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Development of A Critical Thinking Test with Science Content Orientated to Tri Hita Karana Local Wisdom

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ABSTRACT

Critical thinking skills are essential for developing quality individuals, as mandated by Law No. 20 Year 2003. Effective learning should integrate material with the context of local wisdom. This study aims to design a valid and reliable critical thinking skills test incorporating science content oriented to Tri Hita Karana local wisdom for use in primary school education, particularly for fourth-grade students. This research adopts a development methodology based on the steps outlined by Borg and Gall. The process consists of seven stages, starting with research and information gathering and concluding with product revision. An extensive trial was conducted during the seventh stage to finalize a valid and reliable critical thinking skills test. The results indicate that the developed test, comprising 30 items, is both valid and reliable, with a reliability coefficient of 0.89, indicating a very high level of reliability. The study successfully created a critical thinking assessment tool that integrates science content with Tri Hita Karana local wisdom. In conclusion, this research contributes to the development of a robust critical thinking skills test for fourth-grade primary school students. By incorporating local wisdom, particularly Tri Hita Karana, into the learning process, the test promotes the integration of cultural context into education. This contribution is significant for enhancing the educational experience and fostering critical thinking among students.

Keywords: Critical Thinking, Local Wisdom, Science, Tri Hita Karana

INTRODUCTION

Education in the twenty-first century is concerned with developing students' character, competence, and literacy. In the learning process, students are expected to encounter real-world situations that require higher-order thinking, creativity, innovation, communication, cooperation, and problem-solving (ŽivkoviĽ, 2016). The goal of education in the 21st century is to teach students the skills they will need to compete in all areas of life. Improving the quality of education can help improve the quality of human resources to be able to compete in global life.

The government has made and is making reforms in the field of education to improve the quality of Indonesia's human resources. One of them is by changing the curriculum from the 2013 curriculum to the independent curriculum. Each level of education has adjusted learning in accordance with the development of an independent curriculum. Natural science or often referred to as IPA is one of the main subjects taught at the primary school level in

accordance with the independent curriculum. Natural Science is a human effort in understanding the universe through precise observations on targets, as well as using procedures, and explained with reasoning so as to get a conclusion. According to BSNP (2011), science subjects in primary schools (SD) aim to enable students to have the following abilities: (1) have confidence in the greatness of God Almighty based on the existence, beauty and order of His natural creation, (2) develop knowledge and understanding of Science concepts that are useful and can be applied in everyday life,

In connection with the purpose of science learning, in essence, science learning in elementary schools will be able to develop religious attitudes, develop children's cognitive abilities, develop social attitudes to care more about fellow human beings and the surrounding environment. Science learning in elementary school will direct students to construct their own knowledge in accordance with the rules of scientific attitudes, scientific processes and scientific products.

Students' ability to construct their own knowledge will have implications for students' thinking skills. In accordance with the demands of the independent curriculum, teachers must be able to develop a learning process that is able to develop students' High Order Thingking Skills (HOTS). Critical thinking skills according to Beyer (1987) is the ability of a student to make reasonable judgements. A student who is able to think critically will be able to digest existing problems and see these problems in a variety of different perspectives. Based on this thought, a teacher should always make the learning process to stimulate children's critical thinking skills so that it is in accordance with the demands of the curriculum and the challenges of students facing the global world (Falaisme, 2008; Miri et al., 2007).

When converted to international conditions, the current condition of Indonesian education is very concerning. The quality of education in Indonesia is still relatively low in terms of competence and relevance to the progress and development of science and technology. The low quality of education in Indonesia is reflected in the data from international studies. First, the 2018 Program for International Student Assessment (PISA) results released on Tuesday, 3 December 2019. Based on the results of the study, Indonesia's PISA ranking in 2018 has decreased compared to the PISA results in 2015. This study compares the maths, reading and science performance of each child. The difference is that in 2015 there were 70 countries surveyed, while in 2018 there were 79 countries. In 2015, Indonesia scored 397 in the reading ability category, 386 in the maths ability category, and 403 in the science performance ability category. In 2018, Indonesia ranked 74th with a score of 371 in the reading ability category. Indonesia ranked 73rd with a score of 379 in the maths category. Indonesia ranked 71st with 396 in the science performance category (Andrews, 2021;OECD, 2020;Robertson, 2021)

