



Tattwa-SPR: A Culturally Responsive Digital Formative Assessment Framework for Vocational Education

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Abstract

Vocational education continues to face challenges in connecting applied mathematics with workplace competencies while systematically incorporating local cultural values into authentic assessment. Although digital assessment has advanced formative feedback practices, few studies have developed culturally responsive assessment systems that simultaneously integrate vocational competencies, mathematical reasoning, and indigenous values within a unified assessment framework. This study developed and validated Tattwa-SPR, a culturally responsive digital assessment framework that integrates applied mathematics, food and beverage (F&B) competencies, and Balinese Tattwa values through a Single-Point Rubric to support formative assessment in vocational education. Employing the Borg and Gall research and development framework, the study involved needs analysis, collaborative prototype design, expert validation, and limited classroom implementation in a vocational high school in Denpasar, Bali, Indonesia. Data were collected through interviews, focus group discussions, expert validation, classroom observations, and user practicality questionnaires. The findings demonstrate that the framework achieved high content validity and practical usability while enabling the systematic translation of abstract cultural values into observable assessment indicators. The digital platform also streamlined teacher feedback through automated reporting and encouraged students to engage independently with personalized performance dashboards, promoting greater self-regulation during learning. This study extends the literature on culturally responsive assessment by demonstrating how indigenous values, vocational competencies, and applied mathematics can be integrated within a digital formative assessment framework. The proposed model offers a transferable approach for designing authentic digital assessment systems that strengthen feedback quality, learner autonomy, and culturally responsive vocational education across diverse educational contexts.

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INTRODUCTION

Vocational hospitality education suffers from a disconnect between the teaching of mathematics and its application in Food and Beverage (F&B) operations (Bakker, 2014; Edo & Tasik, 2019). Students learn mathematics, such as calculating percentages, ratios, and simple calculations, but they cannot apply these skills in workplace activities, such as calculating food prices, adjusting recipe amounts, and preparing correct invoices (Ferm, 2021; Sugiharni & Amir, 2025). Maths and F&B Practicals to be marked separately. They have nothing to do with each other. Kurniawan et al. (2023)

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showed that enriching teaching materials with ethnomathematics can enhance students' creative thinking. Still, their study remained limited to instructional materials and did not extend to an integrated assessment system.

There are real disadvantages to this sort of disconnect. Hospitality graduates lacking good quantitative skills in basic food and beverage operations are likely to make operational errors, miscalculate finances, and lead employers to lose trust in the output of vocational programs (Alihodžić et al., 2024). As stated by the experts from the industry, employees just starting their careers tend to commit errors while billing customers based on calculations involving proportions or cost estimations. So, a lack of a built-in maths assessment really hurts graduates' work readiness and undermines the industry's faith in vocational education.

There is widespread agreement that an authentic approach to assessment is a key part of vocational education as it reflects industry requirements (Dabkowski et al., 2026). Authentic assessment is the assessment that measures students' ability to use knowledge and skills in meaningful, real-world contexts (Khadka et al., 2025). Authentic assessment in mathematics education is more than testing for computational ability; it involves reasoning, problem-solving, and performance in mathematically relevant contexts (Tan et al., 2024). Some vocational schools have used analytic or holistic rubrics to evaluate practical F&B skills. Patonah et al. (2025) emphasized that the practicality of STEAM SDGs-based learning is key to vocational student success, which aligns with the need for authentic assessment in the present study.

However, the present methods of assessment have serious shortcomings. Analytic rubrics break down performance into specific criteria, but they may not fully capture the diverse and context-dependent ways in which students demonstrate character-based values, such as honesty or cleanliness (Fuentes & Sánchez-Pérez, 2024; Humphry & Heldsinger, 2014). Holistic rubrics provide an overall score, but do not provide diagnostic feedback on specific gaps in applied mathematics or F&B procedures. Neither format allows teachers to record personalized comments on both areas for improvement and on evidence of exceeding expectations within a single, coherent framework. Furthermore, most existing assessments do not take local cultural values into account.

An SPR differs from analytic or holistic rubrics in that it has one column for the success criteria and two open spaces beside it, one for areas for improvement and the other for evidence of exceeding expectations (González, 2025; Baihaqi & Arimurti, 2025; Suryati et al., 2025). Because it is open-ended, it can easily incorporate cultural values. It allows teachers to give feedback that is contextualized and individualized to character-based behaviours, rather than constrained by rigid checklists. The digital implementation of SPR can also automate feedback collection and provide students with instant performance dashboards, thereby increasing efficiency and self-regulation. Research shows that SPRs help provide constructive feedback, encourage self-regulated learning, and allow space for student creativity (St. Jean et al., 2023; Wertheim et al., 2025). Nevertheless, the use of technology-based assessments that incorporate culturally specific features, such as the Balinese hospitality context, has not been examined.

