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Development of a Digital Assessment Instrument for Professional Bridal Bun Practices Based on Multidimensional Item Response Theory (MIRT) Integrated with the Theory of Conservation of Indonesian Family Cultural Values

Dian Pertiwi Josua[1*], Universitas Negeri Jakarta

Jenny Sista Siregar[1] Universitas Negeri Jakarta

Iva Sarifah[4] Universitas Negeri Jakarta

Awaluddin Tjalla[1] Universitas Negeri Jakarta

Mahdiyah[1] Universitas Negeri Jakarta

Gaguk Margono[1] Universitas Negeri Jakarta

Address for Correspondence: dianpertiwijosua@unj.ac.id

ABSTRACT

This study developed a digital instrument to assess professional bridal bun practices, employing a method that evaluates multiple competencies simultaneously and is grounded in the preservation of Indonesian family cultural values. The study involved 120 participants, including cosmetology graduates and freelance makeup artists, who piloted a 30-item instrument that covered technical proficiency, visual aesthetics, and cultural values. The analysis demonstrated how effectively questions differentiated between different skill levels, with test scores indicating that the tool performed well in terms of both difficulty and quality. Expert reviews confirmed that the tool could fully measure technical, cultural, and ethical aspects of bridal hairstyling and that it helps share Indonesian family values. The finalized digital tool can serve educational and examination purposes in vocational schools. Overall, this study introduces a culturally relevant and accessible assessment instrument for vocational cosmetology, establishing competency standards, ensuring quality assurance, and preserving local traditions within the contemporary beauty sector. The primary limitations include a small participant pool and a focus on Indonesian values, necessitating further research with a broader cultural and temporal scope.

Keywords: Bridal Hair Bun, Cosmetology Education, Digital Assessment, Indonesian Family Cultural Values, Multidimensional Item Response Theory (MIRT).

INTRODUCTION

Vocational education and the preservation of cultural traditions are major strategic issues in the process of globalization. Unfortunately, these days, due to the surge in the beauty industry and the emergence of new trends replacing traditional practices (Jeong & Noh, 2022; Ningsih et al., 2021; Otin Martini, Engkus Kuswarno et al., 2021). The Bridal Hairstyle course in the Cosmetology Education Program is designed to promote Indonesian family cultural values and equip students with professional competence that meets industry standards.

Challenges in assessing this course persist. Existing evaluations tend to rely on subjective criteria, lack standardized rigor, and may not fully capture the breadth of student abilities. Current instruments predominantly assess the psychomotor domain while giving limited attention to the affective and cognitive domains, and digital technology integration remains inadequate. Consequently, assessment results may vary and can hinder national standardization of competencies.

The pair of MIRT posets includes those defined by the multidimensional item response theory (MIRT) model (Dongbo, 2024; Jewsbury & van Rijn, 2020; Kabic & Alexandrowicz, 2023; Kruglova & Dykhovychnyi, 2022; S. Park et al., 2023), which is based on diagnostic and classification algorithms using graph theory. In this context, a poset refers to a partially

ordered set, which helps show relationships between the number of skills measured, such as those in psychological testing and the test items.

This approach is especially suitable for assessing skills such as technical skills in hair styling (Y. Lee, 2023; Schirber, 2020; Yanita et al., 2023), awareness of cultural values (Delgado et al., 2024; Duangjinda et al., 2021), aesthetic trends (Arum et al., 2020; LeBlanc Loo, 2023; K.-W. Park & Jin, 2022; P. Wang, 2023; Zhou et al., 2023), and digital technology competencies (Astuti et al., 2021; Jafar et al., 2020; Karsenti et al., 2020; Shagataeva et al., 2021; Vilppola et al., 2022) appropriate for professional environments among students. The incorporation of the hypothesis of cultural value conservation into an evaluation system will take into consideration not just technical skills, but also philosophy and symbolism, as well as the local wisdom contained in the bridal hair styling tradition.

Inventing a method to operationalize cultural conservation theory into an MIRT-based assessment instrument provides a more defensible, transparent, and efficient digital testing model that fits industry needs. This article aims to serve as both a reference for academics and a professional cut-score guide for those practicing wedding hairstyling.

