

DEVELOPMENT OF NUMERACY LITERACY INSTRUMENTS IN THE LOCAL SOCIO-CULTURAL CONTEXT OF SERANG FOR HIGH SCHOOL STUDENTS

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ABSTRACT

To enhance students' numeracy literacy skills, it is essential to develop an instrument that measures these abilities accurately. This research aims to develop a numeracy literacy instrument tailored to the local socio-cultural context of Serang for high school students. The instrument development method employed an R&D (Research and Development) approach using the Wilson model as well as the Oriondo and Antonio model. The subjects of this study were 20 eleventh-grade students from SMAN 8 Kota Serang, selected through purposive sampling techniques. Utilizing both qualitative and quantitative data analysis techniques, the study produced five items that were valid, reliable, and practical. Validity testing showed a score of 89.89% from three experts, and a Cronbach's Alpha value of 0.75, indicating reliability. The instrument's practicality, as derived from student responses, was rated at 88.4%, categorized as highly practical. Therefore, the numeracy literacy test instrument developed in the local socio-cultural context of Serang is suitable for high school students. The findings suggest that this instrument can effectively assess numeracy literacy skills within this specific cultural context, providing a valuable tool for educators.

Untuk meningkatkan kemampuan literasi numerasi siswa, penting untuk mengembangkan instrumen yang dapat mengukur kemampuan tersebut secara akurat. Penelitian ini bertujuan untuk mengembangkan instrumen literasi numerasi yang disesuaikan dengan konteks sosial budaya lokal Serang untuk siswa SMA. Metode pengembangan instrumen menggunakan pendekatan R&D (Research and Development) dengan model Wilson serta model Oriondo dan Antonio. Subjek penelitian ini adalah 20 siswa kelas XI dari SMAN 8 Kota Serang yang dipilih melalui teknik purposive sampling. Dengan menggunakan teknik analisis data kualitatif dan kuantitatif, penelitian ini menghasilkan lima butir soal yang valid, reliabel, dan praktis. Pengujian validitas menunjukkan skor 89,89% dari tiga ahli, dan nilai Cronbach's Alpha 0,75 yang menunjukkan reliabilitas. Kepraktisan instrumen, berdasarkan respons siswa, dinilai sebesar 88,4% yang dikategorikan sangat praktis. Oleh karena itu, instrumen tes literasi numerasi yang dikembangkan dalam konteks sosial budaya lokal Serang ini layak digunakan untuk siswa SMA. Temuan ini menunjukkan bahwa instrumen ini dapat secara efektif mengukur keterampilan literasi numerasi dalam konteks budaya spesifik ini, sehingga memberikan alat yang berharga bagi pendidik.

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1. INTRODUCTION

Mathematics plays a crucial role in various aspects of life. Its importance extends beyond academia and is significantly relevant in daily life (Yasin et al., 2023; Rani et al., 2023; Putri et al., 2022). Proficiency in mathematics is irreplaceable, ranging from basic skills like calculating prices at the market to more complex applications in technology, science, and engineering. The use of mathematics involves problem identification, method selection, calculation, and evaluation of solution strategies. The use of appropriate mathematical notation facilitates the communication of ideas and the analysis of information in various forms such as tables, figures, or graphs, thereby aiding in understanding patterns and drawing conclusions (Oktavianingtyas, 2015). All of these aspects contribute to numeracy literacy, enabling effective use of mathematics in everyday situations, enhancing understanding of the surrounding world, and supporting informed decision-making.

Numeracy literacy refers to the ability and knowledge to use basic mathematical numbers and symbols to solve practical everyday problems. It also includes the ability to analyze information presented in various formats, such as tables, graphs, and diagrams, and interpret the results of such analyses. This ability allows individuals to predict and make decisions based on their mathematical knowledge (Mahmud & Pratiwi, 2019; Iswara et al., 2022; Setiani et al., 2022). Tenny et al. (2021) state that the development of numeracy literacy can be integrated into skill-based and content-based learning. Content-based subjects like language and mathematics play a central role in developing numeracy literacy, while skill-based learning in subjects like mathematics, language, and arts provides the necessary framework to apply these numeracy literacy skills in broader contexts.