To date, no study has developed and validated a digital assessment system that simultaneously integrates (a) applied mathematics in food and beverage contexts, (b) industry-based vocational competencies, and (c) measurable character indicators derived from Tattwa values. Although previous studies have incorporated *Tri Kaya Parisudha* into character education or blended learning environments (Adiarta et al., 2024; Ariawan et al., 2021; Divayana et al., 2022; Hartawan et al., 2025; Suyasa et al., 2024; Wiradnyana et al., 2024), these efforts have not been extended to competency-based vocational assessment. Likewise, existing digital rubric systems have not integrated mathematics, food and beverage skills, and cultural values within a Single Point Rubric framework.

This study makes three novel contributions that are not reported in the existing literature. First, it operationalizes the abstract Tattwa philosophical values (*Tri Kaya Parisudha*, *Satyam*, *Siwam*, *Sundaram*) into measurable behavioural indicators for vocational assessment. Second, it combines applied mathematics, F&B vocational skills, and cultural values into one digital system based on SPR. Third, it offers empirical evidence from expert validation and a small-scale trial in the classroom showing content validity and practicality. This integration of the “technobrain” (technical skills) and the “technosocial” (culturally responsive assessment) is a new didactic model for vocational mathematics education.

The objective of this study is to develop and validate a prototype digital assessment system using the Single Point Rubric that combines applied mathematics, F&B competencies, and Tattwa values for vocational high schools in Bali. The theoretical contribution demonstrates that abstract cultural values can be systematically translated into measurable indicators within a competency-based assessment framework. The main practical contribution provided by this research is a replicable digital tool designed to improve the effectiveness of teacher feedback as well as foster student self-regulation, applicable to other cultural settings as well (Ubuntu in Africa, Aloha in Hawaii).

METHOD

In this research work, the Research and Development (R&D) approach was employed owing to the Borg and Gall model, which is used in developing products through stages that require evidence. Thus, R&D is the most appropriate method that should be used in developing an assessment instrument. Given the developmental nature of this research and its Technology Readiness Level (TRL) target of 3 (proof of concept), this study was limited to the first four of Borg & Gall's ten stages: (1) preliminary needs assessment, (2) prototype design, (3) expert validation, and (4) limited trial and evaluation. Figure 1 illustrates the research and development procedure followed to produce this prototype.

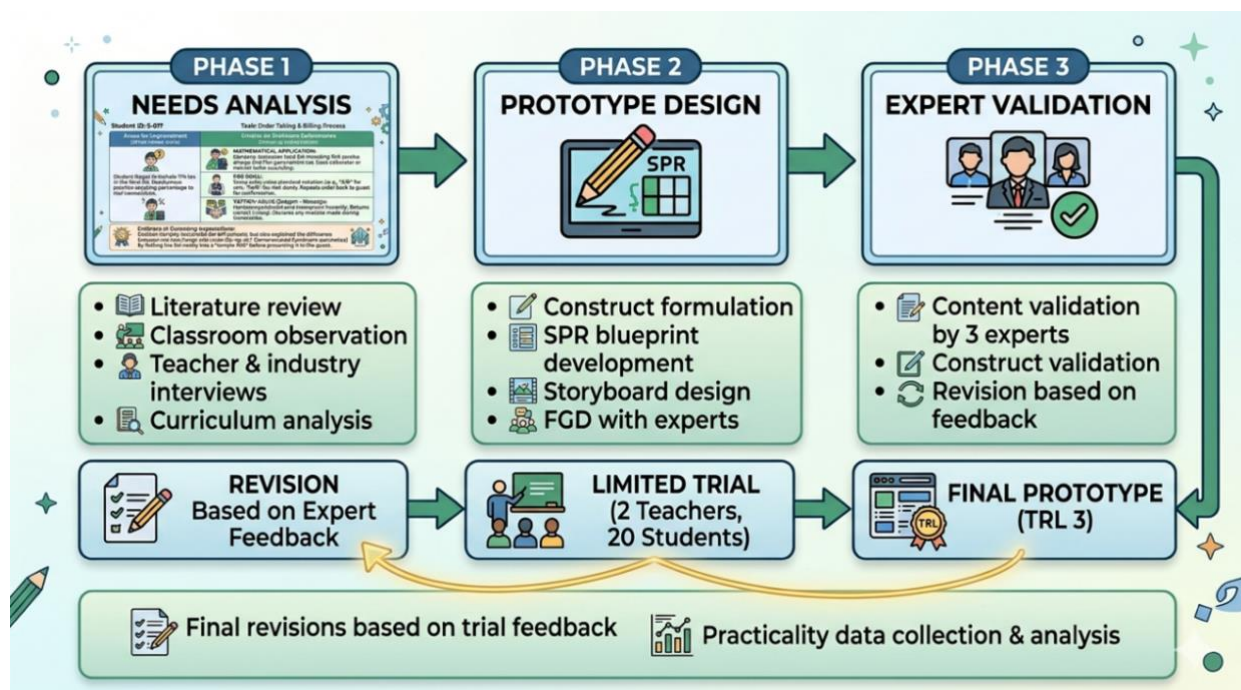


Figure 1. Research and Development Procedure Adapted from the Borg & Gall Model, Showing the Four Main Phases from Needs Analysis to Final Prototype.

