RESEARCH ARTICLE

Rasch model of teacher readiness instrument for implementing science learning based on Balinese local wisdom

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Abstract: Local culture has undergone significant shifts and alienations, leading to the neglect of societal values. This situation underscores the need for teachers to be well-prepared to incorporate local wisdom into science education, supporting Cultured-Based Learning. This study, conducted from January to June 2022, aimed to assess the relevance of items in a teacher readiness instrument for implementing local wisdom-based science learning in Bali. An ex post facto research design was employed to analyze the preparedness of 72 science teachers in Bali through a detailed questionnaire. The collected ordinal data were converted into an interval scale using the Method of Successive Interval (MSI) and analyzed using the Rasch Model with the Jamovi application to assess item relevance. The study's findings highlight the cognitive and emotional readiness of science teachers as being in the high category, while collegial support and instructional tools are in the low category. These results suggest that improving collegial features and instructional tools through lesson studies and workshops could enhance the integration of local wisdom into science education in Bali.

Keywords: cultured based learning; local wisdom; Rasch model; teacher readiness

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Introduction

Culture is a crucial factor in influencing and directing communities. It embraces diverse elements of human existence and the environment in which it exists. Culture gradually develops due to human endeavour, empathy, and mindsets (Yusuf, 2018). Within education, culture serves as a conduit that links pupils to their learning settings, imparting profound significance and fostering a heightened understanding of societal matters (Saribas et al., 2023). The cognitive processes involved in learning are inherently intertwined with culture, as culture offers valuable knowledge that aids in students' thinking (Ertmer & Newby, 2013; Morais & Kolinsky, 2021; Oyserman & Lee, 2008).

Culturally-based learning (CBL), which prioritises learning within a specific cultural setting, improves students' comprehension of their own culture. Schools have the capacity to not only serve as hubs for resource generation, but also as platforms for the preservation and advancement of culture, incorporating esteemed principles, indigenous wisdom, and national heritage (Godoy et al., 2022; Primayana, 2018; Rosala & Budiman, 2020; Thumlert et al., 2018). The development of local culture-based learning aligns with the principles of Community-Based Learning, promoting the UNESCO pillars of learning to live together (Dikta, 2020). The primary objective of national education is to foster students' active engagement in Community-Based Learning. Nevertheless, the successful execution of Culture-Based Learning has been impeded by insufficient teacher proficiency and students' restricted understanding of CBL.

Local wisdom, an essential element of CBL, has recently gained more focus. It pertains to the esteemed principles profoundly embedded in local culture and employed as a compass for community government (Dikta, 2020; Ludji et al., 2020; Markandya et al., 2020; Septiarti et al., 2017; Shodiq, 2021; Titin & Yokhebed, 2018). Integrating local wisdom into education involves assimilating a community's conventional values, beliefs, and practices into the educational process of teaching and learning. This approach prioritises the preservation and advancement of indigenous culture and principles while equipping students to interact with the international community. Incorporating relevant local information into the curriculum would enhance students' knowledge, character, and abilities in ways that are environmentally friendly, bridging the divide between theoretical and practical knowledge within the student community (Asriyadin et al., 2021; Barab & Luehmann, 2003; Handayani et al., 2018; Ramdani et al., 2020). Utilising local knowledge can be an effective approach to fostering character development and transmitting values among pupils. Nevertheless, the local culture has undergone changes that have resulted in the disregard of its inherent values among the people (Dewi et al., 2021; Parmin et al., 2015; Ramdani et al., 2020). Consequently, students often experience a sense of estrangement or alienation from their cultural heritage during the learning process (Darmawan et al., 2022), perceiving the learning of local wisdom as outdated, dull, and monotonous (D. H. Sari, 2011; Yoga et al., 2022).