Numeracy literacy encompasses not only the understanding and conventional use of numbers but also their application in various real-life contexts. In the 21st century, numeracy literacy is increasingly crucial as a foundation for preparing the younger generation to face complex challenges across various life domains (Herawan, 2021; Azzajjad et al., 2023; Gusteti et al., 2023). The Programme for International Student Assessment (PISA), conducted by the OECD since 2009, evaluates numeracy literacy among 15-year-old students from several countries, aiming to advance 21st-century skills. According to the OECD report (2022), Indonesia ranks 68th among participating countries, with a mathematics literacy score of 354. In Indonesia, the Ministry of Education and Culture uses the Minimum Competency Assessment (AKM) to assess students' numeracy literacy in the National Assessment (AN). AKM measures students' understanding and application of basic mathematical concepts across social, cultural, environmental, and scientific contexts.

Rich social and cultural contexts play a significant role in numeracy literacy approaches, enabling students to experience culturally and academically meaningful learning (Rosa & Orey, 2020; Patriana et al., 2021; Polman et al., 2021; Koskinen & Pitkäniemi, 2022; Valero, 2023). This approach not only helps students understand and appreciate their local cultural diversity but also strengthens cultural identity and enhances their ability to apply numerical concepts in their surrounding environment.

Studies related to local wisdom or culturally-based numeracy have been the focus of several recent research efforts. Yasin et al. (2023) conducted research on developing numeracy literacy questions in the context of social and cultural aspects for high school students in Tangerang. Subsequently, Susanta et al. (2023) explored numeracy literacy tasks focusing on numerical concepts within social and cultural contexts in Bengkulu, while Mawaddah et al. (2022) developed an AKM instrument depicting the uniqueness of wetland environments in South Kalimantan. Prafianti et al. (2023) then reinforced this approach by adapting the mathematics learning process for junior high school students, considering the context in East Java.

Overall, these studies indicate that integrating local wisdom into mathematics education can significantly enhance students' abilities. However, the primary challenge currently lies in the limited availability of numeracy literacy learning tools that can adapt to local social and cultural contexts, especially in Serang. For instance, interviews with a mathematics teacher at SMAN 8 Kota Serang highlight that many students struggle with numeracy literacy, while the rapid pace of globalization threatens the preservation of local culture in the region.

Therefore, the development of numeracy literacy instruments rooted in Serang's local social and cultural contexts is urgently needed to improve the quality of education in this area. This research aims to develop and test numeracy literacy instruments that align with Serang's cultural context and values, particularly for high school students.

2. METHODS

This study applies the research and development (R&D) method. The models used in this study are the Wilson model and the Oriondo and Antonio models, which consist of three main stages: instrument design, instrument testing, and instrument assembly. Each stage involves a systematic series of steps.

The first stage, Instrument Design, begins with planning and developing the research instruments. This includes setting development goals, curriculum analysis, topic selection, instrument framework development, construct validation, instrument refinement, and rubric development. The second stage, Instrument Testing, involves sample selection for testing, conducting the tests, data collection, and analysis of test results to measure the effectiveness of the designed instruments. The third stage, Instrument Assembly, is the finalization process of instrument design and preparation of user guides after the instruments have been tested and revised. The assembled instruments are then ready for use in further research contexts.

The numeracy literacy instruments developed in this study include five items designed to measure knowledge, application, and reasoning in the domains of Algebra, Numbers, Geometry and Measurement, and Data and Uncertainty. The study involved 20

students from Grade XI of SMAN 8 Kota Serang in the second semester of 2023/2024, selected using purposive sampling techniques. Data analysis was conducted qualitatively and quantitatively using various data collection instruments, including validation sheets reviewed by three experts holding doctoral degrees, a mathematics teacher with a master's degree, and a mathematics teacher pursuing a master's degree, as well as unstructured interview guidelines, locally wisdom-based numeracy literacy instruments, and student response questionnaires. The instrument's validity was assessed based on expert approval regarding content, construction, and language, while reliability was tested to measure the reliability and practicality of student response results.

3. RESULTS AND DISCUSSION

3.1. Results

The aim of this study is to develop a valid and reliable numeracy instrument for high school students, considering the local socio-cultural context of Serang, Banten. The creation of this instrument follows a systematic and structured process. It begins with interviewing a mathematics teacher of grade XI to assess the current school curriculum. Based on these findings, the instrument is designed to cover curriculum-appropriate topics including Algebra, Number, Geometry and Measurement, as well as Data and Uncertainty, integrating elements of the local Serang culture.