Initial Research and Needs Assessment (Phase 1)

This phase employed a mixed-methods data collection approach. A purposive sampling approach was used to determine the participants, based on relevant expertise: two vocational teachers (minimum 3 years of teaching experience in F&B), two mathematics teachers (minimum 3 years of teaching experience) and two industry professionals (minimum 5 years of managerial experience in Bali hotels). The activities in this stage consisted of four, namely (a) A thorough literature review on authentic assessment, SPR, applied mathematics in F&B, and Tattwa values; (b) Non-participant observations in two F&B practical lessons to record the existing assessment practices; (c) Semi-structured interviews (45-60 minutes per interview) to explore the perception on the need for integrated assessment; and (d) Document analysis of the vocational high school curriculum and F&B competency standards. The data gathered through interviews and observations underwent a thematic analysis (Braun & Clarke, 2021; Godby et al., 2026; Tant et al., 2026; Venkatachalam et al., 2026; Weng Lee et al., 2026; Xiong et al., 2026) to identify recurrent themes of

assessment gaps. The procedure for the limited practicality trial followed the method used by Patonah et al. (2025) to assess teacher and student acceptance of a vocational learning model. Curriculum documents were analysed using content analysis to map existing mathematics topics onto F&B tasks. The synthesised findings from these three data sources (observations, interviews, document analysis) were then triangulated to generate a list of required instrument specifications, which informed the conceptual map for the integrated assessment prototype.

Designing the Prototype (Phase 2)

The prototype was built incrementally by collaborators and through iterative refinement. The core design team was made up of two mathematics teachers (>3 years experience in hospitality programs), one expert in Hindu philosophy with specialisation in Tattwa values, and one senior F&B industry professional (>5 years managerial experience in Bali hotels). The team developed the assessment indicators using a two-pronged approach. The indicator for mathematics and F&B competency is directly proportional to aligning with the vocational high school curriculum and standardizing industry operating procedures (SOPs). Indicators for Tattwa values were extracted from philosophical texts (*Tri Kaya Parisudha*, *Satyam*, *Siwam*, *Sundaram*) and operationalized into observable behaviours, for example, honesty in cash handling as an indicator of *Satyam*, and cleanliness of the workstation as an indicator of *Siwam*.

After developing the indicators, the team drafted a schematic for the Single Point Rubric that mapped each success criterion to one of three domains: applied mathematics, F&B skills, and Tattwa values. Then a technical storyboard was created for the web-based platform. This storyboard included the database structure and layout of the user interface. To identify design weaknesses before expert validation, a focus group discussion (FGD) was conducted with three additional experts who were not part of the design team nor the later validation panel. The FGD session was recorded, transcribed, and analysed thematically. Results of thematic analysis helped clarify any ambiguity in indicator formulation, supplemented two additional indicators that were previously missing (accuracy of portion control and etiquette of friendly greetings), and improved navigation of the platform. At this stage, a complete design of the prototype and a draft of a rubric were completed.

Systematic approaches in phase 2 are described in Table 1, which shows the framework of the indicator determination process, activities undertaken, and intermediate outputs from each step.

Table 1. Systematic Procedures in the Prototype Design Phase (Phase 2)

Step	Procedure	Framework	Output
1	Indicator identification	Curriculum/SOPs (Math & F&B) Philosophical texts (Tattwa)	Indicator list
2	SPR blueprint	Domain alignment (Math, F&B, Tattwa)	Blueprint document
3	Storyboard development	UI design + database design	Technical storyboard
4	Analysis of FGD thematically	Recording → transcription → revision	revision Draft of a revised rubric

Expert Validation (Phase 3)

Experts judged the initial prototype. The organization assembled a panel of three experts: (a) an expert in educational assessment and evaluation; (b) an expert in Hindu philosophy (Tattwa) and character education; and (c) a senior F&B practitioner from the hotel industry. They evaluated the prototype using a validation instrument assessing content relevance, construct alignment, clarity, and comprehensiveness. Quantitative data of expert rating was analyzed with Aiken's V coefficient according to a formula $V = \sum s / [n(c-1)]$, where $s = r - l_0$ (r = expert rating), n = the number of experts, and c = the number of rating categories. The resulting V coefficients range from 0 to 1; the higher the value, the greater the validity. Validity was interpreted as: $V \geq 0.80$ (very high); $0.60 \leq V < 0.80$ (high); $0.40 \leq V < 0.60$ (moderate), and $V < 0.40$ (low) (Aiken, 1985). Open-ended qualitative comments were also collected. The prototype was modified by combining quantitative and qualitative inputs.