The results of the Trends International Mathematics and Sciences Study (TIMSS) in 2011, Indonesia ranked 38th in mathematics with a score of 386 out of 42 countries and 40th in science with a score of 406 out of 42 countries. Meanwhile, in 2015 Indonesia ranked 45th in mathematics with a score of 397 out of 50 countries and 45th in science with a score of 397 out of 48 countries (Mullis et al., 2016; OECD, 2020).

Based on the results of PISA and TIMSS research, Indonesia received a low ranking due to one of the factors, namely the PISA test indicators are not in accordance with the learning indicators implemented in Indonesia. This is in accordance with the opinion of Kusuma et al., 2017; Yuliati & Lestari, 2018) which states that from the results of the PISA survey, the thinking skills of students from Indonesia are still relatively low. The contributing factor is that students are not maximally trained in solving questions in the form of contextual-based narratives, questions that demand intellectual activity, argumentation, and creativity in solving them. Meanwhile, the PISA test contains HOTS elements. In addition, teachers have low ability to

develop HOTS-based assessment instruments, whereas assessment instruments really need to be developed as an assessment to train students in higher stages of thinking.

The low level of critical thinking skills is also evidenced by the results of the critical thinking skills test for fourth grade students of elementary school cluster III in Buleleng sub-district, Buleleng Regency. The activity was carried out on 23 January 2023 at SD 1 Astina, SD N 1 Banjar Jawa, SD N 5 Banjar Jawa, SD N 1 Kendran, SD N 1 Paket Agung. On 25 January 2023 at SD N 1 Beratan, SD N 2 Liligundi, SD N 1 Sari Mekar, SD N 2 Sari Mekar, SD Mutiara. From the results of the analysis, it was found that the average value of students' critical thinking skills was still in the 0-54 interval. If converted to a 5-scale Benchmark Assessment (PAP), the value is in the predicate very less. This shows that students' critical thinking is still low.

Broadly speaking, the causes of students' low thinking skills are caused by the students themselves, teachers, and the learning environment. Students' learning abilities determine their success in the learning process. In the learning process, there are several factors that influence it, such as motivation, attitude, interest, learning habits, and self-concept. Students who have good motivation, interest attitudes, learning habits, and self-concept will have an impact on the student learning process in improving students' higher-level thinking skills (Surayanah, 2020).

Furthermore, constructivism views that knowledge is a person's cognitive construction of objects, experiences, and the environment. Law No. 20 of 2003 on the National Education System and Regulation of the Minister of National Education of the Republic of Indonesia No. 81A of 2013 state that the government supports schools to incorporate local wisdom values. The integration of local potential into the school learning process is necessary. Therefore, students do not forget their true identity and are able to develop the local potential around them. One of the efforts to instil a sense of belonging to local potential is through integrated science learning with local potential around them. According to Setiawan, teachers are expected to be able to develop lessons by utilising local wisdom values as learning resources. Science based on local wisdom values in science learning can encourage students to build and make connections between knowledge and reality in the environment. Science learning based on local wisdom can be developed by reconstructing the original science into western science or scientific science (Setiawan et al., 2017; Azalia, 2020; Karmini, 2021).

The Balinese have a philosophy of Tri Hita Karana (THK). The term THK has become widespread in society. The essence of THK philosophy emphasises three patterns of relationships, namely human relationships with God, human relationships with fellow humans, and human relationships with the natural environment. This concept is very relevant, sustainable, universal, and applicable throughout time (Hartayani & Wulandari, 2022).

