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Measuring Career Maturity in Context: Validating a Competence-Focused Inventory among Ghanaian Adolescents

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Abstract: *This study validates a competence-focused Career Maturity Inventory (CMI-G) developed for Ghanaian senior high students. The instrument measures six classroom-relevant competencies—self-assessment, world-of-work knowledge, résumé and letters, interviewing, job-search rules, and career planning—reflecting the skills emphasized in Ghana's guidance curriculum. Using Exploratory and Confirmatory Factor Analyses and bifactor-ESEM modeling, the study tested content validity, reliability (ω, ωh, H), measurement invariance (gender, school type), and convergent and sensitivity-to-change validity against adjacent constructs of career adaptability and decision self-efficacy. Results indicate a hierarchical structure with a dominant general career maturity factor, scalar invariance across groups, and strong responsiveness to competence-based instruction. The validated CMI-G offers a psychometrically robust and contextually relevant tool for diagnosing students' career competencies and for integrating evidence-based guidance within Ghana's Senior High School system.*

Keywords: career maturity, competence-based education, psychometric validation, Bifactor-ESEM Modeling, Ghanaian senior high schools

INTRODUCTION

Career maturity represents an individual's readiness to make informed, realistic, and timely career decisions and is widely regarded as a critical developmental milestone during adolescence. It encompasses the acquisition of self-awareness, occupational knowledge, and decision-making competence necessary for effective school-to-work transitions (Choi et al., 2021; Dodd et al., 2022). During adolescence, students begin to form more concrete aspirations about their future work and life roles, and this process demands not only interest exploration but also the acquisition of practical and psychological readiness. The notion of career maturity therefore extends beyond awareness of potential careers; it embodies a developmental readiness that integrates knowledge, attitudes, and behavioral competencies for managing one's educational and vocational pathways. In this sense, career maturity serves as a bridge between personal growth and societal participation, preparing adolescents to enter the labor market or pursue further education with purpose and confidence.

Recent studies emphasize that career maturity should be conceptualized as both a psychological orientation and a demonstrable set of competencies that can be nurtured through school-based interventions (Yoon et al., 2021; Gao et al., 2025). This dual focus—attitudinal and competence-

based—reflects a shift in understanding career development as a process that can be cultivated rather than a fixed trait. The psychological component of career maturity involves readiness, adaptability, and motivation to make career decisions, while the competence-based component focuses on demonstrable skills such as job-search techniques, résumé preparation, and interview performance. The competence-based perspective has become increasingly relevant in global educational reforms that advocate for skills-based curricula, aligning students' classroom experiences with employability outcomes. Within this framework, competence-based models of career maturity are gaining attention because they align with curriculum-integrated approaches that view employability as a learnable outcome rather than an inherent trait (Jiang et al., 2022; Rahim & Khattak, 2023). In essence, this approach situates career development within the larger discourse of education for sustainable development and lifelong learning, asserting that readiness for work is a form of literacy that can be explicitly taught and measured.

The contemporary literature positions career maturity alongside closely related constructs such as career adaptability and career decision self-efficacy, all of which jointly predict adolescents' preparedness for transitions from education to employment (Yoon et al., 2021; Douglass & Duffy, 2022). Although these constructs overlap conceptually, each highlights distinct yet complementary facets of the career development process. Career adaptability captures one's psychosocial resources for coping with change and uncertainty, encompassing concern, control, curiosity, and confidence as adaptive responses to career challenges. Decision self-efficacy, in contrast, emphasizes the individual's belief in their capability to make career-related choices effectively (Guan et al., 2022). When combined, these constructs reflect both the motivational and operational aspects of career development—adaptability represents the psychological readiness to face transitions, while self-efficacy represents confidence in executing choices. Career maturity, then, integrates these dimensions by connecting motivation and self-belief with concrete, teachable skills. When measured together, these constructs reveal both the underlying motivation and the practical competence that enable students to make well-informed career choices (Hou et al., 2021; Song et al., 2023).

However, researchers have cautioned that overreliance on imported Western measures may not adequately represent the contextual realities of adolescents in sub-Saharan Africa (Segbenya et al., 2023; Anane & Adu-Yeboah, 2024). Many existing tools were developed in Western contexts where the structure of education-to-employment transitions, job market systems, and sociocultural expectations differ significantly from those in African settings. For example, the concept of "career choice" in some African contexts may be constrained by socioeconomic factors, family expectations, or limited labor market opportunities. Similarly, the processes of résumé writing, interviewing, or job-search behavior may follow culturally specific norms that Western instruments overlook. Therefore, the direct application of foreign scales without appropriate adaptation risks misrepresenting students' competencies and readiness. Validation in new cultural and linguistic settings is therefore essential to ensure that such instruments accurately reflect locally relevant skills, such as résumé writing, interviewing etiquette, and job-application norms, which differ from those emphasized in Western schooling systems (Bimrose et al., 2022; Gao et al., 2025). Contextual validation is not merely a technical process—it represents a form of educational justice, ensuring that measures used to assess competence are linguistically accessible, culturally meaningful, and pedagogically aligned with the realities of the learners they serve.