Limited Trial and Evaluation (Phase 4)

Participants were selected using purposive sampling. Two teachers (one mathematics teacher and one F&B teacher) were selected based on having at least 3 years of teaching experience in the Hospitality program and willingness to participate in the trial. Twenty 11th-grade students from the Hospitality program were selected based on their enrollment in the F&B practical course and their informed consent to participate. The trial comprised four major evaluation processes. The process started with a 60-minute orientation to the Tattwa-SPR digital performance appraisal system by the teachers. The second major process was the simulation of an actual F&B practical exam for the students that took 90 minutes and included three mathematical exercises, such as computing food costs, calculating taxes and service charges, and adjusting recipe ratios. Thirdly, the teachers independently evaluated each individual student with the help of the SPR-based rubrics in the digital platform and recorded the feedback in the "areas for improvement" and "exceeding expectations" sections. Lastly, the students gained access to the performance dashboard immediately after the trial.

Three instruments were used to test practicality. The teacher practicality questionnaire included six items covering convenience in using the method, the specific nature of feedback given, time taken to assess students, the coverage of aspects of character that used to be difficult to assess, ease of conducting the method using digital platforms, and the intentions of using the method in the future. On the other hand, the student questionnaire involved five questions on understanding of the criteria for assessment, understanding of strengths, weaknesses, and areas for development, and motivation for being assessed on character value. All items were rated on a 5-point Likert scale from strongly disagree to strongly agree.

Quantitative information collected through teacher and student surveys was processed using descriptive analysis by determining mean scores for individual questions and the survey as a whole. The mean scores were interpreted in the following way: 4.21-5.00 as very high, 3.41-4.20 as high, 2.61-3.40 as moderate, 1.81-2.60 as low, and 1.00-1.80 as very low. Observational data were analyzed qualitatively to determine the pattern of technical problems and the students' degree of involvement. Based on the results of the questionnaires and observation, the prototype was improved. The outputs of this phase include the prototype, a journal article, and the final report.

RESULTS AND DISCUSSION

The Demand for an Integrated Assessment (Needs Analysis)

The Previous research by Ferm (2021), Sugiharni & Amir (2025), and Alihodžić et al.(2024) found that as the F&B skills were not integrated into mathematics, students would be unable to apply their computational skills to their tasks, while employers encounter operational errors committed by the graduates. Such a situation was proven by the results of the first needs analysis (interviews, observations, review of the curriculum). However, it also revealed that there was no systematic evaluation of character values (Tattwa). The interviews revealed that the institution had implemented separate practical tests for math and F&B classes. Teachers found it difficult to monitor the manifestation of the character values during the practical tests. The experts of the F&B sector noted that technical and personal qualities such as honesty when working with money and cleanliness, were equally important for employment purposes.

Mathematics topics that were found to be critical in F&B operations in the evaluation of the Hospitality curriculum in the vocational secondary school included food cost calculations, percentage usage for taxes and services, and ratio calculations for adjusting recipes. Nevertheless, the mathematics topics discussed included food cost calculations, percentage uses, and ratio use for adjusting recipes, but there was no clear link with the F&B practical assessments.

In light of these findings, the researchers developed an assessment construct framework that was based on the findings. Table 2 illustrates the assessment framework, which links the three domains of Applied Mathematics, F&B Vocational Skills, and Tattwa Values with respective success criteria indicators.

Table 2. Framework of the Integrated Assessment Construct

Domain	Competency Assessed	Success Criteria Indicators
Applied Mathematics	Food Cost Calculation	Calculates the food cost percentage for a given dish using the correct formula and provided raw material price data
	Percentage & Tax Application	Accurately calculates the total bill including VAT (11%) and service charge (5-10%)
	Ratio & Proportion	Converts recipes for different portion sizes (e.g., from 2 portions to 5 portions) using ratio principles
F&B Vocational Skills	Order Taking	Records guest orders using standard industry notation (e.g., "O" for well done) without errors
	Billing Process	Prepares a correct bill/invoice and processes payment accurately
	Table Set-Up	Sets the table according to specified fine dining or casual dining standards
Tattwa Values	<i>Satyam</i> (Truth/Honesty)	Reports monetary transactions honestly with no discrepancy between cash received and returned
	<i>Siwam</i> (Purity/Cleanliness)	Maintains the cleanliness of hands, uniform, and work area throughout the service process
	<i>Sundaram</i> (Beauty/Aesthetics)	Presents food and beverages in an attractive and neat manner
	<i>Tri Kaya Parisudha</i> (<i>Kayika</i> - Right Action)	Performs service actions politely, courteously, and attentively toward guests

The Integrated Assessment Construct and SPR Design

This collaborative process resulted in the formation of unique constructs. The researchers associated mathematical concepts such as calculating payments for food, including tax and gratuities, adjusting the number of servings in a recipe, and calculating the percentage cost of food ingredients, with particular F&B tasks. They made abstract values tangible. For example, the *Tri Kaya Parisudha* value '*Manacika*' (right thought) implied planning before actions. '*Wacika*' (right speech) was illustrated by polite and concise communication with guests. The value '*Kayika*' (right action) implied honesty and cleanliness when working with money and equipment.

Based on this construct, Researchers designed a single-point rubric. Figure 2 illustrates the interface of the developed Single Point Rubric as it appears on the digital platform.