The developed instrument consists of five questions designed to assess various student abilities. These questions are tailored to measure students' proficiency in solving algebraic equations, understanding and applying various types of numbers, mastering geometric and measurement concepts, and analyzing data and uncertainty within the context of everyday social and cultural life in Serang. Each question is crafted considering an appropriate level of difficulty for high school students. The construction of each question's blueprint aims to provide an accurate depiction of students' numeracy skills and support more relevant and contextual teaching.

Table 1. The grid of numeration instruments in the local social cultural context of Serang

No. Question	Domain	Sub Domain	Context	Cognitive Level	Indicator	Types of Question
1	Algebra	Equations and Inequalities	Socio-Cultural	<i>Reasoning</i>	Students determine the true/false value of statements related to fish auctioning at Gopek Beach.	Multiple Choice
2	Geometry and Measurement	Shapes and Geometry	Socio-Cultural	<i>Applying</i>	Students can determine the volume of a geometric solid and the surface area of the tower of Masjid Agung Banten.	Short Answer
3	Number	Number Operations	Socio-Cultural	<i>Reasoning</i>	Students determine the true/false value of statements related to distances between places.	Multiple Choice
4	Data and Uncertainty	Data and Representation	Socio-Cultural	<i>Knowing</i>	Students can obtain information related to the	Multiple Choice

5	Algebra	Equations and Inequalities	Socio-Cultural	<i>Reasoning</i>	population data of Serang Regency. Solving systems of linear equations with one or two variables in everyday problems related to typical Serang cuisine.	Short Answer
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Next, a validation review was conducted by experts covering aspects of content, construction, and language. Based on validation by validators, each aspect was assessed on a scale of 1 to 5:

Table 2. Expert Validation Results

Aspect	Percentage	Criteria
Content	88%	Very Valid
Construction	91,67%	Very Valid
Language	90%	Very Valid
Average	89,89%	Very Valid

With an average validation score of 89.89%, it indicates that the instrument is highly valid, although it still requires revision based on suggestions and feedback from the validators as follows:

Table 3. Suggestions from Expert Validation

Validator	Question Number	Suggested Revision
Validator 1	1 and 2 4	Add a source link for the images used in the questions. The cognitive level does not match the command used.
Validator 2	2 5	Add explanatory captions to the presented images. Design the poster to be attractive.
Validator 3	1 and 3	Clarify the question commands by adding "adding checkmark (✓) captions to each statement."

Based on Table 3, comments and suggestions from validators are used to revise the instrument. After revising the instrument, the next step is to score each question based on its cognitive level and complexity. Once the revised instrument is finalized and scoring criteria are determined, the instrument is then field-tested. In this phase, 20 students from Grade XI at SMAN 8 Kota Serang are selected to answer the prepared instrument questions.

Table 4. Field Test Results

Question Number	Difficulty Level	Difficulty Level Criteria	Discrimination Index	Discrimination Indeks Criteria	Validity Test	Validity Criteria	Reliability Test
1	0,73	Easy	0,40	Good	0,70	Valid	0,75
2	0,30	Difficult	0,33	Accepted Without Revision	0,58	Valid	
3	0,70	Moderate	0,60	Good	0,65	Valid	
4	0,73	Easy	0,53	Good	0,78	Very Valid	
5	0,60	Moderate	0,40	Good	0,66	Valid	

Based on the analysis in Table 4, the instrument used in this study demonstrates high reliability with a Cronbach's Alpha value of 0.75, indicating the instrument's consistency

in measuring students' abilities. Additionally, the difficulty level test showed that questions 1 and 4 fall into the easy category, questions 3 and 5 into the moderate category, and question 2 into the difficult category. Evaluation of student responses to the developed instrument was conducted through a questionnaire administered to 5 students, covering aspects of difficulty level, clarity of questions, and relevance of content. The practicality results of student responses are presented in Table 5.