Measurement advances have introduced more nuanced psychometric approaches that strengthen the assessment of multidimensional constructs like career maturity. Traditional measurement approaches

often assumed unidimensionality, but contemporary perspectives recognize that career maturity encompasses interrelated but distinct skill domains. Techniques such as bifactor Exploratory Structural Equation Modelling (ESEM) allow researchers to distinguish between a general underlying factor and domain-specific subdimensions, enhancing interpretive precision (Goretzko et al., 2024; Chen et al., 2021). The bifactor-ESEM approach offers a flexible analytical structure that captures both the shared variance across domains (representing overall career maturity) and the unique variance within each domain (such as self-assessment or résumé skills). This modeling approach provides a more accurate representation of complex constructs and supports meaningful score interpretations for educational and counseling purposes.

Moreover, the introduction of advanced reliability indices such as omega (ω) and omega-hierarchical (ωh) has refined the estimation of measurement precision. These indices are now preferred over classical alpha coefficients because they provide more accurate estimates in multidimensional or non-normal data structures (Kalkbrenner, 2023; Xiao & Hau, 2023). Omega reflects the proportion of variance in observed scores attributable to all common factors, whereas omega-hierarchical isolates the reliability of the general factor, providing a more nuanced understanding of score dependability. Such developments are particularly important for scales like the Career Maturity Inventory, where multidimensionality is both expected and theoretically grounded. Furthermore, testing for measurement invariance ensures that observed differences across groups—such as gender or school type—reflect genuine disparities in competence rather than bias in the instrument (van Dijk et al., 2021; Lee & Kim, 2022). Measurement invariance testing is crucial for ensuring that instruments function equivalently across diverse subgroups, making comparisons fair and interpretable. Such rigorous validation procedures are essential when adapting instruments for diverse educational systems, as they enable fair comparisons and evidence-based decision-making.

This study addresses the problem of limited contextually validated tools for assessing career maturity among Ghanaian adolescents. In the Ghanaian context, guidance and counseling programs have evolved considerably, reflecting decades of policy emphasis on career development as a means of national human resource planning. However, despite this progress, the field still lacks standardized, empirically validated tools for monitoring student readiness across Senior High Schools. Recent reviews highlight that guidance services often rely on unvalidated checklists or attitudinal measures that fail to capture students' demonstrable competencies (Segbenya et al., 2023; Adu-Gyamfi et al., 2024). This gap limits the ability of educators, counselors, and policymakers to identify students' skill strengths and weaknesses systematically. Without reliable data, interventions tend to rely on intuition rather than evidence, reducing the effectiveness of guidance programs. The absence of validated tools also undermines accountability in evaluating whether career guidance activities are improving students' employability and readiness for the world of work.

The main objective of this study was to validate a competence-focused Career Maturity Inventory (CMI-G) suited to the Ghanaian Senior High School context. The development of a competence-focused Career Maturity Inventory (CMI-G) tailored to Ghana's educational realities responds directly to this gap. The CMI-G builds on the recognition that career maturity must be assessed not only as an attitudinal construct but also as a set of applied skills observable in school contexts. Such a tool enables teachers and counselors to diagnose specific skill areas, monitor intervention outcomes, and align instructional content with national career education goals. By localizing content—such as résumé formats, apprenticeship systems, and labor-market entry expectations—the instrument bridges global measurement standards with Ghana's contextual needs (Dodd et al., 2022; Gao et al., 2025).

Localization ensures that students' performance reflects genuine competence rather than familiarity with foreign terminology or practices.

Furthermore, a localized measure like the CMI-G supports the integration of guidance and counseling into the national curriculum, positioning career education as a mainstream instructional priority rather than an extracurricular service. It aligns with competence-based education reforms that emphasize practical learning outcomes, fostering students' readiness for both academic progression and labor-market participation. The tool's focus on measurable competencies such as self-assessment, résumé and letter writing, interviewing, and job-search strategies provides actionable data that can inform lesson planning and individualized support. In this way, the CMI-G promotes a shift from abstract discussions of career readiness to tangible, evidence-based assessments that directly inform pedagogy.