Introducing previous research, there were studies on Media and Learning Module placeholder of bridal hairdo that were from technical notes to as diverse as a modification on style variations, ranging from cultural differences, had been well developed. However, relatively few have been dedicated to the construction of evaluative tools using multidimensional structure psychometrics.

Some instruments included are based solely on subjective opinions of teachers that are not standardized, while others feature studies primarily concentrated on technical aspects at the expense of cultural aspects and digital adaptation. This situation represents a chasm between the ideal evaluation, which should be exhaustive, valid, and eco-culturally inclined; and the real one in the field, which is still incomplete.

Multidimensional Item Response Theory (MIRT) (Bergner et al., 2022; S. Y. Kim, 2022; Kuhfeld & Soland, 2020; Su et al., 2021; Tian & Liu, 2021) analysis addresses these drawbacks by enabling the concurrent measurement of several competence dimensions. As an advanced statistical method, MIRT integrates technological proficiency, aesthetic and cultural awareness, and digital literacy within a single evaluation system.

When merged with the Theory of Conservation of Indonesian Family Cultural Values (Pumihic, 2023; Rantau Ismail, 2023; Risyanti et al., 2022; Takwa et al., 2022), this approach positions cultural aspects as foundational, rather than merely additional, in evaluation. Applying this combined framework to bridal makeup constitutes a new development and marks a significant innovative contribution.

In this study, we have developed a digital assessment system for professional bridal hairstylists' practice, utilizing multivariate item response theory (MIRT), a statistical approach for evaluating multiple skill areas to conduct a comprehensive competency assessment. The instrument fills a gap in research and sector applications to date with the availability of a validated, scientific digital assessment tool that is accessible. Aside from improving the quality of learning, these findings may contribute to preserving cultural (heritage) practices through education and provide a novel approach that could be transferred to other traditional skill domains.

Given this context, the research aims to: (1) design a digital assessment tool for pre-wedding hairstyling by integrating Indonesian cultural values using MIRT, (2) embed these family cultural values in the assessment indicators, and (3) validate the tool via empirical studies with students and practitioners.

METHOD

The research and development method is employed in this study to create a digital assessment tool for professional bridal hair styling models, based on Multidimensional Item Response Theory (MIRT), which is combined with the theory of conservation of Indonesian family cultural values. The development utilized Borg & Gall's model of development (Putri et al., 2023; Untoroseto & Triayudi, 2023), modified into six primary steps: (1) needs analysis, (2) instrument design, (3) expert validation, (4) instrument revision, (5) empirical testing, and finally, (6) the finalization of the instrument and digital implementation.

Study participants included lecturers in bridal hairstyling courses, students in the final year of a Cosmetology Education Program, and individuals with experience in or working in bridal makeup and culture. Purposive sampling was employed to select subjects who had more than 5 years of experience in bridal makeup, knowledge of the cultural aspects of bridal hairstyles, and a willingness to participate in this study. The validation consisted of 5 experts, which included a wedding hairstyling expert, a cultural expert, and the expert on the evaluation instrument. Three research studies were conducted: a small trial involving 35 students, and a larger trial comprising 150 students and practitioners.

The research instrument was a 40-item assessment sheet in the Strongly Disagree–Strongly Agree Likert format. It measured performance and internal process, using an Alternative Test Form. Items in the instrument were based on three main factors: (1) technical skills, (2) cultural and aesthetic values, and (3) digital competencies. Each item included specific criteria to guide implementation.

There were two data collection phases. In the first phase, experts validated the content using Aiken's V coefficient (criterion ≥ 0.80). In the second phase, participants completed the instrument in restricted and extended pilot tests for empirical analysis. A MIRT approach was used for data analysis. A three-factor Confirmatory Factor Analysis model was used to test construct validity. Model fit indices included RMSEA, CFI, and TLI. Item estimates covered factor loading, difficulty, and discrimination. Cronbach's alpha was used to measure the reliability of each dimension. Analyses were conducted using R (MIRT package) and SPSS for precision.