Table 5. Students Responses Result

Respondent	Percentage	Criteria
5	88,4%	Very Practical

After undergoing intensive development phases, the numeracy literacy tool customized to the local socio-cultural context of Serang becomes crucial for consideration. Based on the analysis of pilot test data, the test instrument has proven to be valid, reliable, and practical for use at the high school level. With an average score of 88.4% from five students, the tool consistently proves highly practical in eliciting student responses. The five items structured according to specific categories illustrate the tool's capability to support numeracy literacy development at the relevant educational level. 5 items/questions are arranged as follows:

Bacalah bacaan dibawah ini untuk menjawab pertanyaan nomor 1

Pantai Gopek



Pantai ini merupakan salah satu lokasi pelelangan ikan terbesar di Banten, yang menampung hasil tangkapan nelayan dari berbagai daerah. Setiap hari, ratusan kapal nelayan akan bersandar di dermaga pantai ini, membawa berbagai jenis ikan segar dan laut. Pengunjung bisa melihat langsung proses pelelangan ikan di pantai ini, mulai dari penimbangan, penentuan harga, hingga pembayaran. Pelelangan ikan biasanya dimulai sekitar pukul 07.00 WIB hingga pukul 10.00 WIB. Pengunjung juga bisa membeli ikan segar langsung dari nelayan atau pedagang ikan dengan harga yang murah dan bersahabat.


Sumber :
<https://www.traveval.com/tempat-wisata/pantai-gopek-karangantu-kota-serang>

Jika Nelayan, menjual beberapa jenis ikan dengan paket ikan terdiri dari ikan kakap, ikan cakalang, dan ikan tuna.

Ikan Kakap	Ikan Cakalang	Ikan Tuna	Harga
3Kg	1Kg	2Kg	Rp. 615.000
2Kg	2Kg	3Kg	Rp. 710.000
3Kg	2Kg	3Kg	Rp. 820.000

Figure 1. Question Number 1 Improvement Result

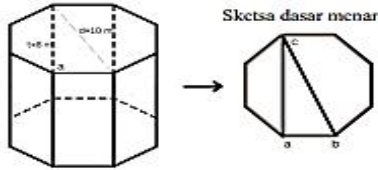
Figure 1 is selected to introduce one of the tourist attractions in Serang that is relatively unknown but holds potential for development in beachside commerce activities. This particular tourist spot is closely associated with fish auction transactions. In this context, students can apply concepts of equations and inequalities to solve problems related to fish auctions. According to Isnaintri et al. (2023), integrating social and cultural contexts into mathematical problems helps strengthen students' understanding of these concepts.



Provinsi Banten, memiliki bangunan yang merupakan bangunan sisa peninggalan Kesultanan Banten yaitu Masjid Agung Banten. Menara Masjid Agung Banten berbentuk segi delapan ini memiliki diameter 10 meter dengan tinggi 24 meter yang dihitung dari dasar hingga ujung mastaka. Mastaka adalah hiasan atau ornamen berwarna merah yang terletak di ujung atau puncak menara. Di dalam menara, terdapat 83 anak tangga yang dapat dinaiki sampai ke balkon teratas, dari atas sini kalian dapat melihat pemandangan di sekitar masjid dan daerah lepas pantai.

Sumber : <https://www.idntimes.com/travel/destination/rizna-m-hidawah/sciarah-masjid-agung-banten-exp-c1e2>

Jika hanya dihitung dari dasar sampai dengan balkon pertama menara hanya memiliki tinggi 18 meter. Dengan ilustrasi gambar seperti dibawah ini



Sketsa dasar menara

2. Apabila setiap tahun dilakukan pengecatan terhadap dinding bagian luar menara, berapakah luas area dinding yang di cat dari dasar menara sampai ke balkon pertama?

Figure 2. Question Number 2 Improvement Result

Figure 2, question number 2 is related to Masjid Agung Banten, a historical building in the Serang area that symbolizes Banten. In this question, students are asked to consider the concepts of surface area and volume of three-dimensional shapes. They can understand the relevant facts and identify the relationship between these concepts with the mosque's minaret. This understanding helps students solve mathematical problems, particularly in applying their understanding of the shape and properties of an octagonal prism, which is the fundamental form of the minaret structure. The emphasis on the importance of spatial concepts in mathematics education is also supported by Rezky et al. (2022).