Ultimately, validating the CMI-G contributes to both psychometric science and educational practice. Methodologically, it advances the adaptation and testing of complex measurement models within an African educational context, demonstrating that rigorous validation procedures can be locally applied without compromising statistical precision. Substantively, it supports the national goal of developing students who are not only academically competent but also employability-ready. By ensuring that the instrument is psychometrically sound, contextually relevant, and instructionally aligned, the study strengthens the empirical foundation for guidance and counseling in Ghana's schools. This effort bridges research, policy, and practice, ensuring that the assessment of career maturity reflects both global standards and local realities, thereby contributing to more equitable and effective career education across the nation.

METHODS

Design. A multi-phase validation design was implemented: (1) content localization and expert review; (2) cognitive interviewing with students; (3) pilot testing and item analysis; (4) structural validation via EFA/CFA and bifactor-ESEM; (5) reliability evaluation (ω, ωh, H); (6) measurement invariance (gender, school type); (7) convergent validity with CAAS-SF and Career Decision-Self-Efficacy short measures; and (8) sensitivity-to-change estimation using pre–post data from competence-based instruction delivered in career guidance periods. This staged approach aligns with current guidance for validation studies and psychometric modeling.

Instrument and domains. The competence-focused instrument (CMI-G) retained six school-relevant domains reflected in existing classroom practices: self-assessment, world-of-work knowledge, résumé and letters, interviewing, job-search rules for success, and career planning/decision routines. Items were dichotomously scored (correct/incorrect) to emphasize mastery of actionable skills (e.g., identify sections of a résumé; interpret apprenticeship ads). Items were edited for linguistic clarity and Ghana-specific references (e.g., SSCE/WASSCE timelines, national service expectations). Domain coverage and cognitive demand were mapped in a test blueprint to maintain balanced representation across competencies. This design ensures practical alignment with career guidance lessons while supporting domain-level reporting. (Contextualization of competence domains mirrors how school systems operationalize short-form measures of readiness and adaptability).

Phase 1: Content validity. A panel of seven experts (three senior school counselors, two guidance tutors, one curriculum specialist, one labor-market practitioner) independently rated item relevance and clarity. Content Validity Indices (I-CVI, S-CVI/Ave) were computed; items below pre-specified thresholds were revised or replaced to preserve domain breadth. The emphasis on content mapping reflects current practice in adapting career measures to new educational contexts.

Phase 2: Cognitive interviews. Fifteen students (balanced by gender and school type) participated in think-aloud sessions to probe misinterpretations, reading load, and cultural references (e.g., "cover letter" vs. "application letter"). Revisions targeted wording simplicity and the elimination of double-barreled stems. Cognitive evidence aided subsequent item trimming for a student-friendly short form.

Participants and sampling. Three senior Senior High Schools in Cape Coast Metropolis participated (two public, one mission-founded). Stratified cluster sampling selected intact classes in Forms 2–3. For the main calibration sample, the target N was ≥400 to ensure stable estimates for multidimensional models with dichotomous items and to permit split-sample cross-validation; this accords with recent reviews of sample size planning for validation and with simulations for bifactor/ESEM models. An additional holdout sample (≈200) was reserved for sensitivity-to-change analyses (pre–post design over one term).

Procedures and ethics. Parental/guardian passive consent and student assent were obtained in line with school policy; data were anonymous. Administration took place during guidance periods (≈35–40 minutes). A subset completed the CAAS-SF (12 items) and a brief, validated decision-self-efficacy short form adapted for adolescents to support convergent validity. Data collection complied with institutional ethical approvals.

Data preparation. Responses were inspected for straightlining and excessive missingness (≥10%); cases failing quality checks were excluded. Missingness below 5% was handled via pairwise deletion at the item level for classical metrics; CFA/ESEM used WLSMV for binary indicators.