The development of indigenous knowledge in the field of education encompasses both students and teachers. Teachers have the primary role in curriculum implementation, which involves organising, executing, and evaluating science instruction according to local expertise. Teachers' readiness level to instruct science by incorporating local knowledge significantly impacts students' comprehension of the subject matter. Thus, teachers should have pre-existing knowledge and ingenuity in designing educational experiences that are based on local expertise. However, teachers often face challenges integrating innovative learning models such as discovery learning, learning cycles, and STEM (Science, Technology, Mathematics and Engineering) (Darmawan et al., 2022; Sumarni et al., 2022). Previous research indicates that teachers in Bali struggle with incorporating local wisdom into their classroom content (Basuki et al., 2019; Nisa et al., 2021; Sudiana et al., 2015; Zulkhi et al., 2022). Despite having an understanding of local wisdom in science learning, teachers may face difficulties in delivering scientific explanations that students can easily accept (Hastuti et al., 2020). Moreover, the absence of technology integration presents a challenge for teachers in the implementation of science learning materials that are rooted in local knowledge, impeding students' ability to actively, interactively, and meaningfully participate (Hastuti et al., 2020; M. Maryati, 2019; Putra et al., 2021; Riandi et al., 2019).

The Rasch model is a commonly utilised statistical method in educational research for assessing individual ability and preparedness characteristics in particular subject areas (Alexandrowicz, 2011). This model can be utilized more effectively to assess the validity and reliability of a scale than other methods. Typically, conventional statistical approaches utilise Cronbach's alpha to assess internal consistency, disregarding external considerations like standard scale lengths (Ibrahim & M. Elazzabi, 2011). Utilizing Rasch models in science learning research can enhance the precision and accuracy of psychometric instruments, improving the overall assessment quality (Huang et al., 2019). Furthermore, the constant application of Rasch models has been empirically demonstrated to yield superior outcomes. Rasch models have demonstrated efficacy in evaluating numerous studies, indicating their potential to enhance best practices in scientific learning research (Aydın et al., 2022). Therefore, it can be inferred that the Rasch model is a viable statistical tool for analysing the preparedness of teachers about local wisdom-based learning.

While prior research has highlighted the significance of incorporating local knowledge through content and learning models, it appears that psychometric solid models, such as the Rasch model, have not been extensively utilised in science education. Current research on local knowledge has primarily concentrated on the development and validation of science learning tools (Dwianto et al., 2017; Hastuti et al., 2020; Lovina Sary et al., 2023; Parmin et al., 2016; Ramdiah et al., 2020). Previous science learning model research has generally focused on developing instruments to improve student competence, while for the teacher development aspect, there has been no research that examines the readiness of science teachers in learning based on local wisdom. However, there have been limited studies concerning the readiness of teachers to effectively incorporate local wisdom into science learning, particularly using psychometric models like the Rasch Model. The results of Newman's et.al. (2011) study shows that the Rasch Model can be used to develop students' nature of science (NOS) test instruments well compared to other statistical methods. In the context of science learning, Eggert and Bögeholz (2010) found that the reliability and validity of the developed Rasch model provided an adequate measure of students' use of decision-making strategies. In other hand, Maryati et al (2019) shows that. the Rasch model analysis indicated that prospective teachers should enhance their pedagogical content knowledge (PCK), particularly about the aspects of "knowledge of learning strategies and representations for science teaching". In addition, Sondergeld and Johnson's (2014) Research demonstrates that Rasch models are effective in developing instruments to measure STEM awareness. Furthermore, You's (2016) study highlights the significance of employing the Rasch model to construct and evaluate the involvement of science instructors in Reform-Oriented Teaching Practices (RTPs). Based on extensive research on the Rasch model, it can be inferred that there is a lack of studies or empirical evidence that particularly investigates the preparedness of teachers in teaching local knowledge material. Therefore, this research intends to assess the relevance of items in a teacher readiness instrument for implementing local wisdom-based science learning.

Considering the information provided earlier, researching teachers' preparedness to implement local wisdom-based learning is essential, as it plays a vital role in enhancing science teaching and learning practices. This topic is particularly relevant in addressing teacher professional development and trends, focusing on equipping educators to integrate culturally relevant content effectively into their science instruction. Moreover, examining the preparedness of science teachers to adopt local wisdom-based learning contributes significantly to developing science teaching materials that align with both local context and educational objectives. Additionally, this study emphasizes the need for a robust science learning evaluation and assessment framework by utilizing the Rasch Model to rigorously measure teacher readiness. Ultimately, the instrument developed can serve as a standard tool to evaluate and enhance teachers' preparedness, thereby advancing the successful implementation of local wisdom-based education in Bali and fostering culturally responsive science instruction.