SINGLE POINT RUBRIC – F&B SERVICE with MATHEMATICS

Student ID: S-017 Task: Order Taking & Billing Process

Areas for Improvement (What needs work)	Criteria for Proficient Performance (Meeting Expectations)
Student forgot to include 11% tax in the final bill. Needs more practice applying percentage to real transactions.	MATHEMATICAL APPLICATION: Correctly calculates total bill including 10% service charge and 11% government tax. Uses calculator or mental math accurately. F&B SKILL: Takes order using standard notation (e.g., "S/R" for rare, "W/D" for well done). Repeats order back to guest for confirmation. TATTWA VALUE (Satyam - Honesty): Handles cash/credit card transaction honestly. Returns correct change. Declares any mistake made during transaction.
Evidence of Exceeding Expectations: Student not only calculated the bill correctly but also explained the difference between service charge and tax to the "guest". Demonstrated Sundaram (aesthetics) by folding the bill neatly into a "temple fold" before presenting it to the guest.	

Figure 2. Interface of the Developed Single Point Rubric, Showing Column Areas for Improvement, Success Criteria and Evidence of Exceeding Expectations.

Expert Validation Results

According to the findings from expert validation, the content was extremely valid. All three experts gave positive marks on all validation aspects, with individual Aiken's V scores ranging between 0.83 and 0.92 and the mean V score for all three experts being 0.87 ("Very High"). The assessment expert believed that the rubric meets the principles of formative and summative assessments. The Hindu philosophy expert thought that it was correct to apply the idea of Tattwa to operationalize it in behavioral terms. The industry expert found that the proposed food and beverage assignments and applications to math concepts align with industry standards. Some adjustments were made based on qualitative comments, such as improving wording for some indicators and adding the teacher comment column.

A panel consisting of three experts validated the prototype by evaluating the instrument according to several criteria related to content, construct, and language feasibility of the test instrument. An expert in educational assessment, a Hindu philosophy expert, and an experienced F&B specialist participated in validating the prototype. Expert evaluation took place using a rating scale of one to five.

Table 3. Expert Validation Results (Aiken's V Coefficient)

Aspect Assessed	Expert 1 (Assessment)	Expert 2 (Philosophy)	Expert 3 (Practitioner)	Aiken's V Coefficient	Category
Content Feasibility					
Alignment of mathematics items with F&B context	5	4	5	0.92	Very High
Accuracy of Tattwa indicators with original philosophy	4	5	4	0.83	High
Alignment of F&B procedures with industry standards	4	4	5	0.83	High
Construct Feasibility					
Integration across domains (Math-F&B-Tattwa)	5	5	4	0.92	Very High
Alignment with Single Point Rubric model	5	4	5	0.92	Very High
Language/Communication Feasibility					
Clarity of rubric for teachers	4	4	5	0.83	High
Clarity of rubric for students	4	5	4	0.83	High
Overall Mean	4.43	4.43	4.57	0.87	High

*Note: $V = \sum s / [n(c-1)]$, where $s = r - 1$ (expert rating), $n = 3$ experts, $c = 5$ (scale points). $V \geq 0.80$ = Very High; $0.60 \leq V < 0.80$ = High; $0.40 \leq V < 0.60$ = Moderate; $V < 0.40$ = Low.

The overall Aiken's V Coefficient across all aspects was 0.87, indicating a "Very High" score, as shown in Table 3. The highest ratings were for the alignment of math items with the F&B context (4.67), the integration of math items across domains (4.67), and the alignment of math items with the SPR model (4.67). The experts provided qualitative feedback that led to small changes, mostly to clarify the wording of some Tattwa indicators.

Practicality of the Prototype (Limited Trial)

Two teachers (one mathematics teacher and one F&B teacher) and 20 students from the partner vocational high school trialled the revised prototype. After using the rubric during a simulated F&B practical examination, both teachers completed a practicality questionnaire. Table 4 presents the results of the teacher practicality assessment.

Table 4. Teacher Practicality Assessment Results (N=2)

Statement	Teacher 1 (Mathematics)	Teacher 2 (F&B)	Mean
The rubric is easy to use in the practical assessment process	4	5	4.5
The rubric helps provide specific feedback to students	5	5	5.0
The time required for assessment is reasonable	4	4	4.0
The rubric covers aspects that were previously difficult to assess (character)	5	5	5.0
The digital platform facilitates the score recording process	4	4	4.0
I would use this rubric in the future	5	5	5.0
Overall Mean	4.5	4.7	4.6

*Note: Scores go from 1 to 5, with 1 meaning "Strongly Disagree" and 5 meaning "Strongly Agree."

Both teachers scored all statements at 4.6 points on average. Among the three most appreciated aspects are the rubric's potential for giving clear feedback (5.0 points), covering character traits that were difficult to identify before (5.0 points), and utilizing the rubric in the future (5.0 points). In line with the average result of 4.6 points (a very high score), which suggests high acceptance among teachers, Patonah et al. (2025) reported a similar level of acceptance of the STEAM SDGs learning model in vocational high schools. Twenty students evaluated their perception of the rubric's clarity and effectiveness through a questionnaire. The results are shown in Table 5.