The application of Tri Hita Karana ideology is expected to be able to examine and describe how students as Balinese people view their world. In addition, it also plays a role in the process of transforming education in Bali. Based on this reform effort, the purpose of education is not only to improve the understanding of the scientific world, but more importantly also how to understand human life itself. The application of Tri Hita Karana ideology in education has been explored in the literature, emphasizing its importance in shaping the worldview of Balinese students and transforming the education system in Bali (Pramerta, 2023). Primary school teachers in Bali recognize the significance of integrating Tri Hita Karana values into the learning process, believing that it strengthens students' character and national identity (Wirahyuni et al., 2021). Furthermore, the implementation of Tri Hita Karana has been shown to positively impact students' behavior and improve learning outcomes (Permatasari et al., 2020; Trisnawati & Yuda Sukmana, 2020).

In line with the learning process, assessment is an integral part of the learning process, in its implementation it is not uncommon to find that learning and assessment are two sides that are in conflict. The results of interviews with several teachers in cluster III Buleleng sub-

district stated that the assessment of learning outcomes carried out, for example assessing daily tests and end-of-semester tests, was only by correcting students' answers right or wrong, then giving scores. Observations show that teachers have never analysed test items such as distractor analysis, differentiating power or level of ease, unless the test will be used in research. In addition, it was seen that some teachers compiled tests in the form of multiple choice, especially in making options, one of which was made correct and other options as an exception as long as it was filled in and not based on the relationship between existing concepts. In addition, teachers did not provide questions at the level of the cognitive domain of analysing (C4), evaluating (C5), and creating (C6) because teachers felt that students' abilities had not reached the stage of analysing, evaluating, or creating.

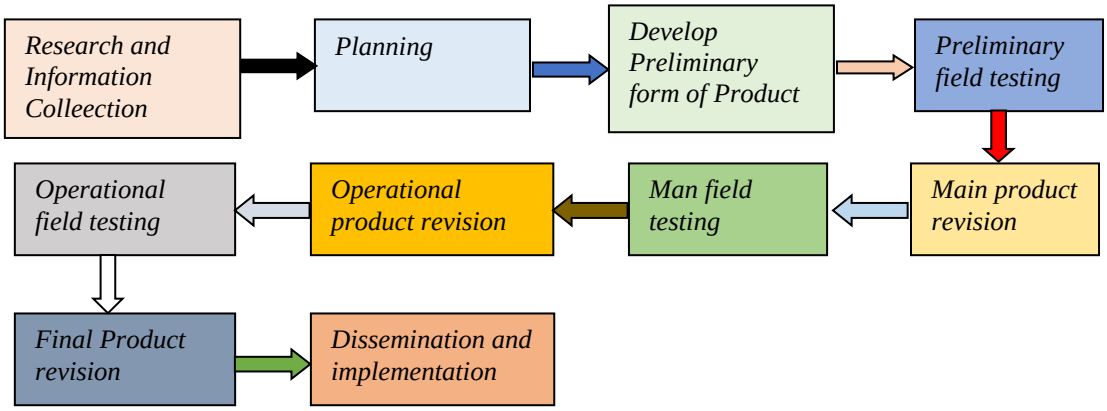
Based on the observations made, it was found that the evaluation tools used were independent or unrelated and did not reflect measurements directed at critical thinking skills so that students did not maximise their skills to think at a higher level in the process of investigation and problem solving. Learning materials tend to show the potential of regions in Indonesia as a whole. Meanwhile, students are not familiar with the local potential in their area even though the principle of the independent curriculum requires teachers to integrate learning with local wisdom.

The development of critical thinking tests with science mat oriented to tri hita karana local wisdom is needed in the development of technology and information. Memorising subject matter without a thinking process is no longer sufficient to keep pace with the rapid development of technology and information. In the current development of science and technology, students are required to be able to explore information with higher-level thinking, evaluate, be open, be able to solve problems in their environment, and make decisions.

Based on the description above, problems in science learning can be seen from the aspect of the learning assessment process in the classroom. Related to that, the researcher wants to reveal this through a study entitled "Development of Critical Thinking Test with Science Material Oriented to Tri Hita Karana Local Wisdom" The objectives of this study are (1) To determine the validity of the critical thinking test containing science material oriented to tri hita karana local wisdom (2) To determine the reliability of the critical thinking test containing science material oriented to tri hita karana local wisdom.