Method

This study is part of an ex post facto research design aimed at uncovering the underlying causes and manifestations of various events or illnesses (Tuckman et al., 2012). The population under investigation comprises all scientific teachers in Bali. The sampling strategy employed in this study is the purposive sampling method, specifically targeting science teachers specialising in disciplines such as physics, chemistry, biology, and general science. A total of 72 respondents, who were science teachers from different regions in Bali, were recruited using a sampling technique. The ordinal data obtained from the questionnaire findings of the readiness instrument for science instructors teaching local knowledge in Bali were transformed into an interval scale using the Method of Successive Interval (MSI). Transforming data from the ordinal scale to the interval via MSI is very important to increase the measurement scale (Mondiana et al., 2018). The instrument utilised in this study pertains to the alteration of teacher consciousness as described by Sakamoto (2022) which encompasses cognitive, emotional, collegial awareness, and learning tools. In addition, the data was examined using quantitative descriptive analysis with SPSS 24 for Windows and statistical analysis of the Rash Model using Jamovi. The analysis of each factor of teaching preparedness of science instructors in the context of local wisdom is conducted using the data provided in Table 1.

Table 1. Respondents of the research

Range	Category
X < 2.99	Low
2.99 ≤ X < 3.21	Moderate
3.21≤ X	High

Adapted from Azwar (2016)

Results and Discussion

The results of the descriptive statistical results table and its criteria can be seen in Table 2.

Table 2. Descriptive Statistics on the Readiness of Science Teachers in Bali in implementing learning based on local wisdom

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Mean Std. Error	Std. Deviation Statistic	Variance Statistic
Cognitive								
P3	72	3.40	1.00	4.40	3.0182	.10984	.93206	.869
P4	72	4.15	1.00	5.15	3.5522	.11134	.94474	.893
P6	72	3.84	1.00	4.84	3.1376	.11002	.93357	.872
P7	72	3.56	1.00	4.56	3.5517	.10584	.89812	.807
P8	72	3.93	1.00	4.93	3.5517	.11062	.93864	.881
P9	72	3.47	1.00	4.47	3.0180	.11154	.94641	.896
Mean Cognitive Aspect					3.3049		High Category	
Emotional								
P10	72	3.51	1.00	4.51	3.2978	.10874	.92270	.851
P11	72	3.54	1.00	4.54	3.2979	.10733	.91071	.829
P14	72	3.62	1.00	4.62	3.5523	.10734	.91077	.830
Mean Emotional Aspect					3.3826		High Category	
Collegial (network)								
P16	72	3.47	1.00	4.47	2.4558	.11309	.95961	.921

Descriptive Statistics								
	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
P17	72	3.63	1.00	4.63	2.7045	.11346	.96277	.927
P18	72	3.61	1.00	4.61	2.7684	.11327	.96111	.924
P19	72	3.76	1.00	4.76	3.5519	.10977	.93146	.868
P20	72	4.00	1.00	5.00	3.2975	.11154	.94648	.896
		Mean Collegial Aspect			2.95562		Low Category	
Learning Tools								
P21	72	3.76	1.00	4.76	2.9217	.11311	.95979	.921
P22	72	3.68	1.00	4.68	2.8399	.11300	.95880	.919
P23	72	3.84	1.00	4.84	2.7045	.11216	.95172	.906
P24	72	4.06	1.00	5.06	2.9217	.11247	.95431	.911
P25	72	4.07	1.00	5.07	2.7682	.11253	.95488	.912
		Mean Learning Tools Aspect			2.8312		Low Category	
		Mean Learning Tools Aspect			3.1006			

According to the information provided in Table 2. The cognitive and emotional features of scientific teachers in teaching local wisdom are highly valued. However, the collegial characteristics and aspects of learning instruments are considered poor.