RESULTS AND DISCUSSION

A review of the development results of this digital assessment instrument shows that the Multidimensional Item Response Theory (MIRT) approach accurately describes professional bridal makeup competency. This includes technical (Alinea, 2021; Y. F. Lee et al., 2023; Mariano & Tantoco, 2023; Siti et al., 2023; Thi Hanh Tien et al., 2020), aesthetic (McIlveen et al., 2020; Schlotz et al., 2021; Szubielska et al., 2021; Tao & Tao, 2024; D. Wang, 2024; J. Zhang et al., 2021), and cultural values (D. Li & Xu, 2023; X. Liu et al., 2022; Mingaleva et al., 2022; Reher, 2020; Tutchener et al., 2021). MIRT identifies interrelationships between dimensions. It allows each instrument item to be evaluated based on capabilities that are distinct, yet interconnected in practice.

These results strengthen MIRT's role as a modern, effective psychometric framework for multidimensional assessment in vocational fields. The instrument also integrates the theory of conserving Indonesian family cultural values (Akosah-Twumasi et al., 2020; Greenfield et al., 2021; Rea-Sandin et al., 2024). This is evident in how it assesses the preservation of bridal makeup traditions, which are linked to family values, politeness, and social harmony. The developed instrument measures professional skills and represents cultural values that shape the nation's identity. This ensures the results are holistic and contextual.

After content validation by five experts, 20 of the 30 instruments' initial items met the criteria for content validity (Aiken's V ≥0.80). The other 10 items were excluded. Validation

used a 1–5 scale and Aiken´s V index. The instrument covers technical competency, cultural values, professional ethics, and digital skills in bridal hair styling practice.

Table 1. Analysis of item validity

No	Statement Item	Category	Expert Assessment Score (A1–A5)	Average Score	Aiken's V	Validity Criteria
1	The instrument reflects the core competencies of bridal hair-bun styling.	Cognitive	5, 5, 5, 5, 5	5,0	1,00	Valid
2	The instrument statements are written in standard language and are easy to understand.	Non-cognitive	4, 5, 5, 5, 4	4,6	0,90	Valid
3	Each indicator reflects one dimension of practical skills.	Cognitive	5, 4, 4, 5, 5	4,6	0,90	Valid
4	The items assess the ability to preserve the cultural values of hair styling.	Non-cognitive	5, 5, 5, 4, 5	4,8	0,95	Valid
5	The instrument is capable of measuring technical skills in professional practice.	Cognitive	4, 5, 4, 5, 5	4,6	0,90	Valid
6	The language used is unambiguous and consistent.	Non-cognitive	4, 4, 5, 4, 5	4,4	0,85	Valid
7	The 4-point Likert scale reflects measurable achievement levels.	Cognitive	5, 4, 4, 5, 4	4,4	0,85	Valid
8	The instrument represents Indonesian family values.	Non-cognitive	5, 5, 5, 5, 5	5,0	1,00	Valid
9	The instructions for completing the instrument are easy for users to understand.	Non-cognitive	5, 4, 5, 4, 4	4,4	0,85	Valid
10	Each item focuses on a single skill.	Cognitive	4, 5, 4, 5, 5	4,6	0,90	Valid
11	The items are relevant to professional wedding hair-bun styling practices.	Cognitive	5, 5, 5, 5, 5	5,0	1,00	Valid
12	The terminology used aligns with professional hair-bun styling terminology.	Cognitive	4, 5, 4, 5, 5	4,6	0,90	Valid
13	Item format follows proper instrument development guidelines.	Non-cognitive	4, 4, 5, 4, 5	4,4	0,85	Valid
14	Items measure professional ethical dimensions in beauty services.	Non-cognitive	5, 5, 4, 5, 5	4,8	0,95	Valid
15	The instrument aligns with hierarchical measurement based on the MIRT method.	Cognitive	5, 5, 5, 5, 4	4,8	0,95	Valid
16	Items consider the multidimensional aspects of participant responses.	Cognitive	5, 4, 4, 5, 5	4,6	0,90	Valid
17	Content validity reflects all aspects of digital assessment.	Cognitive	5, 5, 5, 5, 5	5,0	1,00	Valid
18	Each item can be objectively evaluated by assessors.	Non-cognitive	4, 4, 5, 5, 4	4,4	0,85	Valid