Perhatikan pernyataan dibawah untuk menjawab nomor 4

Pasar Rau adalah salah satu pasar besar yang ada di Kota serang. Pasar tradisional ini menjual berbagai produk kebutuhan pokok dan sembako seperti seperti mencari beras Kota Serang, terigu, gula, garam, sayur mayur, bawang, cabe, ikan, ayam, dan lainnya. Banyak pedagang-pedangan besar yang menjadi pedangan distributor untuk pedang lainnya untuk di pasar rau nya sendiri atau di pasar-pasar lainnya yang ada di Serang. Salah satu distributor sayuran di Pasar Rau memiliki pegawai yang biasanya mengirimkan sayuran untuk penjual dipasar lainnya seperti Pasar Ciruas, Pasar Kalodran, dan Pasar Karangantu. Pegawai-pegawai itu akan mengirimkan akan mengirimkan sayur-sayuran ke pedagang lainnya sebagai berikut :

	Petugas Pengirim
Pasar Ciruas	Pegawai A
Pasar Kalodran	Pegawai B
Pasar Karangantu	Pegawai C

	Keberangkatan Pegawai	
	Pukul	Jarak
Pasar Ciruas	03.00	10 km
Pasar Kalodran	03.15	7,2 km
Pasar Karangantu	03.10	9,2 km

4. Dari informasi diatas, pilihlah benar atau salah dari setiap pertanyaan dibawah ini dengan memberi tanda (✓)

No	Pernyataan	Benar	Salah
1	Dengan kecepatan 40 km/jam pegawai A akan sampai pada pasar Ciruas pukul 03.15		
2	Pegawai A dan pegawai B akan sampai bersama sama jika kecepatan mereka sama		
3	Pegawai C akan sampai terlebih dahulu dari pegawai B jika pegawai C kecepatan 40 km/jam dan Pegawai B kecepatan 35 km/jam		

Figure 3. Question Number 3 Improvement Result

Figure 3, in question number 3, presents a social context concerning arithmetic operations conveyed through information from readings and tables. Students are asked to apply and understand various information and procedures applicable in real-life situations. By employing this reasoning process, students can determine the truth of each statement based on the provided information. This demonstrates a deeper understanding and the ability to connect facts with correct logic. Through practicing everyday mathematical problem-solving, students will improve their ability to handle mathematical problems and apply the same problem-solving patterns repeatedly (Wahyuni & Angraini, 2021).

Perhatikan bacaan dibawah ini untuk menjawab nomor 3

Kabupaten Serang merupakan kabupaten terbesar kedua setelah Kota Tangerang dari segi jumlah penduduk di Provinsi Banten. Kabupaten ini memiliki populasi yang signifikan yang tersebar di 29 Kecamatan yang ada di Kabupaten Serang. Berdasarkan hasil survei BPS Kabupaten Serang, jumlah penduduk Kabupaten Serang berdasarkan jenis kelamin sebagai berikut ini pada tahun 2019-2020

Kecamatan	Jumlah Penduduk Kabupaten Serang Menurut Jenis Kelamin (Jiwa)			
	Laki-laki		Perempuan	
	2020	2019	2020	2019
Cinangka	31752	29744	29063	27586
Padarincang	35826	33832	33821	32139
Ciomas	22241	20525	20530	19366
Pabuaran	22290	21111	20865	19751
Gunungsari	12163	10782	11354	10031
Baros	30990	28784	28312	26362
Petir	31863	27072	30033	26838
Tunjung Teja	24244	21181	22857	20682
Cikeusal	39142	34909	37838	34850
Pamarayan	30971	26554	28834	25940
Bandung	19594	16701	18824	16137
Jawilan	30857	28028	28883	27464

Figure 4. Question Number 4 Improvement Result

Figure 4, question number 4 relates to the population count in Serang Regency. This question requires students to apply basic knowledge of population growth percentages to estimate the population in the following year. Reading and managing data from tables assist in solving the given problem. Consistent with the research by Rachmawati et al. (2024), cultivating habits of reading, interpreting, and accurately responding to information constitutes essential aspects of literacy that can enhance students' academic achievement.