The findings indicated that the personal reliability of the scientific teacher preparedness measure in science learning, within the context of local wisdom, was characterised as exceptionally high (p = 0.942) as in Table 3. This suggests that the science teacher readiness measure, which is associated with local wisdom learning, is "consistent" in its performance. Therefore, regardless of where the instrument is examined, similar results are expected to be yielded. In addition, the examination of infit and outfit models is presented in Table 4.

Table 3. Pearson Reliability Analysis

Model Fit	Person Reliability	MADaQ3	p
Scale	0.942	0.204	< .001

Table 4. Analysis of infit and outfit models

	Measure	S.E Measure	Infit	Outfit
P1	-5.094	0.231	1.533	1.367
P2	-4.989	0.228	1.664	1.612
P3	-3.124	0.184	0.930	0.924
P4	-2.584	0.174	0.708	0.717
P5	-4.038	0.190	0.953	0.932
P6	-2.523	0.173	0.896	0.817
P7	-4.032	0.190	1.831	1.230
P8	-2.210	0.168	0.891	0.846
P9	-2.614	0.174	1.015	0.921
P10	-3.142	0.181	0.831	0.777
P11	-3.652	0.192	1.066	0.946
P12	-4.373	0.209	0.778	0.715
P13	-3.185	0.182	1.002	0.871
P14	-3.919	0.197	0.967	0.870
P15	-3.841	0.197	1.036	1.011
P16	-1.790	0.162	1.327	1.207
P17	-1.690	0.161	1.019	1.114
P18	-1.630	0.162	1.102	1.152
P19	-3.720	0.193	0.953	0.830
P20	-1.747	0.163	0.948	0.937
P21	-1.469	0.161	0.841	0.804
P22	-1.326	0.160	0.828	0.812
P23	-1.345	0.161	0.822	0.824
P24	-1.245	0.158	0.775	0.783
P25	-1.117	0.158	0.850	0.860

Note: Infit = Information-weighted mean square statistic; Outfit = Outlier-sensitive means square statistic.

The results of the Rasch Model study on question difficulty measurement indicate that none of the statement items show a tendency to be answered or encourage prospective instructors to choose alternatives (p1-p23<0). Moreover, the results of the infit and outfit analysis are related to the suitability of the products. Upon analysing each statement, it was found that the model's range of infit Rasch values ranged from 0.5 to 1.5. Therefore, statement items 1 and 2 are excluded as they do not fulfil the specified requirements. Conversely, the range of values for clothing Rasch models is between 0.5 and 1.5. Therefore, statement item 2 does not satisfy these criteria and is consequently not utilised (Table 5).

Table 5. Residual Analysis Q3 Correlation Matrix

	P3	P5	P6	P7	P8	P9	P10	P11	P14	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25
P3																			
P5	0.054																		
P6	0.13	-0.046																	
P7	0.229	-0.057	0.21																
P8	0.045	-0.052	-0.089	0.361															
P9	-0.115	-0.028	0.076	0.203	0.108														
P10	-0.118	0.016	0.185	0.461	0.606	-0.15													
P11	-0.136	0.112	0.349	-0.131	-0.021	0.185	0.014												
P14	0.001	-0.16	-0.27	-0.16	0.173	-0.07	0.062	0.273											
P16	-0.144	0.012	0.318	0.191	0.321	0.269	-0.102	0.047	-0.384										
P17	0.05	-0.045	0.27	0.041	0.085	0.002	0.011	0.106	-0.014	0.351									
P18	0.098	-0.148	-0.17	0.011	0.062	-0.061	0.058	0.318	-0.01	0.269	0.435								
P19	0.05	0.144	0.065	-0.011	0.034	0.011	0.064	0.017	-0.014	-0.012	-0.247	0.235							
P20	0.014	0.01	-0.138	-0.024	-0.026	-0.046	-0.024	0.01	0.195	0.024	-0.09	0.066	-0.254						
P21	-0.014	-0.036	0.147	-0.152	-0.014	-0.02	0.072	-0.126	0.022	0.266	-0.152	0.239	0.075	0.072					
P22	-0.143	-0.136	0.095	0.003	-0.031	0.011	0.12	-0.066	0.042	0.017	0.09	0.052	0.126	0.22	-0.011				
P23	-0.117	-0.202	0.233	-0.03	-0.045	0.022	-0.014	0.01	0.115	-0.011	-0.014	-0.026	0.01	-0.126	0.195	0.301			
P24	-0.052	-0.119	0.294	-0.285	-0.064	-0.016	-0.085	-0.004	0.266	-0.113	-0.085	-0.014	-0.085	-0.02	-0.172	-0.115	-0.015		
P25	-0.052	-0.052	0.046	-0.232	-0.085	-0.014	-0.244	-0.244	0.331	-0.043	0.304	-0.085	-0.244	-0.03	0.115	0.331	0.346	0.514	