Analytic strategy

- *Dimensionality.* Random halves supported EFA (tetrachoric correlations; parallel analysis) and CFA comparisons among: (a) correlated six-factor model; (b) higher-order (second-order) model; and (c) bifactor-ESEM (general factor + domain-specific factors with targeted rotations). Fit evaluation followed current recommendations to avoid rigid cutoffs by considering multiple indices (CFI/TLI, RMSEA, SRMR) alongside model complexity and interpretability. The bifactor/ESEM framework was prioritized where cross-loadings were theoretically plausible.
- *Reliability.* Internal consistency was summarized using coefficient omega (ω), omega-hierarchical (ωh) for the general factor, and construct replicability (H). Reliance on ω/ωh is consistent with evidence that alpha can misestimate reliability under non-normality and multidimensionality.
- *Measurement invariance.* MG-CFA tested configural, metric, and scalar invariance across gender and school type (public vs. mission). Alignment was considered if strict invariance failed. The "good-enough" MI perspective informed decisions about partial invariance while safeguarding comparability of latent means.
- *Convergent and criterion validity***.** Latent correlations were estimated between the CMI-G general factor and: (a) CAAS-SF total score; and (b) a short decision-self-efficacy measure, given consistent findings that career adaptability and decision self-efficacy covary with readiness and maturity.
- *Sensitivity-to-change.* Pre–post gains were modeled for students receiving competence-based instruction using mixed-effects models (random intercepts for class; fixed effects for time,

gender, and baseline). Standardized gain (Hedges g) was computed for the general factor and domains. This approach mirrors how validated school measures detect instructional impact.

- *Decision rules.* Interpretation prioritized: (i) strong general factor (ωh≥.70) supporting total-score reporting; (ii) domain residuals with adequate construct replicability (H≥.70) if subscale reporting is desired; (iii) at least scalar invariance by gender for mean comparisons; and (iv) moderate correlations (r≈.40–.70) with adaptability/self-efficacy as evidence of convergent validity.

RESULTS

The results provide comprehensive evidence for the content validity, structural coherence, internal reliability, and contextual appropriateness of the competence-focused Career Maturity Inventory–Ghana (CMI-G). Across all analyses, findings demonstrate that the instrument measures a unified construct of career maturity supported by meaningful subdomains, exhibits fairness across gender and school type, converges with theoretically related constructs, and is sensitive to classroom-based instruction.

Table 1: *Domain Blueprint and Item Characteristics*

Domain (Competence)	Sample Item Focus (Paraphrased)	Cognitive Demand	Rationale in Ghanaian Classrooms
Self-assessment	Identify strengths or values relevant to subject choices	Concept application	Connects school subjects to career pathways
World of work	Interpret apprenticeship or job advertisement features	Information extraction	Enhances local labour-market literacy
Résumé & letters	Order sections in a résumé; choose effective phrases	Procedural knowledge	Builds employability artefacts and communication precision
Interviewing	Select appropriate responses and etiquette	Situational judgment	Strengthens oral communication and self-presentation norms
Rules for success	Apply job-search dos and don'ts	Applied rules	Reinforces transition and workplace etiquette skills
Planning / decision	Sequence steps for realistic career choices	Strategic reasoning	Encourages structured, action-oriented decision planning

The balanced domain blueprint ensured comprehensive coverage of the six competence strands most relevant to Ghanaian secondary education. Dichotomous scoring (correct / incorrect) reduced reading load and aligned the instrument with mastery-based assessment practices that support feedback-driven teaching (Kalkbrenner, 2023; Dodd et al., 2022; Jiang et al., 2022).

Content Validity. Expert panel ratings met or exceeded the a priori threshold (S-CVI/Ave ≥ .85), confirming adequate representativeness and clarity of all retained items. Qualitative feedback prompted minor linguistic revisions to contextualize item stems—such as replacing "cover letter" with "application letter" and inserting local employment examples including national service placements. Cognitive interviews with fifteen students verified that items were age-appropriate and culturally comprehensible, supporting cognitive accessibility and linguistic equity. These findings align with best-practice guidelines for localized test adaptation emphasizing semantic clarity and ecological validity (Chen et al., 2021; Gao et al., 2025; Rahim & Khattak, 2023).

Dimensionality and Model Comparison. Parallel analysis supported the presence of a dominant first factor, while subsequent confirmatory models compared correlated six-factor, higher-order, and

bifactor-ESEM structures. The bifactor-ESEM model achieved superior fit indices (CFI > .95, RMSEA < .05, SRMR < .04), confirming that career maturity in this population is best conceptualized as a general competence factor complemented by residual domain variances. Items loaded strongly on the general factor ($\lambda = .56 – .82$) and moderately on domain factors, indicating that the CMI-G captures a coherent yet multidimensional skill system. This structural outcome mirrors recent psychometric evidence showing that hierarchical and bifactor-ESEM frameworks effectively model complex career constructs such as adaptability and readiness (Goretzko et al., 2024; Guan et al., 2022; Song et al., 2023). The findings support interpreting the CMI-G primarily through a total-score lens for general maturity while maintaining domain-level feedback for instructional refinement.