Perhatikan bacaan berikut ini

TOKO OLEH - OLEH Berkah Ibu
Kusanya Oleh-oleh khas Banten

PESAN SEKADANG WEBSITE KAMI
022-4341-7820 WWW.BERKAHIBU.COM

Banten memiliki beberapa makanan khas, yang kerap ditemui saat berkunjung di beberapa tempat wisata bersejarah. Beberapa makanan khas yang dimiliki oleh Provinsi Banten seperti Bontot, Sate Bandung, Emping, Rabek, dan Gerem Asem. Di salah satu tempat wisata terdapat Toko Oleh-Oleh Berkah Ibu yang menyediakan makanan khas Banten dengan list harga sebagai berikut :

5. Alfahri adalah siswa SMA kelas 11 di Tangerang. Ia dan keluarganya berkunjung ke tempat wisata Banten Saat ingin pulang Keluarga Alfahri mengunjungi Toko Oleh-Oleh Berkah Ibu. Pertama Ibu Alfahri memesan 3 buah Bontot dan 2 buah Sate Bandung. Tak lama kemudian Ayah Alfahri memesan 5 buah Bontot dan 3ons Emping . Jika Ayah dan Ibu membayar pesanan menjadi satu dengan uang sebesar Rp. 300.000. Maka agar uang tersebut tidak bersisa ibu dan ayah dapat menambahkan 2 jenis makanan yang berbeda. **Tuliskan kemungkinan Makanan tambahan ayah dan ibu yang dapat dipilih dan berikan alasan yang Anda!**

Figure 5. Question 5 Improvement Results

Figure 5 presents a problem involving linear equations and inequalities related to the traditional cuisine of Serang, Banten, in relation to students' cognitive reasoning abilities. These local delicacies are often found in souvenir shops around tourist attractions, closely tied to students' daily lives. In this context, students are asked to make decisions regarding issues related to Serang's local cuisine using concepts of equations and inequalities. The aim is to achieve a coherent and reasonable understanding or solution. According to Chandra et al. (2023), incorporating the context of local cuisine has been shown to enhance students' numeracy literacy skills.

3.2. Discussion

In the initial stage of instrument development, we conducted interviews with a mathematics teacher at SMAN 8 Kota Serang. The purpose of these interviews was to gather necessary information to compile relevant and beneficial numeracy assessment instruments. As suggested by Yunarti & Amanda (2022), numeracy literacy plays a crucial role in fostering high-quality students. Therefore, developing these numeracy literacy instruments is essential for teachers to use as references for numeracy literacy questions in teaching (Apriatni et al., 2022).

The results of interviews with teachers and analyses of needs in the domains of Algebra, Numbers, Geometry and Measurement, as well as Data and Uncertainty, served as the basis for developing these instruments. Integration of elements of local Serang culture, such as tourist spots, local cuisine, historical buildings, and community activities, is expected to enrich the context of the developed instruments. Thus, students are expected to better understand numeracy questions relevant to their daily lives.

These instruments provide teachers with additional resources to teach and evaluate students' numeracy skills within the context of local socio-cultural settings, ultimately enhancing the relevance and meaning of learning (Isnaintri et al., 2023). According to Purnomo et al. (2022), providing numeracy questions related to local socio-cultural contexts can enhance students' motivation in learning mathematics, encouraging them to actively understand numeracy concepts and skills.

Carefully designed questions not only encourage students to memorize facts or concepts but also to apply, analyze, and evaluate information. By considering the local socio-cultural context, numeracy learning can become more engaging and relevant for students, serving as an effective evaluation tool to improve students' overall thinking skills.

4. CONCLUSION

The five-item test instrument developed in this study demonstrates that the test instrument is valid, reliable, and practical, hence it can be used as a numeracy literacy instrument in the local socio-cultural context of Serang. Item validation was obtained from expert validation stages covering material, construct, and language aspects with an average score of 89.89%, indicating very high validity. The Cronbach's Alpha value of 0.75 indicates reliable categorization, and practicality testing was obtained from student responses through a questionnaire, yielding a score of 88.4%, categorized as practical. The first and fourth items were rated as easy, the third and fifth as moderate, while the second item was rated as difficult. Each item's discrimination varied, showing the ability of the

items to differentiate between high and low ability students. Most items showed good discrimination, except for the second item, which, although acceptable, requires revision.

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