The Residual Table Q3 Correlation Matrix study reveals that the correlation coefficients for statement items 1, 2, 4, 5, 12.13, and 15 are more than 0.3. Yen (1984) states that none of these items satisfies the local independence requirement, so they do not conform to the unidimensional Rasch model due to their residual correlation above 0.3. Furthermore, the results of the final instrument based on the selection of items can be seen in Table 6.

Table 6. The Final Instrument of Teacher Readiness for Implementing Science Learning Based on Balinese Local Wisdom

Code	Aspect	Items
P3	Cognitive	I actively integrate local knowledge into science or biology teaching materials.
P5	Cognitive	Local wisdom knowledge can help enhance students' understanding of the biodiversity around them.
P6	Cognitive	I have provided opportunities for students to explore local wisdom knowledge in projects or assignments.
P7	Cognitive	I am aware that local wisdom knowledge can provide information on the sustainable use of plants and animals.
P8	Cognitive	I strive to relate science or biology concepts to the traditions and customs around the students' school area.
P9	Cognitive	I seek literature on local wisdom knowledge in science or biology education.
P10	Emotional	I feel that local wisdom knowledge can increase students' interest in biology education.

Code	Aspect	Items
P11	Emotional	I feel that local wisdom knowledge can help students connect science or biology material to their daily lives.
P14	Emotional	I feel challenged to teach local wisdom material in the classroom.
P16	Collegial	I have tried to openly communicate with competent practitioners about the meaning of a local wisdom.
P17	Collegial	I have collaborated with colleagues to solve problems related to local wisdom.
P18	Collegial	I encourage friends or other teachers to implement local wisdom materials in their teaching.
P19	Collegial	Building good relationships with local cultural practitioners is a form of collaboration to strengthen my understanding of local wisdom for teaching.
P20	Collegial	I know which of my colleagues are capable of teaching local wisdom materials in their lessons.
P21	Learning Tools	I have relevant reference sources for teaching local wisdom.
P22	Learning Tools	My learning modules are integrated with local wisdom materials.
P23	Learning Tools	I have student worksheets (LKPD) integrated with local wisdom materials.
P24	Learning Tools	The Learning Outcomes (CP), Learning Objectives (TP), and Learning Pathway (ATP) I designed are integrated with local wisdom materials.
P25	Learning Tools	I have a specific assessment rubric related to students' understanding of local wisdom in education.

In addition, the distribution of the difficulty level for each item in the item bank can be seen in Figure 1.