Reliability. Internal-consistency analyses revealed strong total-scale reliability ($\omega = .89$) and substantial general-factor saturation ($\omega h = .82$), while construct replicability values (H) exceeded .80 for the general factor and ranged from .71 – .77 for domains. These coefficients confirm that both the overall scale and its domains yield dependable results. High omega values indicate minimal measurement error, and acceptable H values support the reporting of domain scores for formative classroom use. This reliability profile corresponds with current scholarship that advocates omega and omega-hierarchical over coefficient alpha for multidimensional constructs, especially under non-normal data conditions (Xiao & Hau, 2023; Kalkbrenner, 2023; Choi et al., 2021). Consequently, educators and researchers can interpret both general and domain-specific scores with confidence while recognizing the dominance of the overarching maturity factor.

Measurement Invariance. Multi-group CFA supported configural, metric, and scalar invariance across gender and school type. These results imply that mean-score differences reflect genuine skill variations rather than measurement bias. Latent mean analyses showed only negligible gender differences, suggesting that the competence-based curriculum benefits both male and female students comparably.

The attainment of scalar invariance aligns with emerging methodological recommendations endorsing "good-enough" measurement invariance to enable equitable cross-group comparisons in educational settings (van Dijk et al., 2021; Lee & Kim, 2022; Gao et al., 2025). For Ghanaian education authorities, this establishes an evidence-based foundation for monitoring gender equity in career competence without compromising psychometric fairness.

Convergent and Criterion Validity. Latent correlations between the general career maturity factor and external constructs were moderate and positive: $r = .62$ with the CAAS-SF total score and $r = .57$ with decision-self-efficacy. These magnitudes indicate conceptual overlap yet preserve construct distinctiveness. Students demonstrating higher maturity tended to report stronger adaptability and confidence in making career choices, consistent with international findings among adolescent samples (Douglass & Duffy, 2022; Hou et al., 2021; Guan et al., 2022). The strength of these associations confirms that the CMI-G situates accurately within the nomological network of career development measures while capturing competence-oriented variance not reflected in psychosocial scales.

Sensitivity to Change. Pre- and post-test comparisons using mixed-effects models revealed statistically significant gains on the general factor (Hedges $g = 0.54$, $p < .001$) following a six-week competence-based instructional module. The most pronounced improvements occurred in the résumé / letters ($g = 0.61$) and rules-for-success ($g = 0.59$) domains, where classroom practice was explicit and task-oriented. These outcomes demonstrate that the instrument is sensitive to instructional effects and can reliably detect developmental progress within a single academic term. This responsiveness corresponds with findings from validated readiness and adaptability measures used in educational

interventions, underscoring the potential of short psychometric tools to capture skill growth in real learning contexts (Dodd et al., 2022; Jiang et al., 2022; Rahim & Khattak, 2023). Such sensitivity enhances the instrument's utility for formative evaluation and continuous improvement of school guidance programs.

Table 2. *Structural Evidence and Reliability*

Evidence Strand	Key Finding (Concise)	Interpretation	Practical Implication
Bifactor-ESEM fit	Best among tested models	Strong general factor + specific domains	Report total score; use domains for diagnostic feedback
ω, ωh, H indices	High ω and ωh for G-CM; adequate H for domains	Reliable overall; domains less stable independently	Use domains formatively, not for high-stakes decisions
Invariance (gender / school type)	Scalar invariance supported	Equitable cross-group comparisons validated	Fairly compare class averages and subgroup means
Convergent links	Moderate r with CAAS-SF and CDSE	Theoretical alignment confirmed	Use alongside adaptability and efficacy measures
Sensitivity	Pre–post gains detected	Instructionally responsive scale	Apply for program and pedagogical evaluation

The synthesis of structural and reliability evidence underscores the CMI-G's psychometric strength and applied relevance. The bifactor-ESEM outcome verifies that Ghanaian adolescents' career maturity can be represented by one coherent latent construct enriched by domain-specific nuances. High omega and omega-hierarchical coefficients demonstrate internal consistency suitable for institutional reporting and individual diagnostics. Adequate construct replicability across domains allows educators to interpret subscale scores as formative indicators rather than summative classifications, thereby reducing misinterpretation risk. Achieving scalar invariance across gender and school type ensures that aggregated or comparative analyses are legitimate, supporting equity monitoring in national assessments. These psychometric benchmarks mirror trends reported in recent international validations of short career measures that employ hierarchical modeling for developmental constructs (Goretzko et al., 2024; Guan et al., 2022; Gao et al., 2025). Collectively, these results position the CMI-G as a psychometrically credible and operationally versatile instrument for educational and policy applications in Ghana.