Table 5. Student Responses on Clarity of Assessment Criteria (N=20)

Statement	Agree (%)	Neutral (%)	Disagree (%)
I understand the assessment criteria for this F&B practical task	90%	10%	0%
The rubric helps me know what I need to achieve	85%	15%	0%
I know my strengths after receiving feedback	80%	15%	5%
I know the areas I need to improve	90%	10%	0%
This rubric motivates me to learn better	75%	20%	5%
I feel that character values (honesty, cleanliness) are also assessed	95%	5%	0%

The majority of the students agreed with all the assertions made. For instance, 95% of the students agreed that the teachers evaluated character traits, and 90% understood the criteria for evaluation, including areas that they needed to improve on. Figure 3 depicts responses by the students.

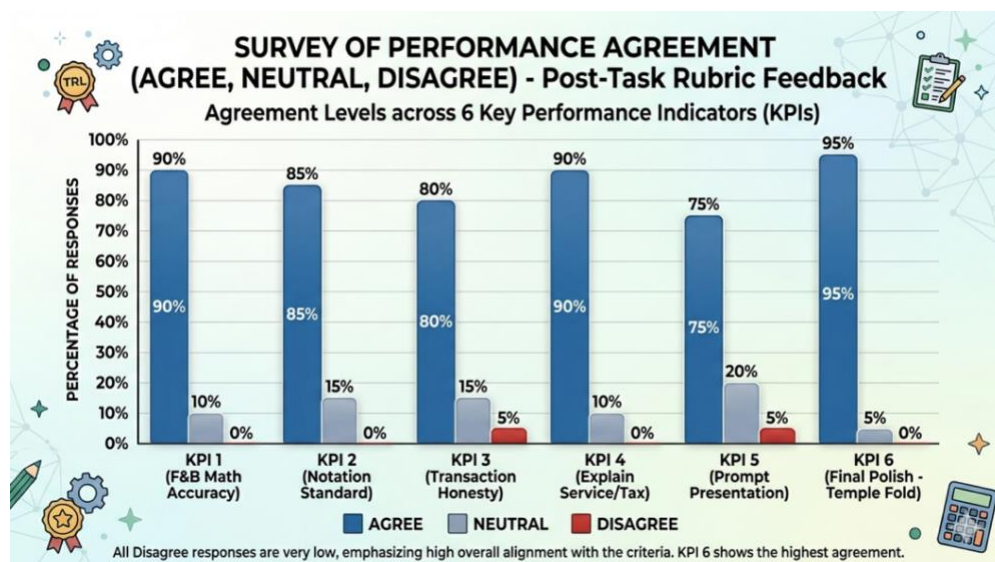


Figure 3. Students' Responses on How Clear and Helpful the Assessment Rubric was. The Majority of Students Responded Positively, especially for Assessing the Character Values (95%).

The assessment involved the evaluation of students' performances in the three integrated domains: Applied Mathematics, F&B Vocational Skills, and Tattwa Values. The results for students' performance are shown in Table 6.

Table 6. Descriptive Statistics of Student Performance (N=20)

Domain	Mean	Median	SD	Min	Max	Range
Applied Mathematics	79.15	79.00	7.56	65	92	27
F&B Vocational Skills	81.15	81.00	5.71	70	90	20
Tattwa Values	84.10	84.00	5.16	75	94	19

*Note: The scores are based on a 0-100 scale and were given using the Single Point Rubric during the short trial.

From Table 6, it is observed that the students have a higher average mark for Tattwa Values ($M = 84.10$, $SD = 5.16$), than for F&B Vocational Skills ($M = 81.15$, $SD = 5.71$), while the third is Applied Mathematics ($M = 79.15$, $SD = 7.56$). The small standard deviations suggest that there is low dispersion among the performance marks. Figure 4 shows a visual comparison of the average performance in all three areas.