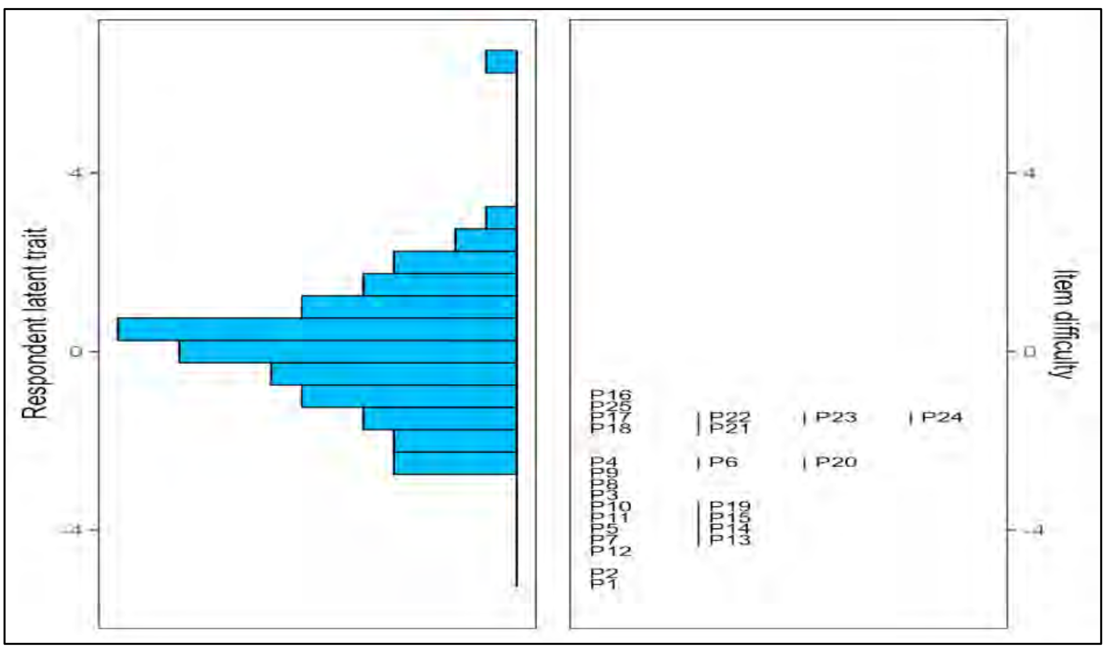

Figure 1. Wright Map Teacher Readiness Instrument in Local Wisdom-Based Learning

The objective of Wright Map is to offer comprehensive data regarding the distribution of the difficulty level for each item in the item bank. The quality of the questionnaire designed in this study is directly proportional to the level of ease with which science teachers can answer it, as it is based on the Rasch Model. The Wright Map does not require the questionnaire instrument to test the ability of respondents across different levels of low, medium, and high skills.

Readiness of Science Teachers in Implementing Local Wisdom-Based Learning in Bali

This study examined the readiness of science teachers in Bali to implement local wisdom-based learning, assessing cognitive, emotional, collegial, and instructional aspects. The findings demonstrate a high level of cognitive and emotional readiness, reflecting teachers' solid understanding and positive attitudes toward integrating local wisdom into their biology instruction. This aligns with the original objective of the study, which aimed to gauge teachers' preparedness in the context of culturally enriched biology education. Table 1's data analysis results show that cognitive and emotional factors highly influence science instructors' readiness to implement local wisdom learning in Bali. Conversely, learning resources and collegial traits are still seen as poor categories. Moreover, claims 1 and 2 did not match the infit criterion and fitted Rasch models, according to the rash model analysis. Analysing Table 01: Residual analysis Assertions 1, 2, 4, 5, 12, 13, and 15 do not satisfy the unidimensional requirements of the Rasch model because they do not meet the assumption of local independence, according to Table Q3 Correlation Matrix.

The way science educators approach fieldwork is directly impacted by their cognitive understanding of the context of local knowledge in learning. Prior research has demonstrated that science teachers possess a remarkable comprehension of traditional knowledge and may even incorporate and create educational resources that align with the inquiry process to support sustainable development objectives (Parmin et al., 2015, 2016; Pornpimon et al., 2014). If cognitive components are absent, teachers cannot connect the information to science products, common sense, or learning resources. Gaining an understanding of science within a cultural framework will empower students to better appreciate their own culture, foster meaningful experiences, and strengthen relationships among them.