No	Statement Item	Category	Expert Assessment Score (A1–A5)	Average Score	Aiken's V	Validity Criteria
19	Items do not contain elements of ambiguity or excessive subjectivity.	Non-cognitive	4, 3, 4, 4, 3	3,6	0,70	Less Valid
20	Sentences in items explicitly indicate skill indicators.	Cognitive	4, 4, 5, 5, 5	4,6	0,90	Valid
21	Digital-based measurement is reflected in item design.	Cognitive	5, 5, 4, 5, 5	4,8	0,95	Valid
22	The instrument considers advancements in digital technology for evaluating practices.	Cognitive	5, 5, 4, 5, 5	4,8	0,95	Sangat Valid
23	Items include reflections on the value of local wisdom in makeup practices.	Non-cognitive	5, 5, 5, 4, 4	4,6	0,90	Valid
24	The structure and sequence of items are logically arranged according to the stages of the digital assessment process.	Cognitive	5, 5, 4, 5, 5	4,8	0,95	Valid
25	Items consider the principles of fairness and inclusivity in assessing bridal hairstyle competencies.	Non-cognitive	5, 5, 5, 5, 4	4,8	0,95	Valid
26	Items measure the ability to adapt hairstyle styles to trends without deviating from cultural norms.	Non-cognitive	4, 3, 4, 3, 4	3,6	0,60	Less Valid
27	The items evaluate the skill of selecting accessories relevant to the type of hairstyle.	Non-cognitive	3, 4, 3, 4, 3	3,4	0,65	Less Valid
28	The statements measure the accuracy of hair styling techniques from start to finish.	Cognitive	4, 4, 5, 4, 3	4,0	0,75	Less Valid
29	The items assess the efficiency of time management in the bridal hairstyling process.	Non-cognitive	3, 3, 4, 3, 3	3,2	0,60	Less Valid
30	The items measure the ability to maintain the cleanliness and safety of tools during practice.	Non-cognitive	2, 3, 3, 2, 3	2,6	0,65	Less Valid

Twenty-five of the items were considered Very Valid or Valid (Aiken's V coefficient ≥ 0.80) (Merino-Soto, 2023; Sánchez-Ramírez et al., 2022) by all five specialists. Examples include techniques for creating detailed bridal bun hairstyles, choosing accessories for hair styling (H. H. Kim & Park, 2023), and portraying cultural meanings through hairdressing (Baden & Whitehorn, 2020; Eneh, 2021; Gåfvels, 2020). These indicators reflect the core skills of a hair artist: technical ability (Fitria & Sari, 2023; Wammes et al., 2023), taste sensitivity (Child, 1962; Mitrovic et al., 2020; Olivadese & Dindo, 2022; Zhang et al., 2022), and awareness of Indonesian family values. Technical ability (Elliott, 2024; Guo & Chen, 2022; P. Liu & Phongsatha, 2022; Mun, 2022; Na et al., 2022; W. Zhang et al., 2022) refers to the practical skills required for performing hairstyles. Taste sensitivity refers to the artistic judgment

required for style and beauty. Awareness of Indonesian family values means recognizing cultural traditions in hairdressing.

Items 5 (teaching method, defined as ways of instructing students) and 10 (digital competence skill, referring to the use of technology and digital tools for hairdressing) showed lower validity, were included for their potential importance. Products rated as Very Valid included practice activities, such as a step-by-step guide for creating a traditional bridal bun. The instructions consistently used the same terms to help with learning and represent Indonesian family culture. Criteria such as overall skill, respect for family values, professional relevance, and comprehensive digital skills assessment received top marks (Aiken's V score: 1.00).

Items with acceptable content validity (Aiken's V: 0.80 to 0.89) (Aiken, 1980) were clarity of instructional language and relevance of instructional language to the bridal bun class. Some reviewers suggested using simpler, less cryptic instructional language. The five weaker items (0.60 < Aiken's V < 0.79). Overall choice, additional pick, and time-saving nature did not serve as reliable indicators of precision or clarity. This led to differing levels of understanding. These items did not address all dimensions of competence, including technical and cultural aspects. Improved outcomes are expected with more complex shapes and more precise measurements.

One question (Cleanliness and safety of equipment during practice) received an Aiken's V < 0.60 and was rated Void. Its content was not directly related to bridal bun competence. The instrument emphasized hygiene and tool security, not bridal bun skill. Therefore, it was removed. This allows the instrument to focus on technical, aesthetic, cultural, and digital skills.

