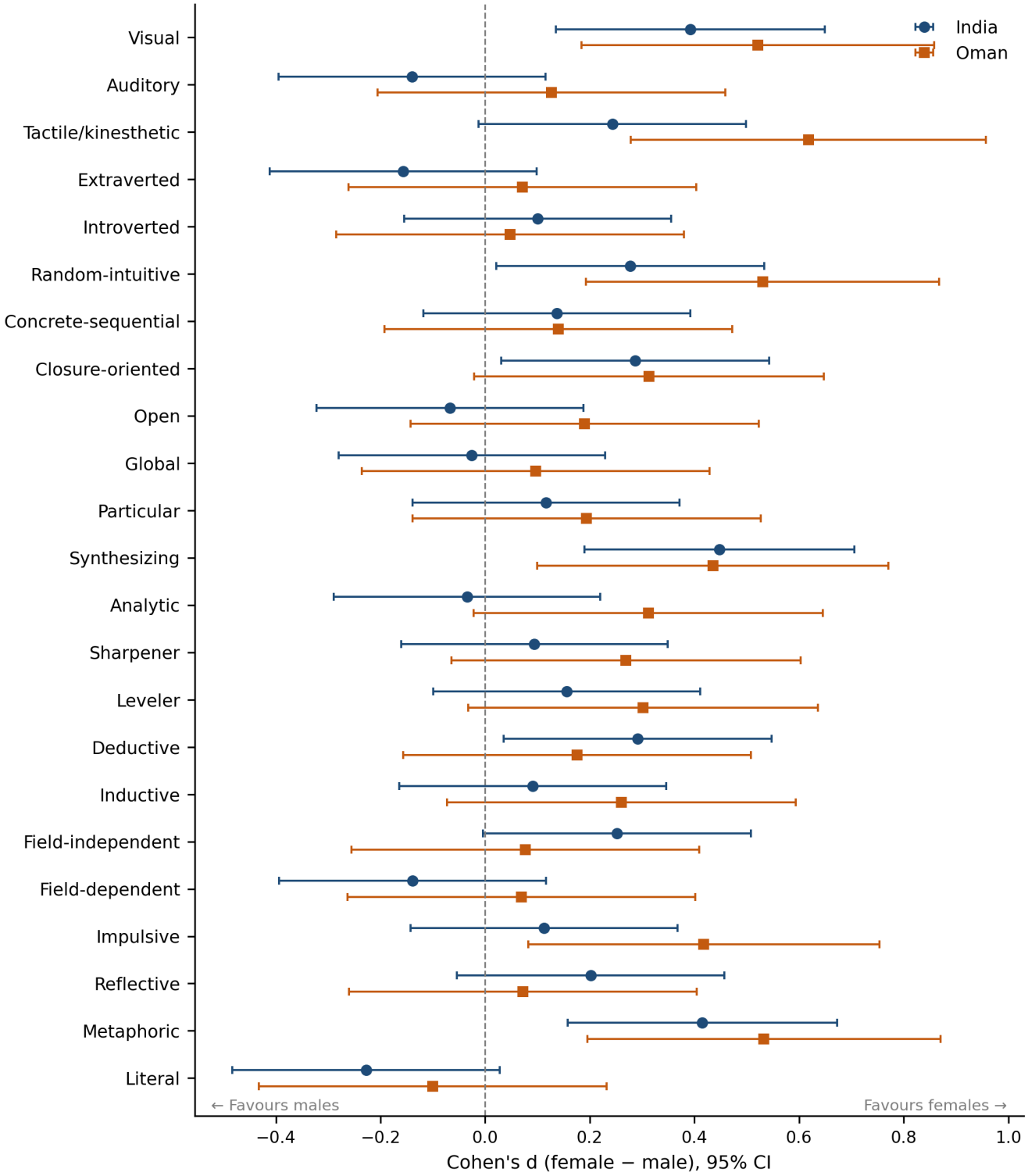


Figure 1

Gender differences in learning style preferences among Indian and Omani students in Oman. Points show Cohen's d (female minus male) on each of the 23 Learning Style Survey subscales for India (circles; 154 female, 96 male) and Oman (squares; 55 female, 95 male), primary sample, raw scores.

Error bars show 95% confidence intervals. Positive values indicate higher scores among female students.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- data.zip