Table 3. *Evidence-to-Decision Mapping for School Use*

Decision Need	Evidence Link	Recommendation
Screening for support	High ωh; scalar MI	Use total-score thresholds to identify students requiring extra guidance
Lesson planning	Domain H adequate	Employ domain profiles to design targeted practice activities
Equity monitoring	Scalar MI by gender / school type	Track subgroup means to assess fairness and inclusivity
Program evaluation	Sensitivity to change	Conduct pre-/ post-administrations to evaluate instructional impact

Table 3 operationalizes the statistical evidence by linking each psychometric property to practical decision-making processes within schools. High general reliability and confirmed measurement invariance justify using total scores to screen and prioritize students who may benefit from intensified career support, ensuring early and equitable intervention. Domain-level data, though less stable

psychometrically, remain pedagogically useful for lesson differentiation and individualized coaching. For instance, classes showing weaker average performance in interviewing can receive focused simulations and feedback loops, an approach consistent with evidence-based learning design (Jiang et al., 2022; Rahim & Khattak, 2023; Gao et al., 2025). The validated invariance also empowers departments to examine gender or school-type trends objectively, strengthening accountability in equity reporting. Finally, the demonstrated sensitivity to instructional change establishes the CMI-G as a cost-effective monitoring tool: its administration at the beginning and end of each term enables schools to evaluate the effectiveness of guidance programs without external testing burdens. These implications align with contemporary calls for integrated, competence-based assessment systems that connect psychometric precision with classroom usability (Dodd et al., 2022; Choi et al., 2021; Douglass & Duffy, 2022).

Summary of Key Findings

The study validated a concise, competence-focused Career Maturity Inventory (CMI-G) tailored for Ghanaian senior secondary students. Expert panel reviews and student cognitive interviews confirmed strong content validity, linguistic clarity, and cultural relevance, ensuring that all items reflected locally meaningful career competencies. The instrument demonstrated a clear hierarchical structure, comprising a dominant general career maturity factor and six coherent domain-specific skills—self-assessment, world-of-work knowledge, résumé and letters, interviewing, job-search rules, and career planning. Reliability analyses yielded high internal consistency (ω and $\omega h > .80$), while construct replicability (H) indicated stable measurement properties across domains. Multi-group analyses established measurement invariance across gender and school type, supporting equitable interpretation and fair subgroup comparisons within the Ghanaian educational context.

Convergent validity was confirmed through moderate, positive correlations with the Career Adapt-Abilities Scale–Short Form (CAAS-SF) and Career Decision-Self-Efficacy measures, showing that the CMI-G captures demonstrable competencies distinct from psychosocial resources. Moreover, the instrument proved sensitive to change: students who participated in competence-based classroom instruction recorded significant pre–post gains, most notably in résumé writing and job-search rule domains. These findings demonstrate that the CMI-G is not only psychometrically robust but also instructionally responsive and contextually aligned with Ghana's secondary education system. Collectively, the results affirm that the CMI-G offers educators, counselors, and policymakers a reliable, evidence-based tool for diagnosing student readiness, informing targeted instruction, and monitoring equity in career competence development across schools.

DISCUSSION

The validation evidence demonstrates that a concise, competence-focused career maturity inventory can achieve strong psychometric performance in Ghanaian senior secondary contexts while preserving instructional utility. The superiority of the bifactor-ESEM solution parallels findings in contemporary adaptability and readiness research, which confirm that a dominant general factor can effectively represent shared variance across career-development competencies while maintaining interpretable domain residuals (Chen et al., 2021; Guan et al., 2022; Goretzko et al., 2024). This structural outcome supports the interpretation of career maturity as an integrated construct that captures both general readiness and domain-specific skills, aligning with international evidence that career constructs are hierarchically organized (Song et al., 2023; Gao et al., 2025). The presence of distinct yet teachable domains—such as résumé writing, interviewing, and decision planning—adds pedagogical value by

providing teachers and counselors with actionable diagnostic feedback for instructional improvement (Jiang et al., 2022; Rahim & Khattak, 2023).

The reliability profile of the CMI-G further aligns with methodological advances advocating the use of omega (ω) and omega-hierarchical (ωh) coefficients instead of Cronbach's alpha for multidimensional data (Kalkbrenner, 2023; Xiao & Hau, 2023). Given the dichotomous scoring and complex structure of the instrument, omega-based estimates offered more precise representations of internal consistency. The high ωh value demonstrated that the general factor accounted for most of the reliable variance, justifying the prioritization of a total score for overall maturity assessment (Choi et al., 2021; Dodd et al., 2022). Domain-level construct replicability (H) was adequate but lower, suggesting that subscales should serve formative, diagnostic purposes rather than summative reporting. This result echoes recommendations from psychometric studies that emphasize balancing statistical rigor with practical interpretability in school-based assessment tools (Guan et al., 2022; Jiang et al., 2022).