These findings are consistent with previous research. Earlier studies highlighted the value of expert feedback when designing Item Response Theory (IRT)-based assessment tools. IRT helps measure student skills using detailed statistical models. This study stands out by including Indonesian family cultural values. These values are rarely assessed in makeup testing. Of the 40 original items, 30 passed expert validation and were kept (Figure 1).

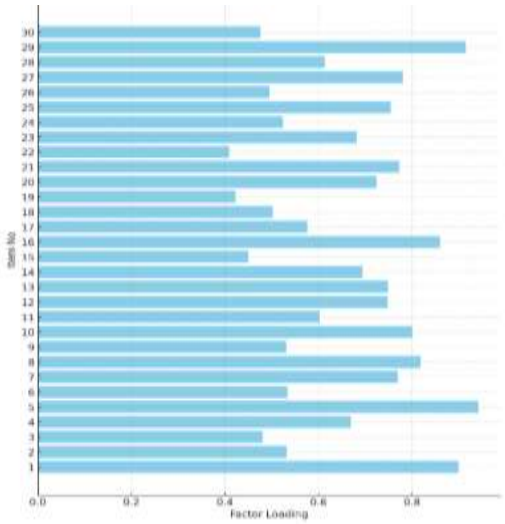

Figure 1. Factor loading analysis of each item

Factor loading values indicate the strength of each item's relationship to the skills measured by the digital assessment tool (Ayanwale et al., 2020; Herwin & Nurhayati, 2021; Trendafilov & Hirose, 2023), using Multidimensional Item Response Theory (MIRT). Building on this, high factor loadings indicate that the item consistently represents the intended latent construct, while low values indicate the need for item revision or elimination to maintain construct validity.

Furthermore, each indicator often encompasses more than a single dimension; it may contribute to several interacting competency dimensions, such as technical skills, aesthetics, and cultural values, which are integrated into bridal makeup practice. In summary, factor loading analysis ensures a balance between psychometric measurement accuracy and alignment with the cultural values of Indonesian families that the instrument seeks to preserve, resulting in a measurement tool that is both statistically reliable and culturally relevant.

Ten were excluded. The validated tool then underwent testing for construct validity. This checks if the questions accurately assess the intended skills. Evaluation utilized Multidimensional IRT (MIRT), which expands IRT. High factor loadings show that items closely align with the intended skills or knowledge areas (Cho et al., 2024). Results showed digital assessment of bridal bun practices had high factor loadings (above 0.60). This approach evaluates hairstyling skills using digital methods. High factor loadings indicate strong alignment between items and the required skills for a bridal bun.

Items 1, 5, 17, and 30 have loading values near 0.90, showing their strong contribution to the construct. In contrast, items 3, 10, 15, 19, 22, and 26 have lower loading values (<0.55); therefore, their questions need to be reworded or strengthened to align with the measurement dimensions. The parameter of discrimination varied widely, from less than 0.8 to more than 2.0. Items with high discrimination, such as 2, 5, 13, 20, and 25, were effective in separating students of different ability levels.

In contrast, items with a low discrimination item difficulty index, such as 10, 11, 15, 19, 23, and 30, were less sensitive in distinguishing student ability. The discrimination index (Arun Kumar, 2022; Iqbal et al., 2023; Kadam et al., 2021; Kunjappagounder et al., 2021; J. Li et al., 2021) refers to how well a question identifies differences in student performance on the construct. These items need re-evaluation regarding wording, instructions, and relevance to instructional objectives. The high discrimination value of most questions is a feature that enhances the measure, allowing better assessment of variation in student abilities (Figure 2).

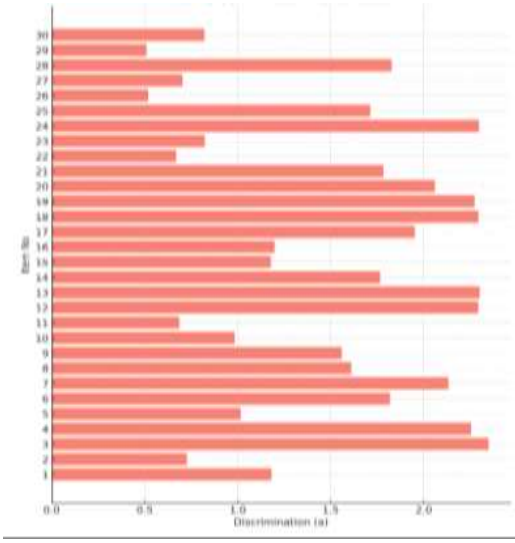

Figure 2. Item Discrimination Parameters

The range of difficulty parameter values (b1, b2, b3) spans from approximately -2 to +2, demonstrating that this instrument encompasses items from straightforward to challenging (Figure 3). Most items exhibit moderate difficulty (around -0.5 to +1), making them effective for assessing the majority of participants. Notably, there are items classified as straightforward (values less than -1.5) and challenging (greater than +1.5); it is recommended