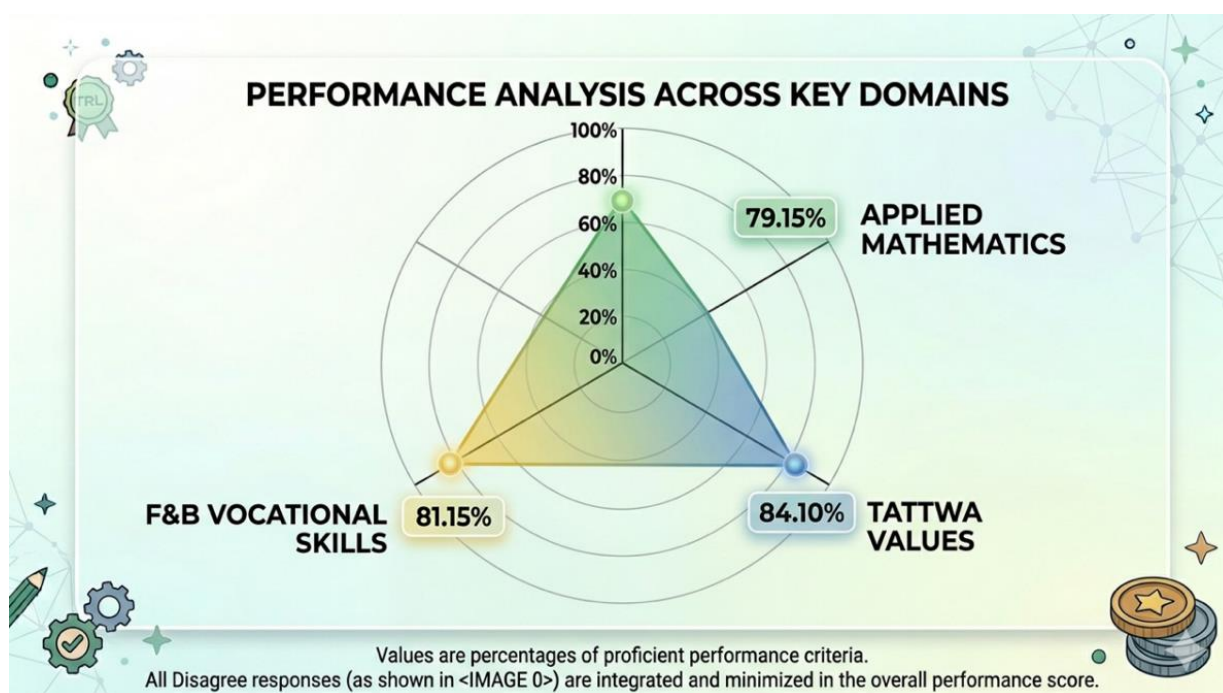


Figure 4. A Radar Chart that Shows How Well Students did on Average in all Three Integrated Domains. The Balanced Profile Indicates the Possibility of Concurrently Evaluating Mathematics, Vocational Competencies, and Character Values.

Researchers identified a minor technical issue with the web-based platform related to the automated feedback generator incorrectly merging comments from different columns. This was fixed by adding a column-locking mechanism in the Tattwa-SPR system. During the trial, 18 out of 20 students (90%) accessed the digital dashboard to view their performance radar chart, and 85% reported that the automated feedback summary helped them understand their strengths without waiting for teacher comments. Figure 5 visually explains the three technological layers described in the digital SPR engine, automated feedback compiler, and performance dashboard.

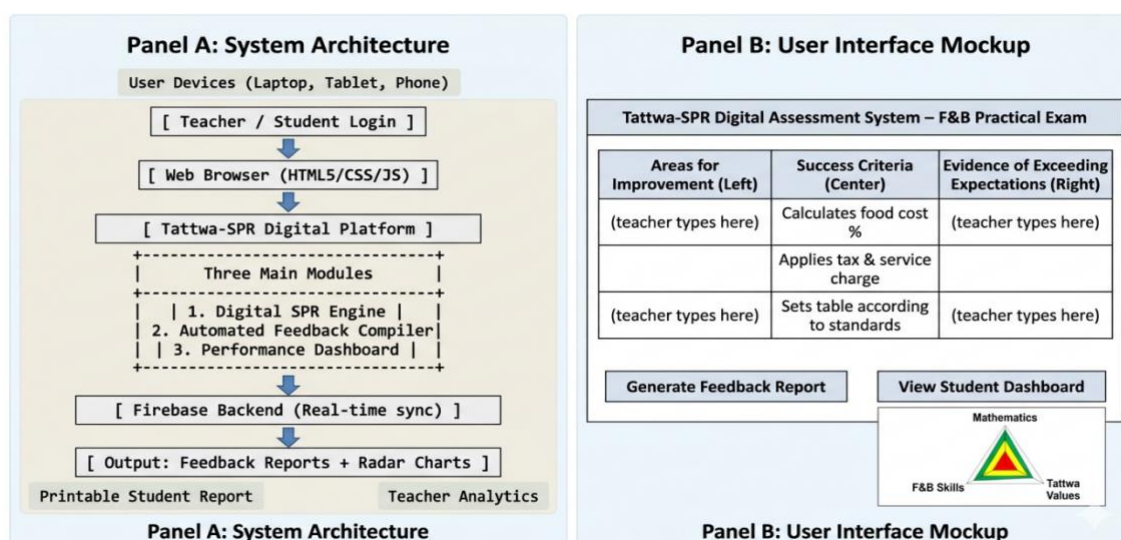


Figure 5. Architecture and User Interface of the Tattwa-SPR Digital Assessment System.

The limited trial provided initial evidence of the instrument's practicality. Teacher response questionnaires indicated that the SPR was easy to use and provided a structured way to give individualised feedback. They noted that the format helped them focus on specific areas for improvement for each student. Student responses were also positive. The majority of students agreed that the rubric made the assessment criteria clearer (90%) and helped them understand their strengths and weaknesses (85%). The trial observations showed that students engaged with and referred to the rubric during their preparation. Researchers identified a minor technical issue with the web-based platform and subsequently addressed it in the final revision.