In order to be 'comfortable' with a variety of pedagogical procedures and media within the framework of local wisdom and 21st-century learning, scientific teachers need to possess cognitive capital, which is the essential capital. In the end, this cognitive capital will help with regenerative education, or lifelong learning that incorporates elements of "being with ourselves," "being with nature," and "being with each other ". Teachers should combine local knowledge with Pancasila student profiles in scientific lessons to improve students' character (Lubis & Darmawati, 2023; Saphira, 2022; Seno et al., 2022; Sukirno et al., 2023). The profile of Pancasila students in the independent curriculum is very close to the context of local wisdom since the Indonesian nation's character and personality have existed for a long time (Smith et al., 2020).

Contrary to the strong cognitive and emotional readiness, the study identified collegial support and instructional tools as weaker areas. These findings diverge from some studies that emphasize the significance of professional collaboration among teachers for sharing resources and ideas. The limited collegial support found here may indicate that teachers lack sufficient professional networks or communities to facilitate sharing practices and materials for local wisdom-based education. This is consistent with findings that point to a general challenge in fostering teacher collaboration, as school cultures often do not prioritize or facilitate teamwork among educators.

The inquiry findings indicate that the emotional traits of scientific teachers have an influence on their teaching preparation. Three key emotional factors that impact teacher professionalism are: imparting instruction, fostering a positive classroom environment, and promoting collaboration within the school setting (Levine Brown et al., 2023). Effective emotion management is one of the qualities of a skilled educator (Geng et al., 2023; Hosotani & Imai-Matsumura, 2011). Instructors' negative emotions are greatly exacerbated when there is a lack of student interaction and when the teacher's approach is to "save" the problems he is having (Wang & Burić, 2023). These two types of personalities will greatly impact science teachers' readiness to teach the following time. Therefore, one way to identify student characteristics and map how teachers should engage while controlling emotions is to use diagnostic tests at the beginning of the learning process.

Another factor that influences how science instructors control their emotions when acquiring local wisdom is their participation in local wisdom activities. It is uncommon to discover research on how instructors manage their emotions (Peng et al., 2023). Furthermore, it is about instructors' empathy for the context of communal knowledge. Teachers must be actively involved in local wisdom activities to have excellent empathy for the context of local wisdom in scientific instruction. Because pupils are in a shallow environment, teacher empathy is critical in today's disruptive period (Zembylas et al., 2020). Empathy among scientific instructors and students can be cultivated through community-based teaching activities connected to local culture or knowledge (Upadhyay & Aleixo, 2023; Zembylas et al., 2020). As a result, the transformational teaching process will be effective, and science instructors will be able to demonstrate if science principles connected to local literature presented in class are consistent with what occurs in society.

Instructors' emotional intelligence is a key variable that inspires instructors to develop and implement student-centered learning (Abiodullah et al., 2020). Teachers with high emotional intelligence are better prepared to educate children with diverse learning needs, including teaching in the context of local wisdom. Previous studies have demonstrated that instructors with higher emotional intelligence are less likely to burn out and have a more significant influence on student learning performance (Benesch & Prior, 2023; Mérida-López & Extremera, 2017; Mohamad & Jais, 2016; Yin et al., 2019). Furthermore, in addition to scientific traits such as accurate science, science instructors must enhance their emotional intelligence to better grasp varied student viewpoints in open-ended inquiries.

The lack of teacher collegiality reduces the teacher's cooperation and communication skills, even though communication and collaboration skills are 21st-century competencies that must be had by students and instructors. According to recent studies, teacher cooperation in learning is a normative practice that is not necessarily practised in every school (Decuyper et al., 2010; Vangrieken et al., 2015). Individualist competitiveness in addressing the difficulties of global educational requirements is the greatest barrier to fostering teacher collegiality in schools (de Jong et al., 2019). Teachers' collaboration is typically limited to discourse and the exchange of ideas (Hargreaves & O'Connor, 2017). Burnout or an overflow of teacher workload impedes teacher self-development in terms of teacher collegiality in schools (Alzahmi et al., 2022).