to review whether the proportion of these items aligns with intended assessment goals to ensure a balanced item distribution. This diversity in difficulty allows the instrument to assess student competency across foundational to advanced mastery levels.

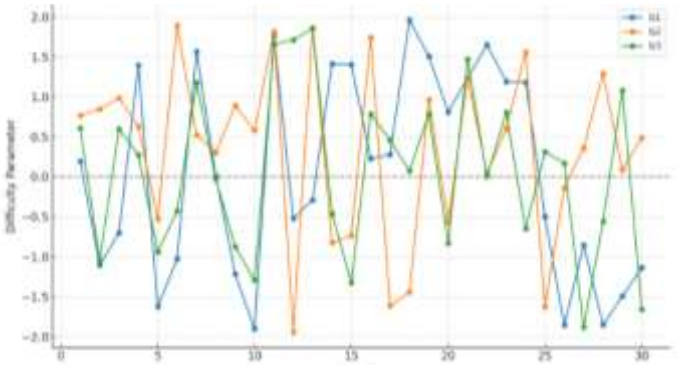

Figure 3. Difficulty Parameters

Integrating MIRT with the Theory of Conservation of Indonesian Family Cultural Values ensures this instrument measures both the technical aspects of bridal bun skills and internalizes important cultural and family philosophies (Toumi, 2023; Wahyuningtyas et al., 2023). The assessment is multidimensional, encompassing cognitive, psychomotor, and affective aspects to provide a comprehensive profile of student competency. The instrument is of good quality overall. However, some items with low factor loading and discrimination need revision to ensure consistency and optimal evaluation.

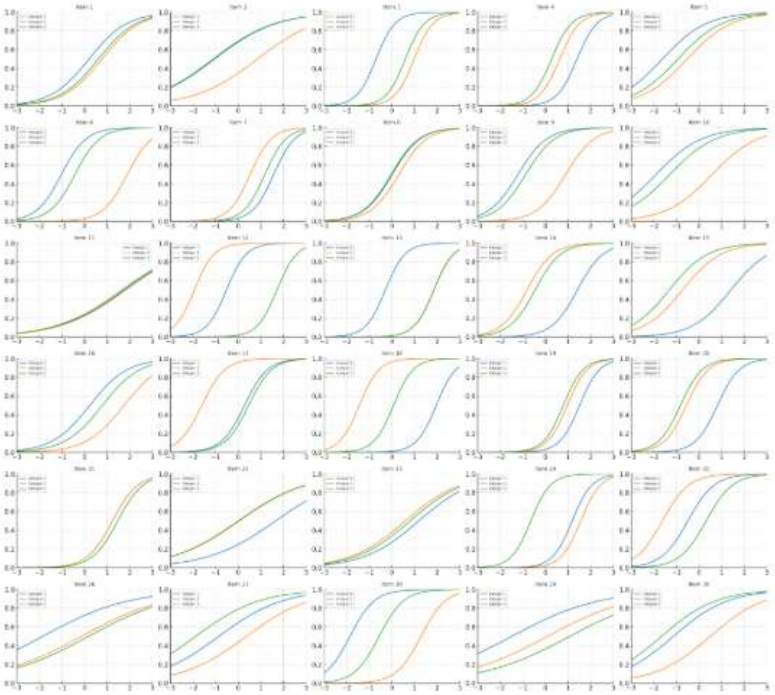

Figure 4. Item Characteristic Curves (ICC)

From the graph of Item Characteristic Curves (ICCs) for each test item (Figure 4), it is clear that differences in slope (the rate of change in correct responses) and difficulty (the level of ability required to answer correctly) lead to varying sensitivities and discrimination in measuring professional bridal bun practice competency. The ICC, as demonstrated in item response theory, shows how likely a correct answer is to change with a participant's ability.