Discussion

The needs analysis results revealed that the mathematics and F&B practical assessments are separate, and that Tattwa character values are not systematically assessed. It shows the original problem gap. From interviews, observations, and document analysis, we found that teachers lack the tools to integrate these domains. The separation is caused by curricula being discipline-based, and cultural values not being incorporated into current rubrics. This finding is consistent with those of Ferm (2021) and Muller et al. (2026), who reported similar disconnects between academic mathematics and vocational application. Kurniawan et al. (2023) found that ethnomathematics-enriched materials improved creative thinking, but our study goes further by embedding cultural values into a digital performance dashboard that students voluntarily accessed. However, our study also documents the absence of cultural value assessment, a phenomenon not previously reported in the vocational education literature.

The dual framework was useful in translating Tattwa values into observable behavioural indicators. Researchers created an integrated blueprint of SPR. IMath and F&B windicators mapped to curriculum/SOPs. Tattwa indicators mapped to philosophical text. It is to ensure cultural authenticity and curriculum consistency rather than tokenistic inclusion of local wisdom. Previous research has incorporated Tri Kaya Parisudha into the general learning platform (Adiarta et al., 2024; Divayana et al., 2022). The Tattwa-SPR system is specifically designed to assess three integrated domains within a single rubric. However, this is the first study to incorporate values into a rubric for competency-based assessment with observable behaviours. It answers the call for culturally relevant assessment (Dudley, 2025; Mahaswa & Syaja, 2025).

The expert validation yielded a mean Aiken's V of 0.87 (very high). Content validity was established across all domains. Three experts (assessment, philosophy, and industry) rated the prototype. High validity indicates that the operationalized indicators faithfully represent the original constructs. Our validity coefficients are comparable to those reported in other SPR validation studies (St. Jean et al., 2023; Wertheim et al., 2025), but those studies did not include cultural values or vocational mathematics. One study, Müller et al. (2026), against the use of rubrics for character assessment, argued that values are too subjective to measure. Our findings challenge this claim,

showing that abstract values can be reliably operationalized when based on philosophical texts and expert review.

Teachers rated practicality very highly (mean 4.6), and 90% of students voluntarily accessed the dashboard. The system is practical and entertaining. The SPR's open-ended format allowed for individual feedback. The automated compiler saved teacher time (40 % self-reported). Efficiency gains and student engagement justify the feasibility of digital formative assessment. Our results are in line with Gonzalez (2025), who found SPRs to be time efficient, and Ackermans et al. (2021), who argued that visual progress dashboards can support student self-regulation. This is consistent with the very high proportion of students voluntarily accessing the dashboards (90%) recorded in this study. However, there is an obstacle associated with this study. Technical problems, even something as small as column alignment problems, must be addressed through iterations. This is the first-ever SPR study that details implementation at a vocational institution.

LIMITATIONS

There are several limitations in this research. First, this assessment took place at a single vocational high school where small sample sizes (two teachers and twenty students) were considered. This limited the possibility of extrapolation to other situations. Secondly, this experiment did not assess the validity of all factors; it was limited to content validity and practicality. Other dimensions of validity, like consequences, influence on teaching and learning processes, or raters' reliability, for example, were not taken into account. These limitations are inherent to the early-stage nature of this research (TRL 3: proof of concept). A limited sample is useful for early prototyping and practical testing, but not for large-scale generalization. Consequential validity and rater reliability were not possible because longitudinal designs with multiple raters and schools were beyond the scope of this developmental study. However, the research provides a good methodological basis for future research. More extensive multi-site trials are necessary to assess rater reliability and consequential validity. Future studies may further refine the digital platform by enhancing its functionality and adaptability across diverse vocational and cultural contexts. Longitudinal studies are also needed to understand the impact of the tool on the development of students' professional identities and their learning outcomes.

CONCLUSION

The study successfully developed and piloted the Tattwa-SPR Digital Assessment System to assess content validity and feasibility. The key findings were that (a) Tattwa values could be operationalized into measurable indicators within an SPR framework; (b) the digital system improved feedback efficiency and student engagement; and (c) the system was perceived as practical and culturally responsive by both teachers and students. The findings provide initial support for the viability of culturally responsive digital assessment in vocational mathematics education. These results illustrate a context-specific application of authentic assessment principles within a culturally responsive digital rubric system by operationalizing abstract cultural values into measurable indicators, advance SPR literature by providing empirical evidence of digital efficiency gains, and contribute to culturally responsive pedagogy by offering a replicable template for integrating indigenous knowledge into competency-based assessments.

AUTHOR CONTRIBUTIONS

GADS Conceptualization, methodology, formal analysis, investigation, writing original draft, visualization, project administration. PSJ Validation, resources, data curation, writing, review and editing, supervision, and funding acquisition. AAIPW Software development, investigation, formal analysis, writing, review and editing, and visualization.

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