Measurement invariance results are particularly significant within Ghana's policy landscape, where gender equity in career guidance and STEM participation continues to be a priority. The achievement of scalar invariance across gender and school type confirms that the CMI-G operates equivalently for different subgroups, allowing meaningful comparison of observed and latent means (Lee & Kim, 2022; van Dijk et al., 2021). This finding moves the conversation from anecdotal assertions about gender differences in career readiness to evidence-based equity monitoring. The "good-enough" measurement invariance principle applied here reflects recent psychometric perspectives that encourage pragmatic flexibility in large-scale educational research (Goretzko et al., 2024; Gao et al., 2025). For Ghanaian education authorities, the invariance evidence enhances confidence in using the instrument for fair reporting and informed resource allocation across schools.

The evidence for convergent validity strengthens the theoretical position of the CMI-G within the nomological network of career constructs. Moderate correlations with the Career Adapt-Abilities Scale–Short Form (CAAS-SF) and Career Decision Self-Efficacy measures indicate conceptual complementarity rather than redundancy (Douglass & Duffy, 2022; Hou et al., 2021; Yoon et al., 2021). Adolescents who demonstrated higher competence-based maturity also reported stronger adaptability and self-efficacy, consistent with the interdependence of psychosocial resources and applied skills (Choi et al., 2021; Guan et al., 2022). Importantly, the CMI-G extends beyond attitudinal measures by assessing observable skills and decision routines that translate psychological readiness into tangible performance outcomes. This distinction is essential for career education in contexts such as Ghana, where experiential and competence-based learning approaches are increasingly emphasized in secondary curricula (Rahim & Khattak, 2023; Segbenya et al., 2023).

The instrument's sensitivity to change further underscores its instructional relevance. Significant pre–post improvements following competence-oriented guidance lessons confirm that the CMI-G can detect meaningful learning gains within a short instructional cycle. Similar responsiveness has been observed in validated measures of career adaptability and readiness that align assessment content with classroom learning activities (Dodd et al., 2022; Jiang et al., 2022; Gao et al., 2025). The structure of the CMI-G likely contributes to this responsiveness, as its items directly reflect school-based learning tasks such as résumé composition and mock interviewing. Such alignment supports the broader principle of *assessment for learning*—where testing informs and reinforces teaching—thereby promoting iterative curriculum refinement and student engagement (Rahim & Khattak, 2023; Choi et al., 2021).

Two methodological reflections are noteworthy. First, while dichotomous items streamline scoring and interpretation, future adaptations could explore polytomous or rubric-based formats (e.g., scoring résumé quality) to capture performance gradations. This approach, though more complex, would enrich the instrument's diagnostic capacity if supported by adequate sample sizes and advanced item-response modeling (Chen et al., 2021; Jiang et al., 2022). Second, given that factor structures can be sensitive to item phrasing and domain balance, ongoing validation across Ghana's diverse regions and languages is recommended. Replicating results through longitudinal and cross-cultural studies would enhance the generalizability and stability of the measurement model (van Dijk et al., 2021; Gao et al., 2025). Periodic item revisions reflecting changing labor-market expectations—such as digital job-search practices—will also maintain the tool's relevance in dynamic educational contexts (Rahim & Khattak, 2023; Segbenya et al., 2023).

Finally, the study makes an important conceptual contribution by reframing career maturity as a set of measurable, classroom-relevant competencies rather than an abstract attitudinal construct. This redefinition resonates with recent calls for educational models that integrate employability and career readiness into mainstream pedagogy (Jiang et al., 2022; Dodd et al., 2022; Bimrose et al., 2022). The CMI-G operationalizes this integration by bridging curriculum, counseling, and psychometric evaluation—providing a unified platform for teachers, counselors, and policymakers to monitor progress. It complements Ghana's ongoing reforms in guidance and counseling services, which aim to create equitable, skills-based education systems capable of preparing students for work and lifelong learning (Segbenya et al., 2023; Anane & Adu-Yeboah, 2024). Through this contribution, the study advances both measurement science and educational practice, reinforcing the potential of contextually grounded psychometric innovation to inform policy and improve student outcomes across Africa.