METHODS

This research is a Research and Development (R&D) model. This development refers to the model of Borg and Gall steps. There are ten steps of Borg and Gall (Borg & Gall, 1984). The scheme or description of the stages of product development from Borg and Gall is as follows:



Test development is a series of processes or activities carried out to produce a test measuring instrument based on existing development theory. Sudjana (2004) argues that to carry out the development of test measurement tools, development models are needed in accordance with the education system. This research was conducted with a 10-stage (R&D) model (Gal, 2003): (1) research and information gathering, (2) planning, (3) initial product development, (4) expert team testing, (5) preliminary revision of product test results, (6) main field testing, (7) revision of main field test results, (8) operational field testing, (9) revision of operational field test products, and (10) implementation and dissemination. In accordance with the (R&D) model (Gal, 2003), to clarify the stages, the ten-stage design above is grouped into four stages, namely: (1) needs analysis and formulating objectives, (2) designing critical thinking instruments with science materials oriented to local wisdom tri hita karana, (3) developing critical thinking instruments with science materials oriented to local wisdom tri hita karana, and (4) implementing and disseminating critical thinking instruments with science materials oriented to local wisdom tri hita karana.

The developed test was analysed for validity and reliability. The validity test using the Content Validity Ratio (CVR) Formula Technique is as follows.

$$\text{CVR} = \frac{Ne - N/2}{N/2}$$

N = Number of panellists who made a rating.

Ne = Number of panellists who expressed a rating of "very relevant".

CVR values range from -1 to 1. If half of the Panelists state "highly relevant" then the CVR value will be 0. CVR will be 1 if all Panelists state "highly relevant" for an item. The standard reference for validity for fifteen Panelists is 0.99. In addition to validity, the test also tested the test's power of difference, difficulty level. The reliability test was analysed using the reliability index using the Kuder Richardson 20 (KR.20) formula (Arikunto, 2002). The Kuder Richardson 20 formula is as follows:

$$r_i = \left\{\frac{k}{k-1}\right\}\left\{\frac{{S_t}^2 - \sum p_i q_i}{{S_i}^2}\right\}$$

Description:

k = number of items

ri = reliability coefficient

pi = proportion of the number of subjects who answered on item 1

qi = 1 - pi

st^2 = total variance

RESULTS AND DISCUSSION

The results of the research on the development of critical thinking tests with science content oriented to *tri hita karana* local wisdom in the development process in general, the results of the trial can be divided into two, namely the results of the limited trial and the results of the expanded test.

Limited Trial Results

The limited trial involved a number of fifth grade students at elementary schools in cluster III of Buleleng Subdistrict, namely SD N 1 Astina with a total of 40 students. The data obtained from the limited trial were then statistically analysed using SPSS. The basis of estimation for the acceptance or cancellation of a question is to use the correlation index of the validity of the question. By using a sample size of 40 students. Based on the results of the analysis of limited trial items, all questions were accepted.

1) Item Validity

From the results of the limited trial we get data to test the validity of the items. Testing the validity of critical thinking items in the form of dichotomous test items (objective tests) uses a scale of 1 (one) and 0 (zero). Score 1 is given to items that are answered correctly and score 0 on items that are answered incorrectly. Item validity is calculated by correlating the item score with the total score obtained by the respondent. The objective test item score is a dichotomous scale, while the total score is an interval scale, namely the sum of the item scores. The level of validity of the item can be known by comparing the item score with the price of r_{tabel}, if $r_{pbi} > r_{tabel}$ with a significance level of 5%, then the item is significantly correlated with the total score, so the item is declared valid. Conversely, if $r_{pbi} < r_{table}$ then the item score is not significantly correlated with the total score, it means that the item is declared invalid. The results of the critical thinking item validity test are summarised in Table 1.

Table 1 Validity of critical thinking test items.