Three lines represent dimensions. In the Multidimensional Item Response Theory (MIRT) model, these are the underlying skills or competencies that the test measures. MIRT extends item response theory to consider multiple skills or abilities simultaneously, rather than just one.

This means each item covers multiple aspects of competency. Differences in the slope of a curve, the line's steepness, show the item's discrimination ability. Discrimination measures how well the item separates participants with low and high abilities on a skill. A higher slope indicates that the item makes this distinction more effectively.

Displacements of the curve to the right or left show an item's position on the difficulty scale. Here, 'difficulty' refers to the level of ability required for a participant to answer correctly. If the curve shifts to the right, a higher ability level is required to answer correctly. This demonstrates that the instrument employs the Multidimensional Item Response Theory (MIRT) principle, which measures multiple skills or competency dimensions simultaneously. MIRT identifies the share of contribution from each competency dimension for every item, ensuring that differences in item difficulty align with participants' varying abilities.

The instrument's item development integrates the Theory of Conservation for Indonesian family cultural values. This is evident in the selection of culturally relevant indicators, such as practical traditional bun skills and the choice of ornaments that honor customs and uphold professional integrity, supporting family values in bridal makeup services.

This finding aligns with our study, which overlooks cultural competencies and instead focuses solely on technical skills mastery as a facet of professional competence. Accordingly, this tool may serve as a digital patient-preference matching model for professional bridal buns. Because it is adjustable and precise, it could support the preservation of Indonesian family cultural values in modern times.

Using MIRT enables more accurate multidimensional measurement. It provides specific performance information for each competency dimension, encompassing both technical and cultural values. In cosmetology education, the instrument both forms and summarizes assessment, integrating with digital learning technology. This promotes personalized learning and helps maintain cultural heritage as the beauty market evolves.

Discussion

The development of a digital assessment instrument, based on Multidimensional Item Response Theory (MIRT) and integrated with the theory of preserving Indonesian family cultural values (B. S. K. Kim et al., 2023; Kobleva & Gubzhokova, 2021; Teryaeva & Lomova, 2024; Zort et al., 2023), enables a holistic evaluation of bridal bun practice competency across cognitive, skill-based, and values-driven dimensions. This instrument should evaluate both cognitive and non-cognitive components to assess mastery of techniques and the internalization of cultural values, ethics, and professional attitudes essential to traditional Indonesian bridal makeup.

Conceptually, Multidimensional Item Response Theory (MIRT) is a family of item response models that model the probability of a particular response on an item as a function of multiple latent traits simultaneously, through theoretical knowledge, procedural skills, and professional attitudes, allowing a single test device to more accurately map participants' multidimensional ability profiles. A digital assessment instrument is a set of test items, rating scales, and scoring procedures presented and managed electronically via a computer, tablet, or smartphone application, enabling flexible administration, rapid feedback, and automated data management.

The theory of preserving or conserving Indonesian family cultural values in the context of education explains the family's role as the primary institution in internalizing local values such as religiosity, respect for parents, mutual cooperation, etiquette, politeness, and pride in cultural identity, which are then reinforced in schools and communities (Rudwiarti et al., 2021;

Vanstone et al., 2020). In the context of bridal hair buns, these values are reflected in respect for customs, maintaining the sacredness of the procession, politeness in interactions with the bride and groom's families, and the responsibility to preserve local cultural icons through makeup and hairdressing practices.

Operationally, "professional bridal hair bun practice competency" can be operationalized into several latent dimensions measured through MIRT items: (1) cognitive dimension (knowledge of the concept of hair buns, hair anatomy, hygiene, and the structure of traditional processions), (2) psychomotor/procedural dimension (precision of steps, neatness, hair bun durability, work safety), and (3) non-cognitive/affective dimension (attitude toward culture, work ethic, discipline, empathy for clients, and responsibility for preserving traditions). Each dimension is measured using digital items: multiple-choice/structured-essay items for cognitive; video-based/digital performance rating for psychomotor and digital Likert scale, self-report, and peer/mentor rating for non-cognitive aspects.