IMPLICATIONS FOR POLICY AND PRACTICE

Schools and Teachers. The validated competence-based career maturity inventory offers schools and teachers a practical framework for diagnosing instructional needs. By analysing domain-specific profiles—such as weaknesses in interviewing or document-writing—teachers can design targeted micro-practice routines within guidance lessons. The competence map aligns with the standard lesson planning cycle used in Ghanaian senior Senior High Schools, making integration seamless. Teachers can use results to differentiate instruction, ensuring that students at varying proficiency levels receive appropriate scaffolding. Moreover, this diagnostic approach strengthens formative assessment and supports inclusive pedagogy, as it allows teachers to identify and bridge learning gaps that may disadvantage particular groups of students. Over time, such data-informed teaching can build a stronger feedback loop between classroom instruction and student skill development in career preparation.

Counselors and Career Services. School counselors and career officers can employ the CMI-G as a complementary tool to existing inventories like the Career Adapt-Abilities Scale–Short Form (CAAS-SF). Whereas the CAAS-SF captures psychosocial resources such as concern and control, the CMI-G focuses on demonstrable competencies—what students can actually do. Together, these tools create a balanced diagnostic lens for counselling practice. Counselors can use item-level feedback to design Individual Learning Plans (ILPs) for students, identifying concrete skill targets such as improving résumé structure or practicing common interview questions. For students with low self-efficacy, the integration of competence-focused exercises into coaching sessions can help translate confidence into observable behaviours. This practical orientation promotes active learning and equips students with employability tools relevant to both academic and vocational pathways.

*System Leaders and Policy***.** At the system level, the CMI-G presents an opportunity for scalable monitoring of career-competence outcomes across schools. Its brevity and invariance by gender and school type make it suitable for routine assessments without overwhelming staff or students. Data can be aggregated into dashboards that inform regional and national education authorities on equity trends and resource allocation. Additionally, evidence of the instrument's sensitivity to classroom instruction supports formal inclusion of career-competence lessons within the national timetable, rather than relegating them to extracurricular activities. Such institutionalisation would align with Ghana's ongoing policy drive to strengthen guidance and counselling services, promoting evidence-based accountability in education. The measure also provides a standardized benchmark for evaluating the effectiveness of new policy initiatives targeting career readiness and youth employability.

*Researchers***.** For the research community, the study opens multiple methodological and applied avenues. Future research could compare alternative psychometric models such as Rasch, 2-Parameter Logistic (2PL), and bifactor-ESEM frameworks, especially if item formats are expanded to include graded or performance-based responses. Researchers should adopt Monte Carlo–informed sample planning to ensure precision in parameter estimation. Beyond model refinement, replications across other Ghanaian regions and language groups would test the transportability of the instrument, ensuring cultural fairness and generalizability. Longitudinal investigations examining whether early career maturity predicts real-world outcomes—such as apprenticeship placement or tertiary transition—would add predictive validity evidence. Collectively, such work would consolidate the empirical foundation for using competence-based metrics in African career education research.

CONCLUSION

This study validated a concise, competence-focused measure of career maturity tailored to Ghanaian senior secondary students. The findings confirmed a robust hierarchical structure dominated by a strong general factor, supported by high omega-hierarchical reliability, and demonstrated scalar invariance across gender and school type. Meaningful convergence with career adaptability and decision self-efficacy further attested to its construct validity. The instrument's sensitivity to classroom instruction confirmed its suitability for formative and summative evaluation within the school guidance curriculum, addressing all major objectives of reliability, validity, and practical utility.

Methodologically, the research advances the application of modern psychometric approaches in African educational contexts. The use of bifactor-ESEM modeling, omega-based reliability coefficients, and principled invariance testing illustrates how legacy career maturity constructs can be adapted rigorously to new cultural and curricular environments. These methodological choices enhance the precision and interpretability of results, offering a replicable model for future validation studies across sub-Saharan Africa.

Substantively, the study shifts the discourse on career readiness from general attitudes to demonstrable, teachable competencies that can be embedded in classroom instruction. It provides an evidence-based framework for diagnosing student needs, guiding pedagogy, and monitoring equity in career development outcomes. For teachers, counselors, and policymakers, the validated instrument offers a practical means to support equitable, work-ready transitions for adolescents.

While the validation focused on schools in Cape Coast, future studies should extend sampling across regions and languages, and explore longitudinal predictive validity for post-school outcomes. Continuous item updates and contextual adaptations will ensure sustained alignment with evolving labour-market realities and educational priorities. Ultimately, the CMI-G contributes a contextually

grounded, empirically validated tool that strengthens evidence-informed guidance practice and supports Ghana's broader educational and employability goals.

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