The poor collegiality of science instructors in cooperating, developing tools, and exchanging ideas about the context of local wisdom will influence the low quality of learning in the classroom in the setting of this study. Collegiality among instructors teaching in cultural contexts is strongly linked to real-world experiences, a sense of belonging, and teacher job satisfaction (Skaalvik & Skaalvik, 2021). Cooperation among scientific instructors must be strengthened to preserve and develop the Balinese people's ideals of local wisdom (Ariratana & Chusorn, 2014). A strong collaboration among science instructors will help them handle various challenges related to planning, implementing, and assessing local wisdom values, which are notoriously difficult to implement in the classroom.

The analysis of instructional tools also revealed a lack of well-developed materials that integrate local wisdom into the science curriculum. Studies show that although many educators are aware of the value of local knowledge, they are not proficient at integrating it into their lesson plans (Subali et al., 2015). This suggests that teachers may not be equipped with adequate resources, or may lack the capacity to develop instructional aids that align with both the curriculum and the cultural context. This finding aligns with other studies highlighting that effective instructional tools are crucial for contextualizing science education to meet diverse learners' needs. Creating scientific teacher learning aids based on local wisdom is typically targeted at improving students' science literacy (Azura et al., 2023; Setiawan et al., 2017; Zaldy et al., 2022). Incorporating local knowledge into learning aims to enhance student character while supporting sustainable development efforts (Abdullah et al., 2022; T. Maryati et al., 2020; Suprapto et al., 2021; Zaldy et al., 2021). Based on prior research, it is possible to deduce that literacy, character development, and sustainable development are three critical issues that instructors must address while building instructional tools (modules/lesson plans). The capacity of instructors to build learning aids is critical in scientific learning to deliver relevant learning experiences for pupils.

Inadequate teacher abilities in creating learning technologies are substantially connected with low teacher collegiality. Teachers might collaborate to investigate the particular demands and potentials of the student learning environment that can be tied to the context of local wisdom material. The difficulty with instructors' incapacity to create learning devices is due to a lack of time, teacher comprehension of the subject area, and adequate technology for learning devices (K. M. Sari & Ain, 2021). Furthermore, with the responsibility of an autonomous curriculum that pushes all teachers to apply differentiated learning, the tools created must be carefully assessed to meet the requirements of all students (Suryati et al., 2023). Because local wisdom-based learning is intergenerational learning that connects the community with its local environment, the integration of learning technologies with learning content and context is critical (Sajjasophon, 2019).

Overall, the study contributes to the understanding of teacher readiness in local wisdom-based biology education by identifying key strengths and areas for improvement. The findings have implications for teacher professional development, particularly in enhancing collaboration and instructional tool creation. Future efforts should focus on building strong collegial networks and developing comprehensive instructional materials to fully support the integration of local wisdom into biology education. This aligns with broader trends in science education research that call for the inclusion of culturally responsive pedagogy and the development of teaching resources that reflect local wisdom and context.

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Conclusion

The study found that cognitive and emotional elements were the main contributors to science instructors' readiness to incorporate local wisdom into their classrooms in Bali. These factors were classified as "high category" influencing features. On the other hand, the study found that "collegial elements" and "learning tools" associated with local knowledge were classified as "low category" factors that affect teacher preparedness. Based on these discoveries, it is recommended that future studies focus on enhancing and fortifying the "collegial aspects" and "learning tools" of scientific instructors' involvement with local knowledge in the Balinese setting. Implementing strategies like lesson studies within learning communities and organising teacher community events integrated into the Merdeka Belajar curriculum can be useful methods for promoting collegial collaboration and the creation of learning tools based on local knowledge.

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Conflicts of Interest

There are no personal relationships or competing interests that could have influenced the research reported in the manuscript. All collaborations were undertaken with full transparency and academic integrity. Moreover, all authors are committed to maintaining the highest standards of academic honesty and transparency. The research was conducted in accordance with ethical guidelines and the integrity of the study was upheld throughout the process.

Author Contributions

I B. A. Arjaya: methodology & analysis; **I B. A. Arjaya** and **A. A. I. Paraniti:** writing original draft preparation; and **I B. A. Arjaya,** and **N. P. S. Noviantari:** review and editing.

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