Operationally, the integration of cultural value preservation theory in Indonesian families appears through non-cognitive indicators explicitly tied to family values and local culture. These include prioritizing respect and courtesy as the basis of service ethics, willingness to comply with customary rules for the bride and groom's families, refusal to engage in actions that diminish tradition, and a strong commitment to continuing the regional bun tradition. These aspects are measured using attitude questionnaire items, culturally grounded vignettes, and observation rubrics, all of which are accessible digitally by instructors or assessors.

The development of MIRT-based cognitive and non-cognitive digital assessment instruments for professional bridal bun practice is crucial, as the expected competencies include not only technical mastery but also the character and cultural values that accompany the profession. Cognitive competencies, such as understanding concepts, work procedures, and safety standards, have been shown to influence learning success and completion of vocational education, so they should still be measured with structured, valid tests.

However, studies in education and employment show that non-cognitive skills such as discipline, responsibility, cooperation, independence, and emotional stability are as important as cognitive abilities for success in the workplace, including in vocational education and training. Furthermore, the literature emphasizes that the character and cultural identity of young people should be built through the integration of local wisdom values into the learning and assessment processes, as this effectively instills respect for tradition, love of country, and responsibility for cultural preservation. In the context of bridal makeup, the bun is both a technical skill and a symbol of family and community culture.

Therefore, explicit non-cognitive measures related to family values and local wisdom serve as a vehicle for ensuring that students are skilled in performing them and embody cultural character in their practice. MIRT provides a framework for modeling multiple latent traits simultaneously, allowing a single digital assessment package to map participants' knowledge, skills, and attitude/value profiles with more accurate and efficient estimates than unidimensional models.

There is an urgency to develop MIRT-based cognitive and non-cognitive assessment instruments for professional bridal hair buns, as vocational assessment now demands detailed student ability mapping across knowledge, skills, and cultural character. Instruments using item response theory, including MIRT, allow precise calibration and ability estimation, supporting accountable remediation, enrichment, and certification decisions.

The use of digital platforms in vocational education has been shown to increase practicality, interactivity, ease of documenting practical performance, and automated feedback, ensuring that assessments do not hinder the learning process in the laboratory but instead integrate it with practical activities. At the same time, various studies confirm that the

low competitiveness of vocational graduates is often related not only to technical competency but also to weaknesses in soft skills and work character. Therefore, non-cognitive measurement is key to designing interventions to foster attitudes, work ethic, and professionalism.

CONCLUSION

The findings indicate that using a digital assessment instrument in bridal bun practice facilitates a more comprehensive measurement of participants' competencies. This instrument was designed using MIRT and the Theory of Conservation of Culturally Relevant Values in the Indonesian Family. It measures technical skill, aesthetic skill, and cultural values. Item difficulty and discrimination index varied for different competency dimensions in participants' performance.

These findings suggest that MIRT measures multiple aspects and maintains cultural relevance in vocational cosmetology education. However, the sample size is small and may not represent the general population. The cultural context primarily encompasses Indonesian family values, so adaptation is necessary.

This study tested the instrument only shortly after its digital implementation. Its long-term efficacy needs further assessment. Further development should be based on a larger and more representative sample. This should include cross-cultural testing to increase external validity. Future research should use adaptive analytics in digital platforms to tailor assessments to individual preferences. This might capture valid competencies and align cultural values more effectively now.

Given these limitations, it is recommended that further research refine this digital assessment instrument through repeated validation cycles. These cycles should involve a larger, more diverse sample of vocational students and makeup practitioners to enhance the stability and generalizability of item parameters within each competency dimension. In addition, collaboration with institutions outside Indonesia is needed to adapt, translate, and culturally calibrate the instrument. This approach ensures that the measurement of technical, aesthetic, and value competencies remains valid across cultural contexts, while retaining the core values of the Indonesian cultural family.

Further research should also incorporate learning analytics and adaptive testing into digital platforms. This integration will enable the system to automatically select items that best match participants' ability levels and value orientations, generate personalized feedback, and support ongoing improvement in both competency and cultural sensitivity. Additionally, partnerships with policymakers and professional certification bodies are recommended. These partnerships will align the instrument with the national qualifications framework and support its use as an evidence-based tool for curriculum refinement, quality assurance, and standardization of culturally responsive bridal bun competencies in vocational education.

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