Item Number	r hit	r tab	Ket.
1	0.347	0.312	Valid
2	0.365	0.312	Valid
3	0.319	0.312	Valid
4	0.413	0.312	Valid
5	0.486	0.312	Valid
6	0.362	0.312	Valid
7	0.361	0.312	Valid
8	0.321	0.312	Valid
9	0.447	0.312	Valid
10	0.365	0.312	Valid
11	0.322	0.312	Valid
12	0.506	0.312	Valid
13	0.331	0.312	Valid
14	0.413	0.312	Valid
15	0.342	0.312	Valid

Item Number	r hit	r tab	Criteria
16	0.342	0.312	Valid
17	0.447	0.312	Valid
18	0.332	0.312	Valid
19	0.357	0.312	Valid
20	0.333	0.312	Valid
21	0.506	0.312	Valid
22	0.333	0.312	Valid
23	0.413	0.312	Valid
24	0.413	0.312	Valid
25	0.321	0.312	Valid
26	0.447	0.312	Valid
27	0.345	0.312	Valid
28	0.396	0.312	Valid
29	0.376	0.312	Valid
30	0.321	0.312	Valid

2) Distinguishing Power

The differentiating power of the test is the ability of the test to distinguish between smart and less smart students, meaning that if the test is given to students who are classified as smart, more can be answered correctly, while if given to students who are classified as less smart, more will be answered incorrectly (Koyan, 2011: 140).

Table 2 Differentiating power of critical thinking test

Item Number	Criteria
1	Good
2	Good
3	Good
4	Good
5	Good
6	Good
7	Good
8	Good
10	Good

Item Number	Criteria
16	Good
17	Good
18	Good
19	Good
20	Good
21	Good
22	Good
23	Good
24	Good

11	Good
12	Good
13	Good
14	Good
15	Very good

25	Good
27	Good
28	Good
29	Good
30	Good

3) Test Level of Difficulty

The quality or not of learning outcome test items can be seen from the level of difficulty or difficulty level possessed by each test item. Test items are said to be good if the items are not too difficult and also not too easy so that the test truly describes the ability of students. Based on the analysis of the level of difficulty of the Mathematics learning outcomes test with the help of the Microsoft Excel programme, the results are as follows.

Table 3 Test Level of Difficulty

Item Number	Number of Items	Correct Level Difficulty	Criteria
1	29	0.73	Easy
2	23	0.58	Medium
3	34	0.85	Easy
4	22	0.55	Medium
5	34	0.85	Easy
6	22	0.55	Medium
7	25	0.63	Medium
8	18	0.45	Medium
10	10	0.25	Difficult
11	24	0.6	Medium
12	14	0.35	Medium
13	34	0.85	Easy
14	24	0.6	Medium
15	11	0.28	Difficult
16	24	0.6	Medium
17	18	0.45	Medium
18	19	0.48	Medium
19	15	0.38	Medium
20	25	0.63	Medium
21	16	0.4	Medium
22	16	0.4	Medium
23	16	0.4	Medium
24	11	0.28	Difficult
25	19	0.48	Medium
27	16	0.4	Medium
28	13	0.33	Medium
29	25	0.63	Medium
30	19	0.48	Medium

Extended trial results

The results of the extended trial were conducted widely to 120 students from SD N 1 Banjar Jawa, SDN 3 Banjar Jawa and SD N 1 Paket Agung. The data from the extended trial results were analysed, the summary of the broad trial analysis is as follows:

Table 4 Recap of Item Analysis of Broad Trial Questions

Item Number	Difficulty level		Distinguishing Power		Item Internal Consistency		Reliability	Decision
	Value	**Criteria**	Value	**Criteria**	Value	**Criteria**		
1	0.70	Easy	0.5	Good	0.347	Valid		Used
2	0.56	Medium	0.60	Good	0.365	Valid		Used
3	0.80	Easy	0.45	Good	0.319	Valid		Used
4	0.55	Medium	0.52	Good	0.413	Valid		Used
5	0.85	Easy	0.55	Good	0.486	Valid		Used
6	0.55	Medium	0.64	Good	0.362	Valid		Used
7	0.63	Medium	0.44	Good	0.361	Valid		Used
8	0.45	Medium	0.45	Good	0.321	Valid		Used
9	0.25	Difficult	0.40	Good	0.447	Valid		Used
10	0.6	Medium	0.45	Good	0.365	Valid		Used
11	0.35	Medium	0.64	Good	0.322	Valid		Used
12	0.85	Easy	0.51	Good	0.506	Valid		Used
13	0.6	Medium	0.55	Good	0.331	Valid		Used
14	0.23	Difficult	0.73	Very good	0.413	Valid		Used
15	0.61	Medium	0.45	Good	0.342	Valid	0,89	Used
16	0.45	Medium	0.64	Good	0.342	Valid		Used
17	0.48	Medium	0.45	Good	0.447	Valid		Used
18	0.38	Medium	0.55	Good	0.332	Valid		Used
19	0.63	Medium	0.64	Good	0.357	Valid		Used
20	0.42	Medium	0.45	Good	0.333	Valid		Used
21	0.41	Medium	0.45	Good	0.506	Valid		Used
22	0.4	Medium	0.55	Good	0.333	Valid		Used
23	0.28	Difficult	0.64	Good	0.413	Valid		Used
24	0.48	Medium	0.45	Good	0.413	Valid		Used
25	0.4	Medium	0.40	Good	0.321	Valid		Used
26	0.33	Medium	0.41	Good	0.447	Valid		Used
27	0.63	Medium	0.43	Good	0.345	Valid		Used
28	0.48	Medium	0.45	Good	0.396	Valid		Used
29	0.72	Easy	0.55	Good	0.376	Valid		Used
30	0.56	Medium	0.60	Good	0.321	Valid		Used

The development of a critical thinking skills test oriented towards tri hita karana has been tested for validation and test reliability. The content validity test shows that all questions developed are in the valid category, the reliability of the developed test shows a value of 0.89 with "very high" criteria. The developed test has been made reliable so that it can be used for different periods of time and places in conducting assessments. The test that has been developed is designed to be done in writing for class-based assessment. In doing this test, students only write objective answers that match the characteristics of the test.

Critical thinking skills are needed in sorting information by classifying, organising, remembering, and analysing information (Nugraha, 2018; Pratama et al., 2020). Critical thinking ability is a thinking skill in solving problems rationally and effectively and must be owned by someone who is developed from basic education (Puspitasari & Nurhayati, 2019; Rosy & Pahlevi, 2015). By being developed from the most basic level, students are expected to be able to solve problems faced in the world of education and in everyday life logically and critically. Critical thinking involves inductive thinking skills such as recognising relationships, analysing open-ended problems (with many possible solutions), determining cause and effect, making conclusions and taking into account relevant data (Nuriani, 2017). Critical thinking skills are important in education so that they need to be developed in students by realising learning situations that are able to foster critical thinking skills in students must start from learning that makes students active (Ikhsan et al., 2017; Istianah, 2013; Marfilinda, 2019; Setiawan et al., 2017). Critical thinking is a multifaceted skill that goes beyond just problem-solving. At its core, it involves the ability to question assumptions, evaluate evidence, and consider different perspectives. Developing strong critical thinking skills empowers individuals to make informed decisions, process complex information, and navigate the challenges of an increasingly dynamic and interconnected world (Kinoshita, 2022).

This research is relevant to research conducted by (Gina Gunawan et al., 2023; Putra et al., 2021) which states that the integration of local wisdom with learning materials in elementary schools can improve students' critical skills. Developing critical thinking skills requires a diverse approach by creating a fun learning situation such as integrating local local culture to be integrated in student learning in the classroom.

CONCLUSION

Based on the results of the study, it can be concluded that this research has been able to develop a critical thinking test instrument with science material oriented towards tri hita karana local wisdom. The test developed a total of 30 items, and all questions were declared valid, the reliability of the questions developed was 0.89 with a very good degree of reliability. In addition to measuring validity, the reliability of the questions developed has also been measured by the differential power of the questions on average well, as well as the level of difficulty of the tests developed in the easy, medium and difficult categories. Based on the research results achieved in this study, the following suggestions can be made: (1) For teachers who want to explore students' critical thinking skills can use develop a critical thinking skills test oriented to local wisdom tri hita karana. (2) teachers are expected to integrate local culture applied in each region into science learning to improve students' critical thinking skills.

CONFLICT OF INTEREST

No potential conflict of interest was reported by authors

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